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Mabalacat City College

Institute of Computing Studies



MCC-IT Research Journal

A.Y 2025-2026

**“Strengthening Systems, Structures, and
Academic Foundations”**

4 QUALITY
EDUCATION



8 DECENT WORK AND
ECONOMIC GROWTH



9 INDUSTRY, INNOVATION
AND INFRASTRUCTURE



11 SUSTAINABLE CITIES
AND COMMUNITIES



13 CLIMATE
ACTION



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FOR THE GOALS



MABALACAT CITY COLLEGE

INSTITUTE OF COMPUTING STUDIES

MCC-IT Research Journal 2026

The MCC-IT Research Journal 2026 is a compilation of CAPSTONE PROJECTS from the academic year 2025-2026. The MCC-IT Research Journal will be published annually by the Mabalacat City College - Institute of Computing Studies (MCC-ICS). MCC-ICS as copyright owner reserves the right to publish, reproduce or copy.

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MESSAGE FROM THE COLLEGE PRESIDENT



It is with immense pride and optimism that I congratulate the Institute of Computing Studies for the successful publication of the MCC-IT Research Journal 2025–2026. This journal stands as a testament to the ingenuity, perseverance, and transformative potential of our student researchers whose works demonstrate how technology can be harnessed to solve real-world challenges and create meaningful impact in society.

Guided by this year's theme, "Strengthening Systems, Structures, and Academic Foundations," the research projects featured in this publication exemplify the vital role of innovation in advancing education, improving governance, enhancing community services, promoting environmental sustainability, and empowering inclusive development. Through your creativity and technical expertise, you have transformed ideas into solutions that respond to the evolving needs of our communities and industries.

More importantly, your research reflects Mabalacat City College's unwavering commitment to the United Nations Sustainable Development Goals (SDGs). Your innovations contribute to SDG 4 (Quality Education) by advancing learning technologies, SDG 8 (Decent Work and Economic Growth) by preparing future-ready professionals, SDG 9 (Industry, Innovation and Infrastructure) through technological advancement, SDG 10 (Reduced Inequalities) by developing accessible and inclusive systems, SDG 11 (Sustainable Cities and Communities) through smart community solutions, SDG 13 (Climate Action) through environmentally responsive innovations, and SDG 17 (Partnerships for the Goals) by fostering collaboration among stakeholders.

As we continue our journey toward becoming a globally recognized institution of higher learning, may this journal inspire a stronger culture of research, innovation, and lifelong learning. Let it remind us that every system developed, every problem solved, and every discovery made contributes to nation-building and sustainable development.

To our student researchers and faculty mentors, thank you for your dedication to excellence. May your work continue to inspire future generations of innovators, researchers, and leaders who will shape a more resilient, inclusive, and technologically empowered society.

Congratulations on this remarkable achievement.

SONNY N. DE GUZMAN, EdD

College President

MESSAGE FROM THE VICE PRESIDENT FOR ACADEMIC AFFAIRS



A Warm Message from the Office of the Vice President for Academic Affairs

It is with immense pride and joy that I congratulate our student researchers and faculty on the publication of the latest issue of the Mabalacat City College Information Technology Journal of Research. This momentous achievement highlights the incredible innovations our students have brought to life through dedicated inquiry and technical expertise.

At Mabalacat City College, research remains a fundamental pillar of the quality education we strive to provide. Publishing the works of our student researchers directly exemplifies academic excellence, technical competency, and an unyielding eagerness to explore knowledge beyond traditional boundaries. May this journal serve as an enduring testament to their dedication to their chosen field, which is advancing technological development while remaining deeply anchored in their identity as Filipino citizens who are creative, resilient, and adaptable to an ever-changing society.

To our brilliant student researchers, your work is truly exceptional. May this milestone inspire you to continue innovating for the betterment of our community and the world.

My sincerest congratulations to everyone involved!

MARILYN S. ARCILLA, RN, PhD

Vice President for Academic Affairs

Mabalacat City College

MESSAGE FROM THE VICE PRESIDENT FOR RESEARCH AND EXTENSION SERVICES



It is with great pride and enthusiasm that I extend my warmest congratulations to the Information Technology Program of Mabalacat City College on the publication of this journal.

In today's rapidly evolving digital world, Information Technology continues to play a vital role in transforming the way we live, learn, work, and address societal challenges. This publication serves as an important platform for showcasing the knowledge, creativity, research initiatives, and innovative ideas of our students and faculty.

I commend the faculty members, student researchers, editors, and contributors whose dedication and collaborative efforts made this publication possible. Your commitment reflects the growing culture of research and innovation that we continue to strengthen within Mabalacat City College.

May this journal inspire our academic community to remain curious, innovative, and committed to generating knowledge that extends beyond the classroom. Let us continue to pursue research and technological innovations that not only contribute to academic advancement but also provide meaningful solutions to the needs of our communities and society.

The Office of the Vice President for Research and Extension Services remains steadfast in supporting initiatives that promote research excellence, innovation, collaboration, and community engagement. May this publication serve as a source of inspiration for future researchers, innovators, and technology leaders.

Congratulations once again to the entire Information Technology Program for this meaningful achievement. May you continue transforming ideas into innovations and knowledge into positive change.

GLEN S. NOLASCO, MSc

Vice President for Research and Extension Services

Mabalacat City College

MESSAGE FROM THE DEAN



I am truly proud to extend my warmest congratulations to our BSIT researchers. The successful defense of your capstone projects is more than just an academic milestone—it is a celebration of your creativity, perseverance, and technical brilliance. From web systems and mobile applications to IoT and hybrid solutions, your work reflects not only mastery of your programming and networking skills but also a deep sense of purpose.

Guided by this year's research theme, "Strengthening Systems, Structures, and Academic Foundations," you have shown how innovation can reinforce the very pillars of education and community development. Your projects do not simply exist in classrooms; they reach out into society, addressing real needs and aligning with the Sustainable Development Goals (SDGs). By harnessing technology with empathy and vision, you have created solutions that uplift communities, strengthen industries, and inspire future innovators.

We celebrate this achievement with pride and joy, knowing that your work will inspire others to innovate with inclusivity, compassion, and excellence. May this milestone be the beginning of even greater contributions, and may your path ahead be filled with impact, purpose, and success.

Congratulations, researchers—your work now shines as part of MCC's enduring legacy of innovation, academic strength, and global impact!

DENNIS L. TACADENA, DIT

Dean, Institute of Computing Studies

Mabalacat City College

MESSAGE FROM THE CAPSTONE ADVISER



To our 4th Year Researchers,

Seeing your capstone research published in this journal is truly something to be proud of. Behind every research paper and every system featured here are weeks and months of hard work, revisions, discussions, challenges, and, of course, moments when you probably asked yourselves, “Matatapos pa ba talaga ito?” :)

As your research professor, I had the privilege of witnessing part of that journey. I saw how your ideas developed, how you worked through problems, listened to feedback, made revisions, and eventually turned your ideas into something you can now proudly call your own.

I hope that when you look back at this journal years from now, you won’t just see your capstone project. I hope you will also remember the people you worked with, the challenges you overcame, the things you learned, and how much you have grown along the way.

Your capstone may be the last major research project you do as students, but it doesn’t have to be the last time you create something meaningful. As future IT professionals, you will have many more opportunities to build, innovate, solve problems, and use technology to make a difference.

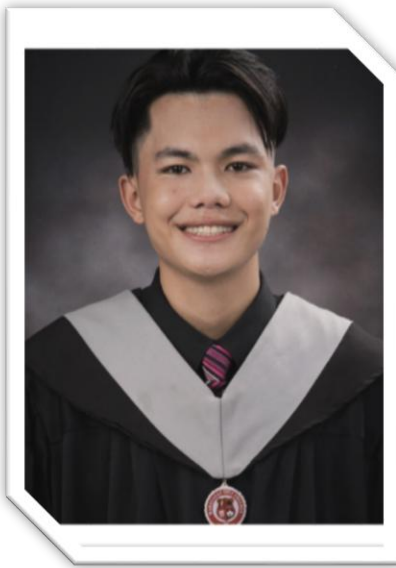
Congratulations, everyone! I am proud of what you have accomplished.

RITCHELL Z. ESCOTO, MIT

Capstone Project Adviser

Mabalacat City College

MESSAGE FROM THE BOARD OF PANELISTS



Congratulations to the BSIT Researchers of A.Y. 2025–2026!

Your successful Capstone Project represents your hard work, perseverance, collaboration, and dedication to innovation. Through the challenges you encountered, you turned your ideas into meaningful solutions and strengthened the skills that will guide you as future IT professionals.

As Artificial Intelligence continues to shape and influence our society, your responsibility extends beyond creating new technologies. It is also about using technology responsibly, ethically, and purposefully to address real-world challenges and contribute to a better society.

Continue to learn, adapt, innovate, and embrace the ever-changing world of technology. May you use your knowledge, skills, and creativity to develop solutions that create meaningful and lasting impact.

Congratulations, BSIT Researchers! Your Capstone Project marks not only the completion of an important academic journey, but also the beginning of your journey as innovative, responsible, and future-ready IT professionals.

KHYLE L. ALEGRE

Technical Adviser / Panel Member

Mabalacat City College

MESSAGE FROM THE BOARD OF PANELISTS



I am truly proud to extend my heartfelt congratulations to all of you for the successful defense of your Capstone Projects. This milestone is not only a testament to your perseverance and creativity, but also a reflection of the passion you bring to the field of technology.

As your Instructor in Application Development, Emerging Technologies, and the Internet of Things, I feel deeply fulfilled seeing how the lessons and guidance shared in our classes have blossomed into innovative solutions. Your projects—especially those that harness IoT controlled by mobile applications—showcase the potential of turning academic ideas into marketable products that can make a real impact in society.

Your achievements remind us that learning is most powerful when it leads to creation, and creation is most meaningful when it serves people. You have proven that with vision, teamwork, and determination, students can become innovators ready to shape the future.

Congratulations once again. May this success inspire you to continue exploring, building, and leading with purpose. I am honored to have been part of your journey, and I look forward to seeing how your talents will transform the world of technology.

ENGR. ROBERT M. BAMBA, MEECE

Technical Adviser / Panel Member

Mabalacat City College

MESSAGE FROM THE BOARD OF PANELISTS



Congratulations on successfully completing your capstone projects!

This achievement is more than just the completion of a requirement. It is a reflection of your hard work, dedication, creativity, teamwork, and perseverance throughout your research journey.

I know that the road to completing your projects was not always easy. You experienced ups and downs, faced unexpected challenges, dealt with revisions, deadlines, technical problems, and moments of doubt. There may have been times when things did not go as planned, but you continued to find ways to move forward, learn from your mistakes, and overcome every challenge along the way.

Your successful capstone project is something you should truly be proud of. It represents not only what you have learned as BSIT students, but also your ability to apply your knowledge, solve problems, work with others, and turn an idea into something meaningful and functional.

More importantly, I hope you recognize how much you have grown throughout this journey. The challenges you faced and the solutions you came up with are part of what made this experience valuable. Research is not always about getting everything right on the first try—it is about being willing to learn, improve, adapt, and keep going.

May this achievement remind you that you are capable of accomplishing difficult things when you believe in your work and persevere through the challenges.

Be proud of your journey, be proud of your work, and most importantly, be proud of yourselves.

Congratulations, BSIT researchers! Your academic journey may be ending, but the knowledge, skills, and experiences you gained from it will continue to be part of your journey as future IT professionals.

DESSA LYN J. DE CASTRO

Technical Adviser / Panel Member

Mabalacat City College

MESSAGE FROM THE BOARD OF PANELISTS



Warmest congratulations to the Mabalacat City College – Institute of Computing Studies and to all the dedicated student researchers, administration, faculty and staff for the successful release of your MCC-IT Research Journal!

This publication is a reflection of your hard work, curiosity, creativity, and commitment to research. May your work inspire fellow students, contribute to the field of computing, and encourage a culture of meaningful and innovative research.

Congratulations on this remarkable achievement! May you continue to learn, explore, and innovate.

RONALYN T. DOMINGO, MSIT

Panel Member

Tarlac State University

MESSAGE FROM THE BOARD OF PANELISTS



I am elated to have been part of your research journey and to have had the opportunity to provide ICT solutions to real-world problems in our community as your Technical Adviser.

Indeed, the completion of your capstone projects marks the end of a subject, but rather, it is the beginning of your roles as front-end/back-end developers, analysts, UI designers, and team leaders who are capable and competitive in meeting the needs of the government, industry, and academe.

I am more than proud that you were able to surpass even life's challenges throughout your journey and become ethical and responsible in using technology to help the community.

Remember the quote from the United Nations Asian and Pacific Training Center for Information and Communication Technology for Development (UN-APCICT):

“ICT is simply a developmental tool and only a means to an end; its value lies in how effectively it addresses the needs of the people.”

Congratulations on completing your capstone projects, the products of your hard work and perseverance, and most importantly, of your competency and preparedness in the field of Information Technology.

I am looking forward to seeing more significant research bearing your names and that of your alma mater.

GILBERT G. GONZALES, MIT

Technical Adviser

Tarlac State University

MESSAGE FROM THE BOARD OF PANELISTS



“Great things are done by a series of small things brought together.”* — Vincent van Gogh

To our BSIT researchers, congratulations on an achievement that deserves to be celebrated!

You began with questions and ideas, but through dedication, technical expertise, teamwork, patience, and perseverance, you turned them into something tangible—systems, prototypes, IoT solutions, and innovations not only for requirements but designed to address real needs and deployments.

As you move forward, never underestimate the power of an idea backed by determination. Continue to question, create, innovate, and build technology that serves a purpose.

Your capstone may be the end of a requirement, but it can be the beginning of something much bigger.

Good luck on your next endeavors!

ENGR. ERNIE LEE E. PINEDA, MIT

Technical Adviser / Panel Member

Mabalacat City College

MESSAGE FROM THE BOARD OF PANELISTS



Congratulations on the successful publication of your IT research! Your hard work and effort in completing this study are truly commendable. It's great to see your research finally published and shared with others.

As one of your Technical Adviser and panelists, I'm happy to see how far your research has come. I hope this achievement encourages you to continue learning, exploring new ideas, and doing more meaningful research in the future. Congratulations again, and well done!

Per aspera ad astra.

JOCELON C. SANGUYU, DIT

Technical Adviser / Panel Member

Mabalacat City College

MESSAGE FROM THE BOARD OF PANELISTS



Congratulations on successfully defending and completing your capstone research!

Reaching this final milestone is a massive achievement. Over the course of this project, you have faced tight deadlines, endless revisions, complex technical hurdles, and rigorous evaluations. Seeing your growth from an initial proposal to a fully realized, polished piece of work has been immensely rewarding for us as your panel and adviser.

You have demonstrated resilience, critical thinking, and true scholarship. The dedication you brought to your research reflects the high quality of your work, and you should be incredibly proud of what you have accomplished.

As you step into the next chapter—whether in industry, advanced studies, or new creative ventures—carry the skills and mindset you built during this process with you. You have proven that you can tackle complex problems and see them through to completion.

Thank you for your hard work, receptiveness to feedback, and commitment to excellence. It has been an honor to guide and evaluate your journey.

Wishing you all the very best in your future endeavors!

FREDERIC D. SANTOS, MIT

Panel Member

City College of Angeles

MESSAGE FROM THE BOARD OF PANELISTS



“Research transforms curiosity into knowledge and knowledge into solutions that improve lives.”

To the BSIT student-researchers of Mabalacat City College, I extend my warmest congratulations on the publication of your research outputs in this journal. This achievement reflects your dedication to transforming your knowledge and technical skills into meaningful solutions to real-world challenges.

It has been a privilege to serve as a lead panelist and panel member during your title and final defenses. The experience has also been a valuable learning opportunity for me, particularly in research documentation and technical writing. I commend your consistent observance of the prescribed research format and your meaningful integration of the United Nations Sustainable Development Goals into your studies.

May this publication inspire you to continue your pursuit of research, innovation, and responsible technological development. May your capstone projects serve not only as academic requirements but also as foundations for future solutions that benefit the institution and the wider community.

MARK GIL Q. SUPERIO, MIT

Panel Member

City College of Angeles

MESSAGE FROM THE BOARD OF PANELISTS



To say I am proud of you is an understatement. Watching you transform a blank canvas of rough ideas into a rigorous, fully realized research project has been one of the most rewarding experiences of my academic journey with you.

I know how demanding this road was. You survived endless revisions, daunting panel questions, late-night data crunching, and the inevitable moments where nothing seemed to work. Yet through every setback, you adapted. When you stood before us during your final defense, you didn't just present a project—you spoke with authority, confidence, and true mastery of your work.

As your adviser and panelist, my goal was always to challenge you to reach your full potential. Seeing you rise to those high standards with such grit, intellectual curiosity, and grace fills me with immense pride. You are no longer just students completing a requirement; you are real researchers and innovators capable of solving complex problems.

Take a moment to celebrate this achievement. The skills you forged here—critical thinking, resilience under pressure, and collaborative problem-solving—will serve as your foundation for whatever comes next.

Congratulations on crossing the finish line! Remember that while this chapter of your capstone is complete, my door will always remain open to you as a mentor, advocate, and lifelong champion of your success.

LOVELY RUTH C. VALDEZ-SANTOS

Technical Adviser / Panel Member

Mabalacat City College

BSIT FACULTY MEMBER, TECHNICAL ADVISER & BOARD OF PANELISTS



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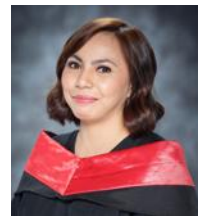
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BSIT
JOURNAL PRESENTATION

AloHOA: A Web-Based Homeowners Association Management System for Xevera Subdivision, Mabalacat City

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ABSTRACT

This study presents the development of AloHOA, a web-based Homeowners Association Management System designed to streamline administrative processes, enhance security, and improve resident engagement for Xevera Subdivision, Mabalacat City. The system features amenity booking, online payment integration via Xendit gateway, incident reporting, chat support, Two-Factor Authentication (2FA), and Role-based Access Control (RBAC). It also provides a dedicated module for homeowners and tenants to manage monthly rents and process move-out clearances. Developed using the modified Waterfall Model of the Software Development Life Cycle (SDLC), the system was built with the VILT stack, comprising Vue.js v3, Inertia.js v1, Laravel v10, and Tailwind CSS v3. The system underwent rigorous evaluation based on ISO 25010 standards, assessing Functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility. Alpha testing yielded an overall mean score of 4.77, while beta testing demonstrated improvement with a mean score of 4.78, both categorized as “Excellent”. The developed system aligns with Sustainable Development Goals (SDGs) 4 (Quality Education), 9 (Industry, Innovation, and Infrastructure), and 11 (Sustainable Cities and Communities).

Keywords: Homeowners Association Management System, Laravel PHP Framework, Payment Gateway Integration, Role-Based Access Control (RBAC)

INTRODUCTION

Technology has transformed how communities manage their operations and engage with residents. Homeowners' associations (HOAs) have a long-standing history in the management of residential communities, dating back several decades. These organizations have been instrumental in maintaining shared spaces, enforcing community regulations, and fostering a sense of belonging among residents. Traditionally, HOAs relied on manual processes for managing resident information, tracking payments, and ensuring security. However, as communities have expanded in size and complexity, these outdated methods have become increasingly inefficient, leading to administrative challenges and diminished resident satisfaction (Chen, 2024).

A global trend toward more effective and technologically advanced community management practices is evident, as residential communities worldwide have embraced digital platforms for online payment processing, automated administrative workflows, and

enhanced resident communication (Kovacova, 2023). These developments have made it possible for community managers to simplify complex tasks, reduce manual error rates, and provide residents with easier access to necessary services. Additionally, the broad use of these digital technologies has improved information security, increased transparency, and promoted quicker responses to resident concerns.

In the Philippines, where urbanization is accelerating, many subdivisions, including Xevera Subdivision in Mabalacat City, continue to grapple with antiquated systems that hinder effective administration. Recent studies highlight the necessity for automated systems that integrate online payment processing, secure identification, and real-time communication to address these issues effectively. The Philippine government has recognized the importance of digital transformation in various sectors, promoting initiatives aimed at enhancing technological infrastructure.

Mabalacat City, a rapidly growing urban area, faces unique challenges in managing its residential communities. Xevera Subdivision, with its diverse population and increasing number of residents, requires a more efficient and secure management system to address issues such as payment tracking, communication, and community engagement.

Feedback from residents has indicated dissatisfaction with the current manual processes, highlighting the need for a more streamlined approach. By implementing a web-based Homeowners Association Management System, Xevera Subdivision can enhance administrative efficiency, improve security, and foster a stronger sense of community among its residents.

Objective of the Study

The primary objective of this study was to develop an efficient and user-friendly web-based platform, "AloHOA: A Web-Based Homeowners Association Management System for Xevera Subdivision, Mabalacat City."

In line with this, the study aimed to achieve the following specific objectives:

1. To gather relevant literature and data on existing HOA management systems, their challenges, and technological solutions implemented in other communities.
2. To identify the necessary hardware and software requirements for developing the web-based system, utilizing a software stack comprising Laragon, Visual Studio Code, Vue.js, Laravel (PHP), Inertia.js, Tailwind CSS, and MySQL.
3. To design the software by employing various modeling and analysis tools, including storyboards, use case diagrams, data flow diagrams, entity-relationship diagrams, and visual tables of contents.
4. To create and develop the system with features such as Role-Based Access Control (RBAC) for secure user management, Two-Factor Authentication (2FA) for enhanced login security, amenity booking functionality, online payment integration through the Xendit gateway, as well as real-time chat support and incident reporting modules.
5. To test the system through alpha and beta testing phases.
6. To evaluate the system's performance based on ISO 25010 criteria: Functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility.
7. To deploy and implement the system on a PLDT bare-metal server located at the VITRO Data Center in Clark, utilizing a Linux-based server environment.

Each specific objective interconnect to support the successful development, deployment, and operation of the AloHOA platform. Together, they form a comprehensive approach to achieving the

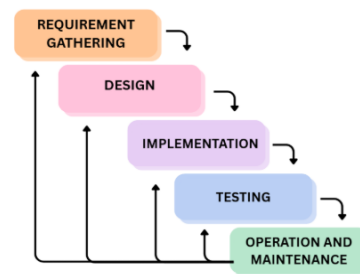
study's primary goal of enhancing community management and resident engagement at Xevera Subdivision.

METHODOLOGY

The research employed the Modified Waterfall Model, a structured yet flexible approach that facilitated iterative refinements at each development stage (See Figure 1). This methodology provided systematic development processes while allowing adaptability to user feedback and challenges, ensuring quality, consistency, and maintainability of the system.

Figure 1

The Modified Waterfall Model



Requirements

The requirements gathering phase identified essential hardware components, including a desktop computer equipped with an Intel Core i5-13th generation processor, 16GB RAM, 8GB video RAM, and 500GB SSD to facilitate system development and testing. The software requirements included Visual Studio Code 1.93 for code editing and debugging. For development, the researchers utilized Vue.js v3 for dynamic client-side interactions, Laravel v10 for server-side logic and operations, Inertia.js v1 for seamless single-page application functionality, and Tailwind CSS v3 for designing the user interface with a utility-first approach.

PHP 8.3 served as the primary programming language for backend development, with MySQL v8 managing the platform's data storage. Laragon provided the local development environment, while Node.js handled dependency management. For creating visual assets and mockups, Canva was employed, while Miro supported brainstorming, planning, and wireframing tasks. Version control and collaboration were facilitated using Git.

This combination of hardware and software ensured a versatile, efficient, and collaborative environment for developing the AloHOA system.

Design

The system's design employed tools such as Storyboards, Visual Tables of Contents, Use Case Diagrams, Data Flow Diagrams, Entity Relationship Diagrams (ERD), and Gantt Charts to visualize the user interface, functionality, and workflows. These tools provided structure and clarity, supporting effective project management and ensuring alignment with user needs.

The AloHOA system integrates inputs, processes, and outputs to create a cohesive and user-focused platform. Inputs include community management requirements, with a focus on analyzing resident needs, payment tracking systems, security protocols, and communication channels. The processes encompass detailed system requirements analysis, system design, and iterative development phases. These steps incorporate features such as resident registration, online payment processing, amenity booking, incident reporting, and real-time communication channels, ensuring that the system meets the operational and administrative needs of its users.

The system architecture comprises a secure database and an intuitive user interface. The database manages resident information, payment records, amenity bookings, and incident reports, while the user interface provides an accessible and seamless platform for residents and administrators. This design ensures smooth interactions, enabling users to access services, monitor activities, and manage community operations effectively.

Figure 2
Storyboard

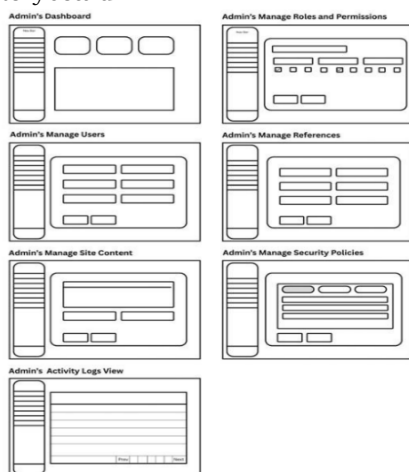


Figure 3
Visual Tables of Content

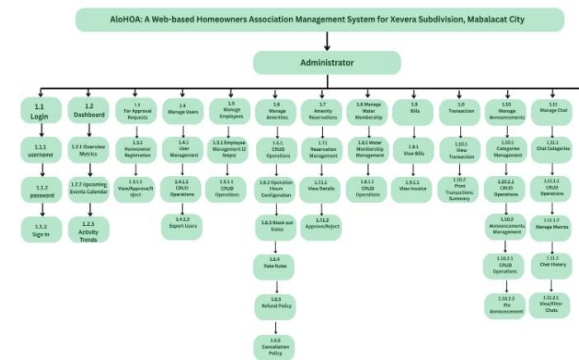


Figure 4
Use Case Diagrams

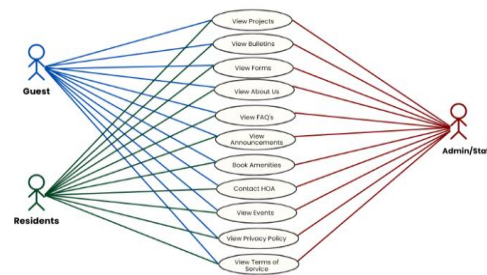


Figure 5
Entity Relationship Diagram (ERD)

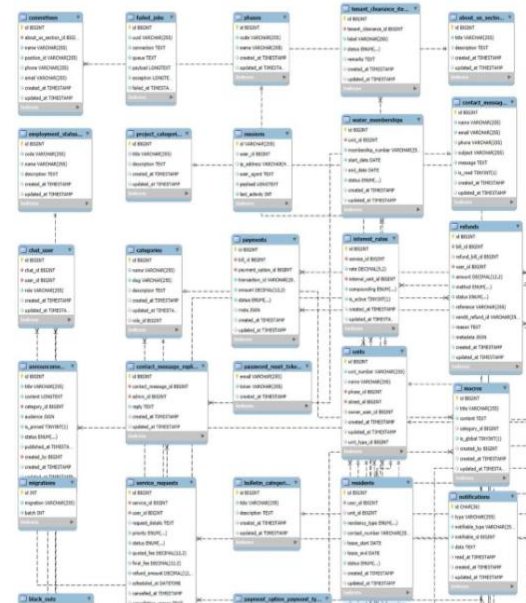


Figure 6
Gantt Chart



Development

The development phase of the AloHOA system involved the use of various analysis tools and diagrams to guide the system's creation. An Entity-Relationship Diagram (ERD) was developed to model data entities and their relationships, forming the foundation for the system's database design. This database securely manages resident data, payment records, amenity bookings, incident reports, and chat communications, ensuring data integrity and efficient retrieval.

Storyboards were created to visually represent the user interface and application flow, helping the development team align their efforts with user expectations. Storyboards for residents outlined interactions such as registering accounts, booking amenities, making payments, and reporting incidents. Storyboards for administrators depicted the administrative user flow, illustrating functionalities such as managing resident accounts, processing payments, monitoring incidents, and updating community announcements.

Visual Studio Code served as the primary integrated development environment (IDE) for designing and coding the platform. The interface was crafted using modern frameworks, with Vue.js v3 providing dynamic client-side interactions, Inertia.js v1 enabling seamless single-page application functionality, Tailwind CSS v3 offering utility-first styling, and Laravel v10 with MySQL ensuring a secure, scalable, and efficient backend.

The researchers integrated comprehensive payment functionality into the system through a thorough assessment of available payment gateways. After evaluating multiple options,

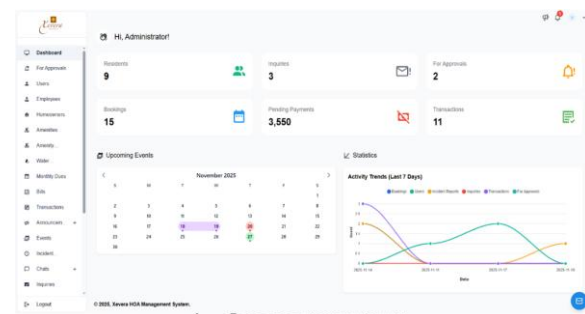
Xendit was selected as the primary payment processor due to its extensive support for various payment methods relevant to the Philippine context, including e-wallet payments (GCash, GrabPay, PayMaya), bank transfers, and credit/debit card payments.

Throughout the development process, iterative testing was conducted to refine features and guarantee they met the specific needs of Xevera Subdivision residents and administrators. The final platform integrated community management tools and resources seamlessly, providing residents with an efficient service environment and equipping administrators with tools for effective system management.

Figure 7
Landing Page



Figure 8
Dashboard



Testing

The testing phase of AloHOA was comprehensive and methodical, employing multiple testing approaches to ensure functionality, reliability, and user satisfaction. Alpha and beta testing formed the core of the evaluation process, involving iterative refinement and feedback collection.

During alpha testing, three Information Technology (IT) experts rigorously examined the system to identify bugs, vulnerabilities, and

areas for improvement. The alpha test was conducted across three separate sessions at different locations: Cafe Beni in Mabalacat, Pampanga on October 4, 2024; the IT Office of the Municipality of Mabalacat City on October 7, 2024; and through an online meeting on November 22, 2024. Feedback from this phase informed several refinements to ensure a stable and functional platform before beta testing commenced.

Beta testing involved 30 participants consisting of five HOA staff members and 25 residents from Xevera Subdivision. The beta test was carried out from October 8-10, 2024. Participants were selected to represent the primary user demographic, ensuring that the testing results were directly aligned with the needs and expectations of the target audience. Feedback was collected using structured questionnaires designed to assess key aspects of the system, including usability, functionality, and overall satisfaction.

Following the testing phases, a quantitative descriptive research method was employed to objectively evaluate the system's quality and performance. A structured survey questionnaire was created based on the ISO 25010 software quality product model, which evaluated critical attributes such as Functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility. The results were statistically analyzed using a 5-point Likert scale to describe the overall quality level of the system:

Table 1
Likert Scale used by the Researchers

Response Categories	Numerical Value	Range Interval	Verbal Interpretation
Strongly Agree	5	4.21 – 5.00	Excellent
Agree	4	3.41 – 4.20	Good
Neutral	3	2.41 – 3.20	Acceptable
Disagree	2	1.81 – 2.60	Marginal
Strongly Disagree	1	1.00 – 1.8	Poor

Operation and Maintenance

The system, AloHOA, was deployed on a PLDT bare-metal server located at the VITRO Data Center in Clark, utilizing a Linux-based server environment. The domain <https://www.xevera-hoa.online> was registered to make the platform accessible to the Xevera Subdivision community.

The deployment process included setting up the server environment, configuring security settings with SSL encryption, and ensuring smooth integration with the front-end and back-end components. Comprehensive testing was performed to ensure all system functionalities work seamlessly post-deployment. Regular maintenance protocols were established to ensure AloHOA's reliability and effectiveness. Key metrics, such as user feedback, system performance, and usage statistics, were monitored regularly to address issues promptly. Periodic updates enhanced functionality and resolved bugs, while administrators were trained to report concerns efficiently for swift resolution. The maintenance phase ensures sustained operation and continuous improvement of the platform.

RESULTS

The website platform interface was evaluated during the alpha testing phase using the ISO 25010 software quality standards, focusing on Functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility. The evaluation, conducted with three IT experts across three sessions in October and November 2024, demonstrated excellent performance across all criteria.

Table 2
Summary of Alpha Test Results

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.85	Excellent
Compatibility	4.67	Excellent
Interaction Capability	4.75	Excellent
Security	4.83	Excellent
Flexibility	4.77	Excellent
Overall Mean Score	4.77	Excellent

The alpha test results demonstrated exceptional performance across all evaluated criteria, with an overall mean score of 4.77, interpreted as "Excellent." Functional Suitability received the highest score of 4.85, reflecting the system's robust ability to fulfill its intended functions and meet user expectations comprehensively. Compatibility recorded the lowest average score at 4.67, which, while still falling under the

"Excellent" verbal interpretation, suggests that the system's ability to seamlessly integrate or exchange data with other platforms may benefit from further enhancement to ensure optimal interoperability with external systems and technologies.

A comprehensive evaluation of the website platform interface was conducted during the beta testing phase, focusing on Functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility, as outlined in ISO 25010 standards. The beta test took place from October 8-10, 2024, with 30 participants consisting of five HOA staff members and twenty-five residents from Xevera Subdivision in Mabalacat City.

Table 3
Summary of Beta Test Results

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.78	Excellent
Compatibility	4.83	Excellent
Interaction Capability	4.73	Excellent
Security	4.85	Excellent
Flexibility	4.70	Excellent
Overall Mean Score	4.78	Excellent

The beta test results showcased significant improvements, achieving an overall mean score of 4.78, interpreted as "Excellent." Security received the highest score of 4.85, demonstrating strong confidence in the system's capability to safeguard sensitive data. Compatibility scored 4.83, Functional Suitability scored 4.78, Interaction Capability scored 4.73, and Flexibility scored 4.70. All criteria achieved "Excellent" ratings, indicating the platform's effectiveness in meeting user needs and ISO 25010 standards.

Overall, the beta test results highlight the platform's significant improvements since the alpha testing phase. The platform demonstrated excellent usability, robust security, seamless cross-platform compatibility, and adaptability. These findings confirm the system's readiness for deployment and its ability to effectively meet user expectations.

DISCUSSION

The development of AloHOA: A Web-Based Homeowners Association Management System for Xevera Subdivision aimed to provide

residents and administrators with a comprehensive and efficient community management environment. This study sought to address the limitations of existing manual systems by introducing a user-centered, feature-rich platform tailored to the needs of homeowners' associations. Specifically, the study identified the current systems utilized for community management and the challenges faced by residents and administrators in managing operations. Based on these findings, the researchers designed a platform that incorporates essential features to enhance the overall community management experience. Conducted at Xevera Subdivision, Mabalacat City, the research involved residents, HOA staff, and administrators. Their insights were pivotal in shaping the platform's features, ensuring that AloHOA meets the specific operational and administrative needs of its users.

The study concluded that AloHOA successfully provides a secure and interactive community management environment. Features such as Two-Factor Authentication, Role-Based Access Control, and secure payment processing ensure data protection and operational integrity, making it suitable for homeowners' associations. The platform's integrated tools, including amenity booking, incident reporting with geolocation, real-time chat support, and online payment processing via Xendit gateway, provide practical and efficient methods for community management. These tools, combined with the platform's intuitive design, enhance operational efficiency and resident satisfaction.

The system emphasizes ease of use and adaptability, benefiting both residents and administrators. Residents gain access to convenient services that support their community engagement, while administrators enjoy efficient resident management, payment tracking, and real-time monitoring capabilities. Features like notification alerts, announcements, and incident tracking enhance communication and transparency, making community operations more responsive and effective. Additionally, the platform offers administrators significant control over community management, user monitoring, and content updates. This functionality ensures flexibility and responsiveness to the evolving needs of users.

To further enhance the platform, advanced features could be incorporated such as native mobile application development for iOS and

Android to increase accessibility and convenience for on-the-go community management, expansion of payment options beyond Xendit to include additional processors or cryptocurrency for greater flexibility, and integration with the existing RFID system for automated vehicle identification and seamless synchronization between digital records and physical scanning at entry points.

By addressing these recommendations, AloHOA can evolve into a more comprehensive, secure, and user-friendly platform that continues to meet the needs of homeowners' associations while fostering community engagement and operational excellence.

ACKNOWLEDGMENTS

The successful completion of this capstone project is the result of collective support and guidance from numerous individuals and organizations. We begin by expressing profound gratitude to Almighty God, who bestowed upon us the strength, wisdom, and resilience to navigate through the myriad challenges encountered during this academic endeavor.

We extend our deepest appreciation to Mrs. Ritchell Z. Escoto, MIT, our Capstone Adviser, whose unwavering commitment and insightful guidance were instrumental in shaping the trajectory of our project. Her continuous mentorship and constructive feedback provided us with critical direction and inspiration throughout the development process.

Our sincere gratitude is also directed to Mr. Robbert M. Bamba, MEECE, our Technical Adviser, whose expertise, dedication, and patient guidance were crucial in helping us overcome technical obstacles. His meticulous approach and technical acumen were pivotal in ensuring the system's robust design and functionality.

We are immensely thankful to Engr. Dennis L. Tacadena, DIT, Dean of the Institute of Business and Computing Education (IBCE), for granting us permission to conduct our research and supporting its focus on enhancing community management. His encouragement and endorsement, along with his supportive presence during our panel defense, were both reassuring and invaluable to the success of this study.

Special appreciation is extended to Xevera Homeowners Association (HOA) for its valuable contributions and support, which played a significant role in facilitating the research process and enhancing the project's outcomes.

The contributions of our Alpha and Beta testers cannot be overstated. Their thorough engagement and constructive feedback were essential in refining the system's design, functionality, and user experience.

We are eternally grateful to our families, friends, and team members, whose unwavering encouragement, collaborative spirit, and emotional support sustained us through this challenging yet rewarding journey.

To every individual who played a role, whether big or small, in bringing this project to fruition: our heartfelt thanks. Your belief in our potential and collective support have made this academic milestone possible.

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ARBORWATCH: A Web-Based Mapping and Monitoring System for Conservation of Trees in Mabalacat City.

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ABSTRACT

Urban forest management has grown more critical as climate change and urban heat island effects threaten both human well-being and the ecological health of green spaces. In Mabalacat City, the absence of an effective digital tool has limited the capacity of the City Environment and Natural Resources Office (CENRO) to fully implement conservation efforts. This study introduces ArborWatch, a web-based system developed to digitize and streamline tree conservation and record-keeping. ArborWatch enables CENRO to maintain accurate tree records and visualize them on an interactive map — bridging the gap between traditional monitoring and modern digital management. Built using back-end technologies (TypeScript, JavaScript, Firebase) and a front-end powered by Tailwind CSS and Vite.js, the system delivers a user-friendly interface and robust database management. Testing results yield high user satisfaction: 4.32 in alpha testing and 4.47 in beta testing, reflecting its reliability, usability, and security. By aligning with the Sustainable Development Goals (SDGs), ArborWatch promotes sustainability, supports climate action, enhances terrestrial ecosystems, and strengthens community engagement in environmental planning.

Keywords: Urban Green Space, Map Key, Main Thorough Fares, Interactive Map, Ecological Balance

INTRODUCTION

The conservation of tree populations has become increasingly essential as climate change continues to surge and affect communities around the world. Although no credible scientist claims that climate change can be solved with trees alone, extensive research confirms that humanity cannot survive without them. The ongoing reliance on fossil fuels remains a major driver of worsening climate conditions, making the role of trees even more critical in climate regulation and environmental stability (Lotspeich, 2023).

Urban green spaces significantly contribute to mitigating climate change while also serving as safe habitats for wildlife and preserving ecological balance. Rising temperatures and the intensifying urban heat island effect have increased health risks and heightened energy demands for cooling buildings. Despite the well-established environmental, social, and economic benefits of urban green spaces, there remains a significant lack of knowledge regarding appropriate tree conservation and preservation strategies (Li et al., 2023). As the primary

component of urban greenery, trees are essential in keeping ecosystems healthy and supporting both wildlife and local communities.

Trees are vital for regulating climate, combating global warming, and preventing environmental degradation. However, rapid urbanization has caused a reduction in tree populations, and without a proper monitoring system, trees are increasingly exposed to threats such as diseases, illegal cutting, and environmental stressors. Regardless of whether they are native or exotic, trees provide substantial value to communities and ecosystems. Climate change has further impacted wildlife, environmental stability, and various societal sectors, prompting stronger efforts to conserve and protect tree populations (Castelo et al., 2024).

Accurate information on tree diversity and current conditions is crucial in planning effective conservation programs (Choi & Kim, 2022). Successful implementation depends on geographic context, political will, and public participation. Community involvement is especially important, as it improves the efficiency of conservation initiatives while optimizing time and resources (Nowak, 2025).

In the Philippines, forest loss underscores the urgent need for enhanced conservation efforts. In 2023, the country recorded a 4.1% decrease

in humid primary forest area compared to 2002, amounting to 190 thousand hectares lost and representing 13% of total tree cover (Global Forest Watch, 2024). This highlights the growing necessity for accurate baseline information and a reliable tree monitoring system. Such data enables appropriate conservation actions and safeguards remaining forest resources (Lleno J. et al., 2023).

The ecological functions of trees are essential for sustaining ecosystems, protecting wildlife populations, and supporting societal well-being. Trees help mitigate greenhouse gas emissions, provide habitats for species in both rural and urban areas, and contribute to environmental, economic, and social stability. However, the Philippines continues to experience a decline in flora and fauna, largely due to rapid urbanization and the conversion of natural landscapes (Forest Foundation Philippines, 2022).

Population growth and land conversion have accelerated tree cutting and further reduced tree cover. In Pampanga, Mabalacat City experienced the highest tree cover loss at 140 hectares—significantly higher than the provincial average of 68 hectares. This decline contributes to more severe climate impacts, such as extreme summer heat, colder “Ber” months, and increasingly unpredictable weather patterns (Vizzuality, 2024). These changes demonstrate how environmental degradation directly affects daily life and long-term community resilience.

Ecological conservation is essential to ensuring that natural assets continue to provide environmental and societal benefits. While restoration efforts, such as those occurring in the Arayat mountain, are underway, the effects of climate change remain visible in communities. Environmental groups stress the importance of conserving both large forests and smaller green spaces within local neighborhoods, as these urban trees also play a substantial role in mitigating climate-related risks (Joven et al., 2023).

The rapid decline of tree populations has created alarming consequences for communities, affecting agriculture, businesses, public health, and overall quality of life. Climate change and global warming pose escalating threats, and one widely recognized solution is the planting and conservation of trees to help counter environmental impacts (Woodland Trust, 2021).

ArborWatch: A Web-Based Mapping and Monitoring System for Conservation of Trees in Mabalacat City aims to address these challenges by providing a comprehensive platform for monitoring and protecting urban trees. The system offers an interactive map and quarterly updates on tree status, enabling more organized and transparent conservation activities. It allows the community to engage with the City Environment and Natural Resources Office’s (CENRO) efforts, strengthening environmental stewardship and promoting shared responsibility. Through this digital platform, ArborWatch enhances community participation, supports data-driven decision-making, and improves the city’s capacity to maintain ecological balance.

By enabling accurate tree monitoring and promoting public involvement, ArborWatch contributes to long-term climate resilience and environmental sustainability in Mabalacat City.

Objective of the Study

The General objective of this study is to develop a system entitled “ArborWatch: A Web-Based Mapping and Monitoring System for the Conservation of Trees in Mabalacat City” to efficiently map and monitor tree conditions, ensuring swift action when needed. The system aims to provide a centralized and accessible platform for viewing verified tree data, supporting the CENRO’s conservation efforts, enhancing community awareness, and promoting proactive management of urban green spaces.

In line with this, this study aims to achieve the following specific objectives:

1. To gather scholarly published literature on monitoring and conserving of trees that will help establish the system point and provide backup information.
2. To identify and specify the hardware requirements such as a desktop computer, mobile phone, range finder, and tape measuring, as well as the software requirements including Shadcn, Canva, JavaScript, React.js, TypeScript, Vite, Tailwind CSS, Wouter, Recharts, Firebase, React-Leaflet, Visual Studio Code, MyHealth App, Timestamp App, Google Lens, Git, GitHub and Vercel for the development and deployment of the system.
3. To design the web-based mapping and monitoring system using Storyboard, Use Case

Diagram, Entity Relationship Diagram, Gantt Chart, and Data Flow Diagram.

4. To develop a website that maps and shows tree data.

5. To evaluate the system using the ISO 25010 criteria.

6. To deploy and implement the system, ArborWatch.

Each specific objective interconnects to support the successful development, deployment, and operation of the ArborWatch platform. Together, they create a comprehensive framework that ensures the study's primary goal—enhancing tree conservation efforts, strengthening environmental stewardship, and promoting sustainable urban ecosystem management in Mabalacat City—is effectively achieved.

METHODOLOGY

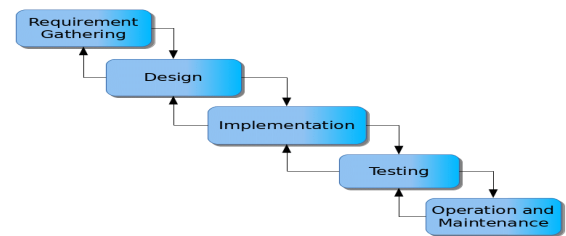
The research adopted the Modified Waterfall Model as the Software Development Life Cycle (SDLC) (see Figure 1) method in creating the system “ArborWatch: A Web-Based Mapping and Monitoring System for Conservation of Trees in Mabalacat City.” This model is a flexible variation of the traditional waterfall approach, maintaining a sequential flow of phases while allowing feedback loops and revisions when necessary. It suited the project's needs because of its structured yet adaptable nature, enabling the researchers to refine earlier stages once implementation and testing began.

In the Requirements Phase, the researchers initially identified the needs of CENRO and the community, defining system features and data requirements. The Design Phase followed, where system architecture, interface layouts, and data structures were planned. This transitioned into the Implementation Phase, during which the actual coding and development of the web-based platform took place. The Testing Phase ensured that all features functioned correctly, met the ISO 25010 criteria, and aligned with project goals. After revisions and improvements, the system proceeded to the Deployment Phase, where ArborWatch was made accessible for use. By following the Modified Waterfall Model, the researchers were able to work systematically while maintaining the flexibility to revisit and improve earlier phases. This approach allowed the team to enhance the system continuously and ensure that the final output aligned with its

overall objectives and intended conservation impact.

Figure 1

The Modified Waterfall Model



Requirements

The Requirement Gathering process for the ArborWatch system involved a collaborative effort among the researchers to collect essential insights needed to build a reliable and effective tree monitoring platform. The process began with brainstorming sessions to identify the system's purpose, initial features, and the specific environmental issues it aimed to address. An interview with the target locale helped verify the need for the system and provided valuable input for refining and adding features based on real community challenges. Scholarly literature and related studies were also reviewed to establish a strong research foundation and determine appropriate hardware and software requirements.

User requirements were assessed through feedback from CENRO personnel, Biology students from Mabalacat City College, and web development professionals. Their insights significantly improved ArborWatch's mapping functions, data organization, and user experience.

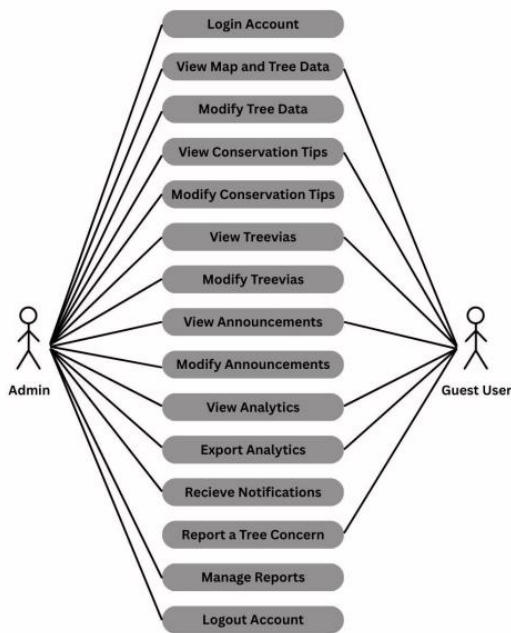
The researchers identified the necessary hardware, including a development computer with an Intel Core i7-6700 processor, 16GB RAM, and Windows 11 Pro. Essential software tools included Visual Studio Code for coding, Vite for front-end development, Canva for UI design, Git and GitHub for version control, and Vercel for deployment. These components ensured efficient development, stable performance, and seamless online accessibility of the ArborWatch system.

Design

During the system design phase, the researchers used several analysis tools and diagrams to effectively plan and construct the ArborWatch

system. Storyboarding was used to visualize user interactions and outline the system's flow, ensuring all developers shared a unified understanding of the interface and processes. Use Case Diagrams (see Figure 2) helped define system requirements by illustrating how users interact with core features, enabling clear communication among developers and stakeholders.

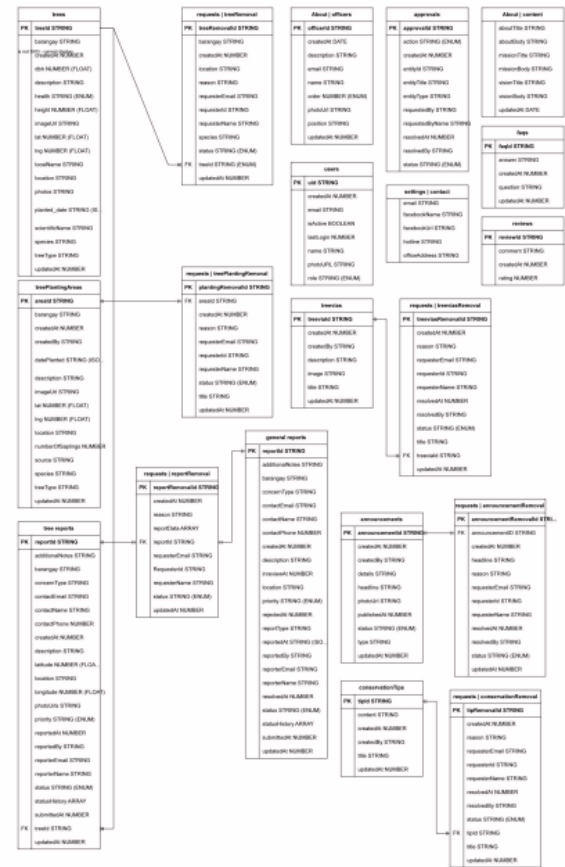
Figure 2
ArborWatch Use Case Diagram



An Entity Relationship Diagram (ERD) (see Figure 3) was utilized to map out the system's data architecture, showing entities, their attributes, and how they interact. This ensured database accuracy, proper data organization, and efficient management. Data Flow Diagrams (DFDs) (see Figure 4) were also employed to illustrate how information moves throughout the system, clarifying inputs, processes, and outputs for better functional design.

Lastly, a Gantt Chart was used to schedule tasks, track progress, and manage dependencies, helping the team stay organized and meet deadlines. Collectively, these tools ensured structured development, alignment with project goals, and early detection of issues, ultimately contributing to a functional, efficient, and user-centered system.

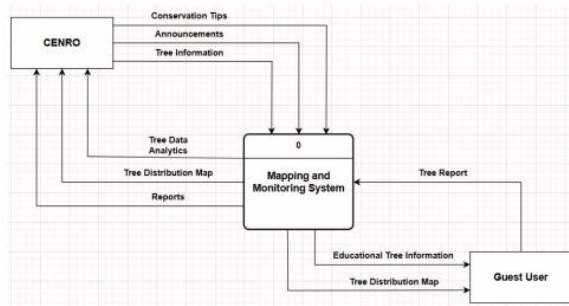
Figure 3
ArborWatch ERD



Development

During the implementation phase, the researchers utilized a combination of hardware and software tools to transform the ArborWatch concept into a fully functioning web-based mapping and monitoring system. Hardware tools such as a mobile phone, range finder, and tape measure supported fieldwork by enabling accurate tree measurements and location recording. To enhance data collection, additional applications were used: the MyHealth app provided location tracking to mark traversed areas during field visits, the Timestamp app captured geo-tagged photos with time and date stamps for easier site verification, and Google Lens assisted in identifying tree species to ensure accuracy and reliability in the gathered data.

Figure 4
ArborWatch Data Flow Diagrams



On the software development side, various technologies were integrated to build a modern, efficient, and easy-to-navigate platform. Canva was used for designing visual elements of the system, while Shadcn provided a UI component library that ensured consistency across interfaces. The front-end development relied on React.js, TypeScript, Vite, Tailwind CSS, Wouter, and Recharts to create interactive pages, smooth navigation, and visually clear graphs and dashboards. For the backend, Firebase handled authentication, hosting, and database management, enabling secure and scalable operation. Interactive mapping features were made possible through React-Leaflet, which allowed precise visualization of tree locations. Git and GitHub supported version control and collaborative coding, while Visual Studio Code functioned as the main environment for writing and debugging the system. Deployment was managed through Vercel, ensuring that the platform was accessible online and could be updated seamlessly during development. Through these tools, the researchers successfully implemented key system features, such as the interactive tree map with filters, condition indicators, information windows, an announcements page, quarterly assessment alerts, dashboards for analytical insights, database management functions, and report generation capabilities. This phase also involved rigorous testing and debugging to address potential issues before deployment. Overall, the implementation process was essential in building a functional, user-friendly system aligned with the needs of the Mabalacat City Environment and Natural Resources Office (CENRO), ultimately supporting more efficient and sustainable tree conservation efforts.

Testing

Upon completing the development of ArborWatch, the researchers conducted alpha and beta testing to identify missing features, errors, and potential system enhancements. Survey questionnaires based on the ISO/IEC 25010 software quality standards were used to assess functional suitability, usability, compatibility, security, and reliability. Prior to deployment, the questionnaires underwent validity testing to ensure they accurately measured the intended criteria and produced reliable results. Preparation included defining protocols, selecting a sample, setting objectives, and designing questions to evaluate user satisfaction and preferences. Participants were recruited from relevant user groups, and the surveys were administered face-to-face to collect feedback after system use.

The researchers employed a heterogeneous purposive sampling method to ensure diverse perspectives. Thirty participants were selected: five CENRO representatives, ten biology students from Mabalacat City College, and fifteen general users. This approach enabled the inclusion of experts, semi-experts, and ordinary users, ensuring comprehensive evaluation of system functionality. Ethical standards were strictly observed, including informed consent, confidentiality in line with the Data Privacy Act of 2012, and proper attribution of intellectual property in accordance with the Cybercrime Prevention Act of 2012.

Data were analyzed using descriptive statistics, including frequency distribution, percentages, mean scores, and Likert scale interpretation. Alpha testing involved three IT experts evaluating system functionality, usability, and design, while beta testing collected feedback from the broader user group. Tally sheets were used for organized data processing. The results provided insight into system performance, user satisfaction, and areas needing improvement, serving as a foundation for future enhancements. This rigorous evaluation ensured that ArborWatch is reliable, user-centered, and capable of supporting the Mabalacat City CENRO in effective tree monitoring and conservation efforts.

Table 1: Likert Scale used by the Researchers

Response Category	Numerical Value	Range/ Interval	Narrative Interpretation
Strongly Agree	5	4.21-5.00	Excellent
Agree	4	3.41-4.20	Very Good
Neutral	3	2.61-3.40	Acceptable
Disagree	2	1.82-2.60	Marginal
Strongly Disagree	1	1.00-1.80	Poor

Deployment

The ArborWatch system was deployed on a designated server, ensuring secure and reliable access for users in Mabalacat City. Full access was provided to the City Environment and Natural Resources Office (CENRO) to enable real-time tree mapping, monitoring, and record-keeping. Public beta testing was conducted to gather feedback from administrators, students, and community users, allowing the researchers to refine system features and prepare for official use.

Maintenance

Regular maintenance protocols were implemented to ensure ArborWatch's reliability and long-term stability. System performance, user interface interactions, and accessibility were continuously monitored to promptly address any issues. Feedback from users and administrators was systematically collected to guide improvements, optimize usability, and enhance functionality. Periodic updates were applied to resolve bugs, implement enhancements, and ensure the system effectively supports tree conservation and management in Mabalacat City.

RESULTS

The ArborWatch website interface underwent comprehensive alpha testing conducted by three IT experts to evaluate its functionality and user experience. The tests took place on September 20 and 23, 2025, at Mabalacat City College and Skytech, Camachiles, Mabalacat City, Pampanga, scheduled separately to accommodate participants' availability. Each session included live demonstrations, hands-on testing, question-and-answer discussions, and the collection of expert feedback, criticisms, and suggestions. Following the tests, the experts completed survey questionnaires designed to

assess the system's performance based on ISO 25010 standards, focusing on Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, and Security. The results, detailed in Appendix H, provided valuable insights into the system's functional stability, interface design, and user-centered features, guiding refinements to enhance usability, reliability, and overall system performance prior to broader deployment.

Table 2: Summary of Alpha Test Results

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.29	Excellent
Performance Efficiency	3.93	Very Good
Compatibility	4.42	Excellent
Usability	4.40	Excellent
Reliability	4.39	Excellent
Security	4.47	Excellent
Overall Mean Score	4.32	Excellent

Table 3: Summary of Beta Test Results

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.41	Excellent
Performance Efficiency	4.51	Excellent
Compatibility	4.48	Excellent
Usability	4.42	Excellent
Reliability	4.39	Excellent
Security	4.59	Excellent
Overall Mean Score	4.47	Excellent

The alpha testing of the ArborWatch platform, evaluated using ISO 25010 standards, showed strong performance across all criteria. Functional Suitability scored 4.29 ("Excellent"), indicating that core tasks such as adding, updating, and displaying tree information were successfully performed, with minor expert suggestions addressed before beta testing. Performance Efficiency received 3.93 ("Very Good"), highlighting slight delays in map loading and page transitions when multiple markers were displayed. Compatibility scored 4.42 ("Excellent"), demonstrating smooth operation

across various devices and browsers. Usability achieved 4.40 (“Excellent”), with participants finding the interface intuitive and easy to navigate, alongside minor recommended adjustments to icons and font sizes. Reliability scored 4.39 (“Excellent”), reflecting stable system operation, and Security rated 4.47 (“Excellent”), confirming effective authentication, role-based access, and database protection. Overall, the ArborWatch interface achieved a mean score of 4.32, underscoring its functional stability, user-centered design, and readiness for beta testing.

The beta testing of the ArborWatch platform involved a comprehensive evaluation using survey questionnaires completed by thirty (30) participants from diverse backgrounds, including ten Biology students, five CENRO personnel, and fifteen general public members. Conducted from September 30 to October 3, 2025, the testing aimed to capture insights from multiple perspectives to provide a well-rounded assessment of the system. Prior to completing the surveys, participants were given an introduction and live demonstration of the platform, followed by a question-and-answer session to ensure informed feedback. The evaluation was based on ISO 25010 standards, assessing six key criteria: Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, and Security. The survey responses and results, presented in Appendix I, provided detailed analysis of each criterion, offering valuable information for identifying strengths, areas for improvement, and guiding future enhancements of the ArborWatch system.

The beta testing of the ArborWatch platform demonstrated excellent performance across all evaluated criteria, reflecting significant improvements from the alpha phase. Functional Suitability scored 4.41 (“Excellent”), indicating that core features like tree addition, updates, and map visualization were effective and user-friendly. Performance Efficiency achieved 4.51 (“Excellent”), showing faster map loading and smoother page transitions following optimizations. Compatibility was rated 4.48 (“Excellent”), confirming seamless operation across multiple devices and operating systems. Usability scored 4.42 (“Excellent”), with users praising the clean interface, organized dashboard, and intuitive navigation. Reliability remained strong at 4.39 (“Excellent”), as no major errors were encountered during

continuous use. Security recorded the highest score at 4.59 (“Excellent”), reflecting enhanced authentication measures and clear separation of admin and guest roles. Overall, these results highlight ArborWatch’s high-quality design, user-centered interface, cross-platform functionality, efficient performance, and reliability, demonstrating its effectiveness in meeting both administrator and end-user needs while adhering to ISO 25010 standards.

DISCUSSION

The development of ArborWatch: A Web-Based Mapping and Monitoring System for Tree Conservation aimed to provide the Mabalacat City Environment and Natural Resources Office (CENRO) with an efficient platform to monitor and manage urban trees. This study addressed the limitations of current manual processes, such as paper-based record-keeping and physical inspections, which constrained CENRO’s ability to effectively track tree locations, conditions, and conservation status. In response, the researchers designed a user-centered system that integrates mapping, data management, and reporting features to support tree conservation efforts. Conducted in Mabalacat City, the study involved CENRO personnel, biology students from Mabalacat City College, and community members. Their input was crucial in shaping the system’s features, ensuring ArborWatch meets the practical needs of both administrators and end-users.

ArborWatch provides a secure and interactive platform with features including an interactive map, color-coded indicators for tree conditions, and a dedicated information section detailing tree species, status, and conservation updates. Distinct user roles were implemented: CENRO administrators can add, update, and delete tree records and post announcements, while regular users can explore published information to foster awareness and education. The system also supports reporting, enabling community members to submit tree-related concerns, thereby integrating citizen input into environmental management activities.

Evaluation results demonstrated that ArborWatch successfully met its objectives. The system improved data accessibility, promoted community awareness, and strengthened environmental management capabilities. Users reported ease of navigation, reliable

functionality, and effective visualization of tree data, highlighting the platform's usability and cross-platform compatibility. Moreover, ArborWatch contributes to sustainable development goals, particularly SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), SDG 15 (Life on Land), and SDG 17 (Partnerships for the Goals), by enabling more organized and efficient tree monitoring and conservation strategies.

Overall, the study concluded that ArborWatch effectively transformed tree management in Mabalacat City. The platform provides verified tree data, precise locations, and analytical tools to support decision-making, while fostering community engagement in urban tree conservation. By digitalizing monitoring processes, ArborWatch enhances CENRO's ability to protect trees, prevent unauthorized removal, and respond to environmental threats. The system underscores the importance of technology-driven initiatives in environmental sustainability and demonstrates a practical approach to integrating digital solutions with local conservation efforts, benefiting both administrators and the wider community.

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AxleSys: A Web-Based Automotive Service and Tire Sales Management System

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ABSTRACT

This study presents the development of AxleSys, a real-time, web-based appointment and management system created to address operational challenges caused by traditional manual processes in scheduling, service tracking, inventory monitoring, and sales recording. The previous reliance on phone calls and walk-ins led to overlapping appointments, long waiting times, lost information, and difficulty monitoring service histories. Developed using the Modified Waterfall Model, the system includes modules for customer appointment booking, automated reminders, inventory and sales management, service status monitoring, administrative dashboards, and report generation. Results indicate that AxleSys reduces scheduling errors, improves customer experience, streamlines administrative tasks, and enhances overall operational efficiency, while its modular design supports scalability and future enhancements such as SMS notifications, expanded analytics, and additional service features.

Keywords: AxleSys, Web-Based Appointment and Management System, Automotive Service Operations, Modified Waterfall Model, Inventory and Sales Management, Service Tracking, Scheduling System, System Scalability

INTRODUCTION

The concept of appointment scheduling software developed as computer systems became more accessible and sophisticated, displacing manual methods like appointment books. There are numerous advantages to using an electronic appointment book. It reduces the likelihood of duplicate reservations and missed appointments by streamlining the reservation process. Additionally, it provides a single platform for managing schedules, making it easier to access and update information while traveling. This improves customer happiness and efficiency because clients may rapidly plan appointments. After-sales services are provided by automakers through their dealers or retailers. Retailers are used by automakers like Toyota, Volkswagen, BMW, and many more to provide services like routine maintenance and other repairs (2020, Shokouhyar).

In the digital age, traditional methods of organizing appointments, such as using a handwritten schedule, can greatly increase problems. By using scheduling software, your auto shop can maintain a clear shop calendar. The ability to enter and examine appointment information makes it easy to determine your

shop's daily appointment capacity based on the difficulty of the incoming jobs. You won't schedule follow-up appointments either (PartsTech, 2023).

The potential of harm at an auto repair shop cannot be ignored because many of the tools, equipment, and even substances that employees work with can be dangerous if not handled and used correctly. The quality of the equipment is very important because many of the daily duties in these workshops require the handling of high weights and dangerous tools, which could cause harm or serious harm if they malfunction.

Working in an auto repair shop can be fascinating and even fulfilling if those who choose this career path have more financial security and a fun, unstructured work environment. However, it is more difficult than it seems for owners of auto repair firms to ensure that they take all necessary precautions to safeguard their employees.

Beyond marketing and brand awareness, social media has an impact on e-commerce. It serves as a crucial platform for social commerce sales, enabling users to locate, browse, and purchase products without ever leaving the platform. Features that streamline the shopping experience, reduce barriers, and increase conversion rates include Facebook Marketplace, Instagram Shopping, and TikTok Shop. Influencer marketing and user-generated content also have a significant influence on consumers' purchasing decisions since people

tend to trust the counsel of individuals they respect and look up to.

Mabalacat City's Axle Tires and Services face comparable operating challenges to those of its larger rivals. The business offers reliable auto repair and maintenance services, although at present it primarily accepts walk-ins and phone calls using a more traditional appointment system. Excessive waiting times, lost bookings, and difficulties tracking service requests are among the inefficiencies caused by this. Increasing client satisfaction and operational efficiency is the aim of putting in place a real-time appointment scheduling and tracking system.

Objective of the Study

This study aimed to design, develop, and evaluate AxleSys, a web-based automotive service and tire sales management system that integrates appointment scheduling, service tracking, inventory management, and sales recording into a single platform.

In line with this, the study aimed to achieve the following specific objectives:

1. To develop and implement an appointment and management system for Axle Tires and Services using a structured and systematic approach.
2. To gather relevant information and best practices through interviews with car owners and shop owners, reviews of textbooks and reference materials, analysis of related systems, and examination of previous research on appointment management systems.
3. The study identifies the required hardware and software specifications, including the use of desktop or laptop computers and mobile devices, as well as development and testing tools such as Visual Studio Code, MySQL, XAMPP, Canva, and Google Chrome.
4. It aims to design the system using standard system analysis and modeling tools, including system flowcharts, storyboards, Gantt charts, and use case diagrams.
5. The system development focuses on integrating key features such as web-based appointment booking, check-in functionality, automated reminders, appointment cancellation, accessibility features, and mobile responsiveness.
6. The study includes system testing through alpha testing for internal functionality and bug detection, and beta testing involving

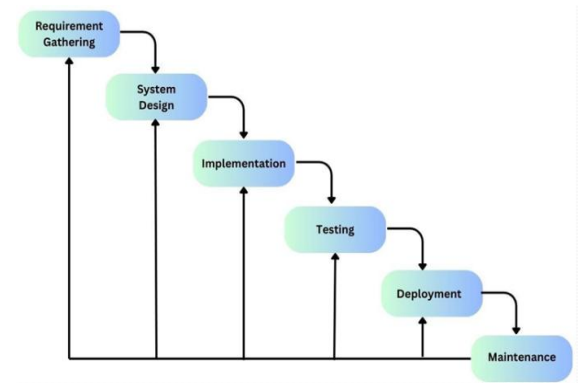
staff and customers to evaluate usability and performance.

7. Finally, the study aims to deploy the system through a pilot implementation followed by full deployment to ensure smooth integration into daily operations and effective real-world use.

METHODOLOGY

The study used the Modified Waterfall Model (see Figure 1) to provide a structured yet flexible development process, covering all SDLC phases from requirements gathering to maintenance. Operational issues in the manual scheduling system were identified through consultations with Axle Tire and Service Center personnel and resolved through proper system design and implementation. Supporting diagrams clarified system processes, leading to the successful development of AxleSys as a reliable and user-friendly web-based appointment scheduling system.

Figure 1
The Modified Waterfall Model



Requirements

The requirement gathering process for AxleSys was conducted collaboratively to ensure alignment with the operational needs of Axle Tire and Service Center. The researchers identified core system features through internal discussions and gained deeper insights into existing scheduling problems such as overlapping appointments, long waiting times, and the absence of centralized workload tracking through informal interviews with staff and management. To strengthen the system design, the team analyzed related web-based appointment systems and reviewed academic

literature on service automation and digital transformation. Overall, this combined approach of stakeholder consultation and literature review provided a solid foundation for developing a functional, efficient, and industry-aligned automotive service scheduling system.

Design

During the design phase, the researchers employed structured analysis tools such as Storyboard (see Figure 2), Use Case Diagram (see Figure 3), and Gantt Chart (see Figure 4) to develop an efficient and user-friendly appointment scheduling system. The Context Diagram defined the system boundaries and interactions with external users, while the Data Flow Diagram detailed internal data processes such as appointment handling, technician assignment, and service updates. The System Flowchart illustrated the step-by-step operational flow of the booking and service process. Collectively, these design tools enabled the researchers to clearly define system behavior, reduce potential inefficiencies, and ensure that AxleSys would provide a streamlined and intuitive user experience upon deployment.

Figure 2
Storyboard

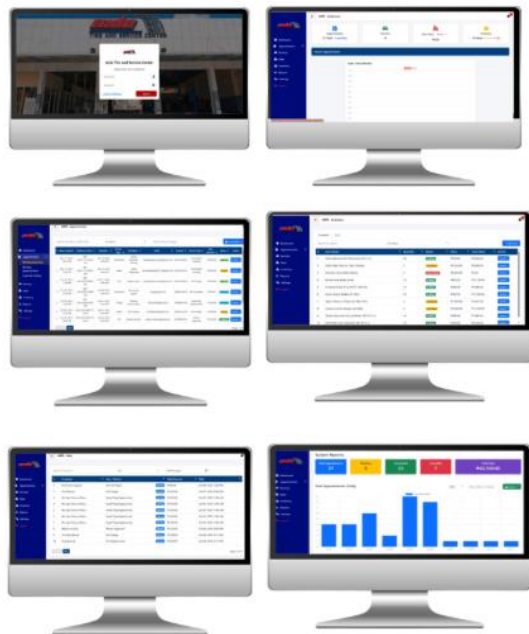
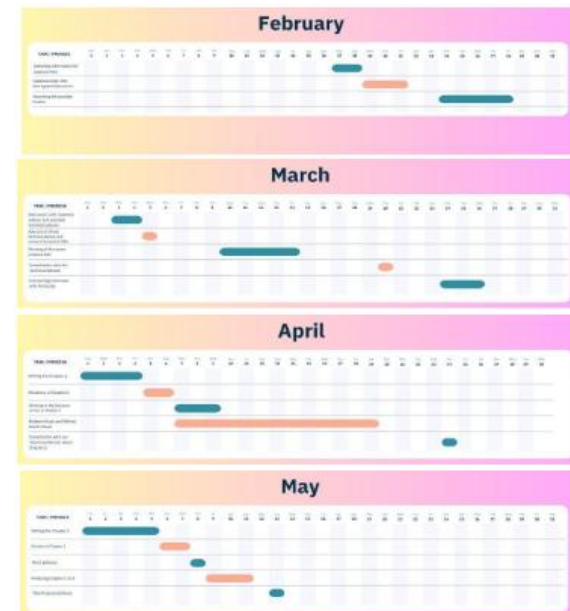


Figure 3
Use Case Diagrams



Figure 4
Gantt Chart



Development

The deployment phase involved transferring the AxleSys system from the development environment to actual operational use at Axle Tire and Service Center (see Figure 5). This phase ensured that the system was properly configured, functional, and ready for real-world

implementation. The production environment was prepared by setting up the web hosting service, configuring the server, and installing the required software components, including the web server, PHP, and MySQL database. After the environment was finalized, the system files were uploaded to the production server and configured to match live server settings. A live MySQL database was created, and the finalized database structure was deployed to support system operations. Before full implementation, a pilot deployment was conducted with selected staff members to validate system functionality. Core features such as appointment scheduling, service management, inventory monitoring, and sales recording were tested under actual usage conditions. Minor issues identified during this stage were addressed to ensure system stability. Following the successful pilot deployment, AxleSys was fully deployed for official use. Live testing was performed to verify system performance, data accuracy, and accessibility. The system became accessible to authorized users through standard web browsers, enabling efficient and reliable daily operations (see Figure 6).

Figure 5
Home Page

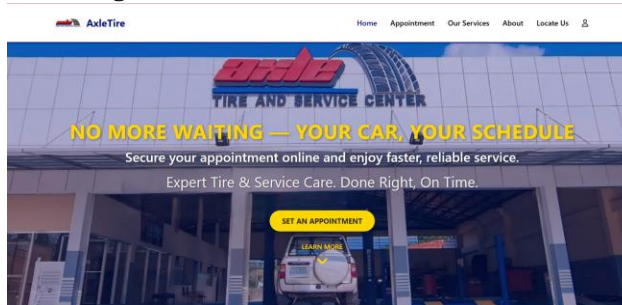
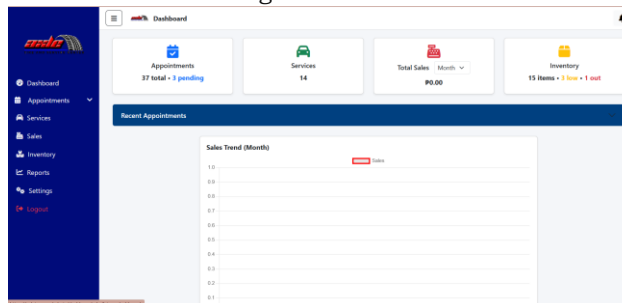


Figure 6
Admin Dashboard Page



Testing

The testing phase was conducted to ensure that the AxleSys system met the specified functional and performance requirements before and after deployment. This phase aimed to identify errors, verify system accuracy, and confirm that all features operated as intended. Functional testing was performed on the system's core modules, including appointment scheduling, service tracking, inventory management, and sales recording. Each module was tested to validate correct data processing, proper system responses, and accurate output generation. Testing ensured that user inputs were correctly handled and that system functions followed the defined workflows. User acceptance testing was also conducted with selected staff members of Axle Tire and Service Center. The users evaluated the system based on usability, functionality, and overall performance in a real operating environment. Feedback gathered during this stage was used to address minor issues and improve system reliability. After deployment, live testing was carried out in the production environment to verify system stability, accessibility, and data integrity. The results of the testing phase confirmed that AxleSys was reliable, functional, and ready for continuous operational use.

Operation and Maintenance

During this phase, the system was used for daily business operations at Axle Tire and Service Center, including appointment scheduling, service tracking, inventory monitoring, and sales recording. Authorized users accessed the system through web browsers, allowing efficient and consistent use without the need for additional software installation. System maintenance was conducted to ensure continuous reliability, security, and performance. Routine maintenance activities included monitoring system performance, managing user accounts, and ensuring data accuracy through regular database backups. Minor system updates and corrections were applied when necessary to address technical issues and improve system functionality.

Preventive maintenance practices were also implemented to reduce the risk of system failure. These included periodic checks of server configurations, database optimization, and security updates. Through proper operation and maintenance procedures, AxleSys remained stable, dependable, and capable of supporting the ongoing operational needs of the service center.

RESULTS

AxleSys underwent a comprehensive evaluation through internal Alpha Testing and real-user Beta Testing at Axle Tires and Services. These tests verified the system's readiness for deployment. The public appointment module at axletsc.com and the admin dashboard were tested to confirm that all functions met the project's requirements.

Testing confirmed that AxleSys reliably prevented duplicate bookings, accurately updated service status, and correctly generated reports. Issues detected during alpha testing were resolved, and beta testing concluded with high acceptance ratings.

Table 1
Summary of Alpha Test Results

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Sustainability	3.2	Agree
Interaction Capability	2.2	Agree
Reliability	2.6	Agree
Security	3.0	Agree
Overall Mean Score	2.75	Agree

Alpha testing results (see Table 1) supported the ISO 25010 attribute of functional suitability by demonstrating that the system consistently and accurately carries out its primary activities. Every key module, including inventory tracking, real-time appointment scheduling, admin-side service administration, and report creation, was verified to function properly under various testing scenarios, demonstrating that the system performs its intended function without experiencing any functional interruptions. The system's user interface was evaluated for usability, responsiveness, and accessibility in accordance with interaction capacity; testers reported easy navigation, transparent workflows, and intuitive design on both customer and administrative sites.

Table 2
Summary of Beta Test Results

ISO 25010 Criteria	Mean Score	Verbal Interpretation
Functional Sustainability	3.9	Excellent
Interaction Capability	3.6	Very Good
Reliability	3.7	Excellent
Security	3.8	Excellent
Overall Mean Score	3.75	Excellent

The Axle Tires and Services location in Mabalacat City was the site of the AxleSys beta test. One administrator and two employees were

questioned. The researchers personally visited the shop during this time to do the testing and watch how the system was used in a real-world setting. This beta phase offered genuine insights into how AxleSys supports procedures like service monitoring, appointment scheduling, inventory management, and sales recording because it only included administrative and staff members who frequently engage with the system, in contrast to internal alpha testing. Thirty (30) participants, including staff and administrative workers, completed tasks like documenting sales, managing inventory, updating appointments, and tracking service progress. They also evaluated the responsiveness of the system on desktop and mobile devices (see Table 2). This made it possible for the researchers to assess the system's accuracy, speed, stability, and usefulness under actual workload circumstances. The ISO 25010 standards served as the foundation for the researcher's query, which ultimately centered on functional sustainability, interface capacity, reliability, and security.

DISCUSSION

The results demonstrate that AxleSys effectively addressed the operational problems identified in the manual appointment and management processes of Axle Tires and Services. The integration of real-time scheduling and centralized data management reduced scheduling conflicts, minimized waiting times, and improved service coordination. These outcomes align with findings from related studies on web-based appointment systems, which report improvements in customer satisfaction and operational efficiency. The high evaluation scores during beta testing indicate that the system met user expectations in terms of functionality, usability, reliability, and security. The application of the Modified Waterfall Model contributed to systematic development and thorough validation at each stage, ensuring that system requirements were met before deployment. One of the system's strengths lies in its modular and scalable design, allowing future enhancements such as SMS notifications, advanced analytics, and expanded service offerings. The use of open-source technologies also supports affordability and maintainability, making the system suitable for small to medium-sized service centers. Despite its strengths, the system has limitations. Its performance is dependent on internet

connectivity, and it currently supports only predefined service types available within the platform. Additionally, users must complete authentication procedures before accessing system features, which may limit accessibility in low-connectivity environments. Overall, AxleSys demonstrates that digitizing appointment scheduling and service management processes provides a practical, secure, and sustainable solution for modernizing automotive service operations. The study confirms the system's viability as a long-term digital tool that enhances efficiency, accuracy, and customer experience while offering opportunities for future expansion.

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CrimeTrack: A Web-Based Case Information Management System for Mabalacat City Police Station

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ABSTRACT

CrimeTrack: A Web-Based Case Information Management System for Mabalacat City Police Station was developed to enhance the efficiency of crime reporting, incident monitoring, record management, and information dissemination. The system was designed to assist both Philippine National Police (PNP) personnel and the citizens of Mabalacat City by providing a centralized platform for managing crime and incident-related information. It addresses the challenges of delayed reporting, manual record-keeping, limited public awareness, and difficulties in accessing accurate public safety information. The system aims to strengthen the relationship between law enforcement authorities and the community by promoting transparency, accessibility, and efficient communication. Through its web-based platform, users can submit incident and blotter reports, monitor case status, view crime-related information, and access public safety resources. These features facilitate faster data collection, improve coordination between citizens and police officers, and support timely responses to incidents. Furthermore, CrimeTrack utilizes a centralized database that enables the secure storage, retrieval, and management of crime and incident records. The system supports the analysis of crime patterns and trends, assisting the PNP in making informed decisions for crime prevention and public safety strategies. Overall, the implementation of CrimeTrack enhances operational efficiency, improves information accessibility, and contributes to building a safer and more informed community in Mabalacat City through the effective use of web-based technology.

Keywords: *crime, web systems, incident report, blotter*

INTRODUCTION

Around the world, crime continues to evolve in complexity due to rapid technological advancement, globalization, and increasing urban populations. Criminal activities are no longer limited to traditional offenses such as theft, assault, or robbery; they now extend to cybercrimes, organized syndicates, and transnational offenses that require more sophisticated monitoring systems. Law enforcement agencies across the globe are therefore increasingly turning to digital solutions to enhance the way they record, monitor, and respond to incidents.

In the Philippines, the Philippine National Police (PNP) is mandated under Republic Act No. 6975, known as the “Department of the Interior and Local Government Act of 1990,” to ensure peace and order, prevent crimes, and enforce laws.

Over the years, the PNP has initiated several technology-driven programs to

Modernize its services. The PNP has implemented initiatives such as the Crime Information Reporting and Analysis System (CIRAS) and electronic blotter systems to modernize crime data management. These efforts aim to reduce reliance on paper-based reporting, enhance crime mapping, and improve policy decision-making. Despite these developments, many police stations still struggle with outdated manual recording methods that cause delays, inconsistencies, and inefficiencies in crime reporting. With increasing demands for faster and more reliable law enforcement services, there is a pressing need for scalable, web-based solutions that can be localized to address the operational realities of specific police stations across the country.

In the urban area of Mabalacat City, which serves as a gateway to Clark Freeport Zone and hosts a growing business and residential community, maintaining peace and order is a

priority. However, the absence of a centralized and digitized system makes it difficult for local police to track incident trends, generate timely reports, and share data effectively across units. CrimeTrack: A Web-Based Case Information Management System for Mabalacat City Police Station would address these gaps by digitizing records, enhancing accessibility, and ensuring real-time monitoring.

Objective of the Study

The general objective of this study is to design, develop, and implement a web-based system entitled “CrimeTrack: A Web-Based Case Information Management System for Mabalacat City Police Station” to improve the efficiency of crime reporting, case management, and information dissemination. The system aims to support the Philippine National Police (PNP) in Mabalacat City by providing a centralized and accessible platform for recording, monitoring, and analyzing crime-related data, while also enhancing public awareness and strengthening communication between law enforcement authorities and the community.

In line with this, the study aimed to achieve the following specific objectives:

1. To gather and analyze relevant literature, studies, and related systems concerning crime reporting, incident management, blotter records, and case tracking to support the development of CrimeTrack.
2. To identify the hardware and software requirements needed for system development, ensuring compatibility, security, and efficient performance across devices such as desktop, laptop, and smartphone.
3. To design the system architecture, database structure, and user interface (UI/UX) using appropriate tools such as storyboard, use case diagram, data flow diagram (DFD), entity relationship diagram (ERD), and Gantt chart.
4. To develop a web-based CrimeTrack system that allows authorized PNP personnel to manage crime reports, incident records, blotter entries, and case information in a centralized platform.
5. To implement secure authentication and user verification to ensure that only authorized users can access and submit sensitive reports such as blotter and incident reports, along with efficient search and case tracking features.
6. To test and evaluate the system using ISO/IEC 25010 standards and a researcher-

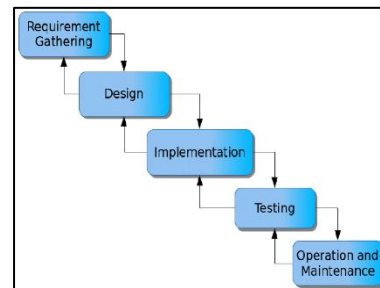
made survey tool to assess its functionality, usability, reliability, security, and overall performance.

7. To deploy the system using a web hosting platform called Hostinger, allowing the system domain called “pnpmaalacat.online” accessibility anytime and anywhere with an internet connection.

METHODOLOGY

The researchers adopted the Modified Waterfall Model (see Figure 1) as the Software Development Life Cycle (SDLC) methodology in developing the system due to its structured and sequential approach, which ensures that each phase is completed before moving to the next.

Figure 1
Modified Waterfall Model



Requirements

During the first stage, the project's vision and scope are established. The team works together with stakeholders to detail project objectives, recognize possible obstacles, and establish overall goals. Thorough planning is conducted at the start of each sprint, where the team divides the project into smaller, more manageable tasks and develops a prioritized backlog. Tasks are allocated according to their priority and complexity.

The researchers identified and evaluated the necessary hardware specifications (see Table 1) to ensure that the CrimeTrack operates efficiently, securely, and reliably. These specifications were selected to provide a stable and high-performance environment for both system development and deployment. By carefully determining the appropriate hardware and software requirements, the researchers ensured that the system could effectively manage important functions such as crime and incident reporting, case tracking, record retrieval, user authentication, and report generation without performance issues. This assessment of system requirements contributed

to the system's stability, responsiveness, and overall user experience for both police personnel and authorized users.

Table 1
Hardware Specifications

Component	Specification
Processor Ryzen 7 5700	Processor Ryzen 7 5700
Memory 16 GB	Memory 16 GB
Video Card 6 GB GTX 1660 SUPER	Video Card 6 GB GTX 1660 SUPER
Hard Disk/ Solid State Drive M.2 1 TB	Hard Disk/ Solid State Drive M.2 1 TB
Processor Ryzen 7 5700	Processor Ryzen 7 5700

Design

The design of the system utilized tools like Storyboard, Conceptual Framework (see Figure 2), Use Case Diagram (see Figure 3), Data Flow Diagram (see Figure 4), and Entity Relationship Diagram (ERD) (see Figure 5) to depict the user interface, features, and workflows. These tools offered organization and transparency, facilitating efficient project management and guaranteeing consistency with user requirements.

The system covers functionalities such as encoding and management of case details, including crime type, date and time, location, persons involved, case status, and assigned officer. It also includes user authentication and access control, ensuring that only verified users can access sensitive features such as incident and blotter reporting. The system allows users to submit detailed incident reports, which are then validated by authorized personnel before being processed. A search and filtering function is also integrated to allow quick retrieval of records and support analysis of crime trends based on time and location.

Development

The system includes an admin dashboard that allows authorized personnel to manage crime and incident records, monitor case statuses, verify user accounts, and generate reports efficiently. The platform is also designed to be responsive and accessible on both desktop and mobile browsers to improve usability and accessibility for users. Furthermore, the system provides authorized PNP personnel with the capability to review submitted incident reports,

monitor ongoing cases, and analyze crime-related data through graphical summaries and searchable records.

Figure 2
Conceptual Framework

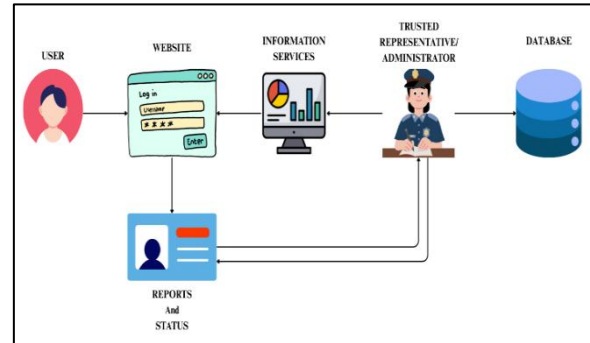


Figure 3
Use Case Diagram

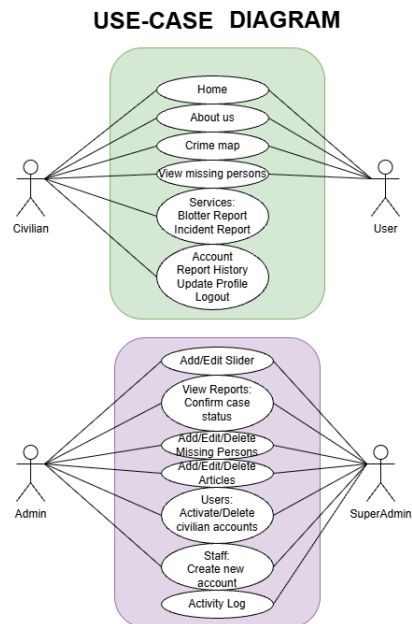


Figure 4
Data Flow Diagram

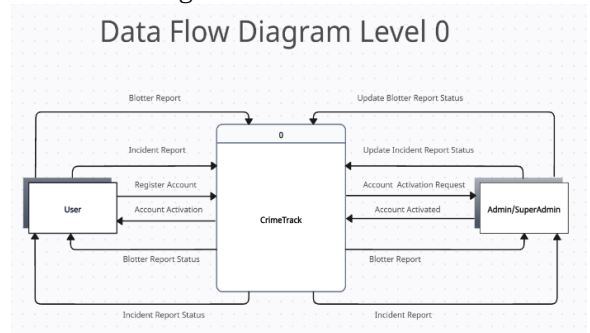
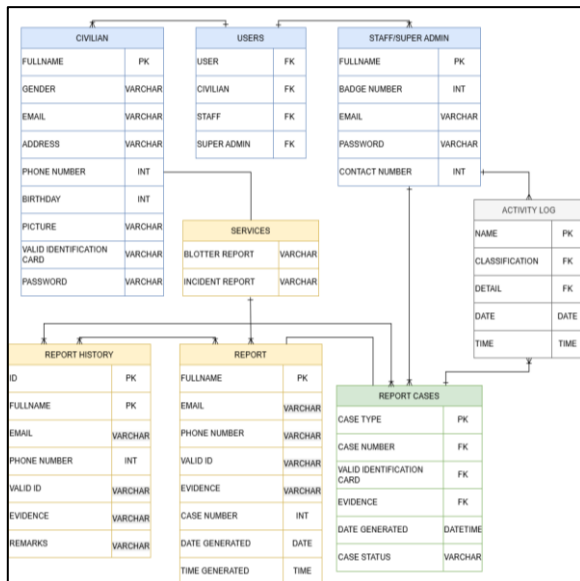


Figure 5
Entity Relationship Diagram (ERD)



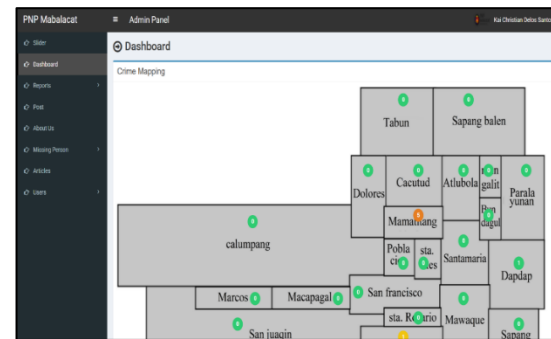
During the development phase, the web-based application was built according to the planned design specifications (see Figure 6). The developers implemented the core system features, including crime and incident reporting, blotter record management, user authentication, real-time case tracking, and data retrieval functionalities (see Figure 7). Search and filtering features were also integrated to allow quick access to specific records such as case number, type of crime, persons involved, location, and case status. Additionally, graphical charts and statistical summaries were developed to support crime trend analysis and improve decision-making processes.

Figure 6
Home Page



The development phase followed industry-standard practices to ensure system maintainability, scalability, security, and performance optimization. Development tools such as XAMPP were utilized to provide a local server environment for PHP and MySQL development, while Visual Studio Code served as the primary code editor for coding and debugging. GitHub was used for version control and project collaboration, and Hostinger served as the web hosting platform for deployment and testing. These technologies contributed to the smooth development, testing, and implementation of the system.

Figure 7
Dashboard



Testing

The CrimeTrack system went through a testing and evaluation process to make sure it worked well, was easy to use, and was reliable. Three (3) Alpha Testers who are IT experts tested it first and gave feedback on its design and performance. The system was also tested by thirty (30) users, known as Beta testers. They helped find areas that needed improvement and confirmed the system's features for all types of users. The testing was done using the ISO 25010 software quality standards. Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability. The goal was to ensure that CrimeTrack met quality standards and worked efficiently. The CrimeTrack system was tested to make sure it was suitable for its users. CrimeTrack was evaluated to confirm its performance. The testing process helped to identify areas for improvement in CrimeTrack. The survey took place in Mabalacat City, Pampanga, between December 2025 and February 2026. Before filling out the forms,

participants received a brief orientation on how to correctly answer the survey form. To ensure clarity and comprehension, instructions were provided in the language familiar to the respondents.

Table 2
Summary of Alpha Test Result

Alpha Test Overall Score

Criteria	Weighted Mean	Interpretation
Functional Suitability	3.83	Very Good
Performance Efficiency	3.66	Very Good
Compatibility	3.99	Very Good
Usability	4.13	Very Good
Reliability	4.19	Very Good
Security	3.86	Very Good
Maintainability	4.12	Very Good
Portability	3.44	Very Good
Overall mean	3.90	Very Good

Table 3
Summary of Beta Test Results

Criteria	Weighted Mean	Interpretation
Functional Suitability	4.02	Very Good
Performance Efficiency	3.92	Very Good
Compatibility	3.98	Very Good
Usability	3.95	Very Good
Reliability	4.08	Very Good
Security	3.76	Very Good
Overall mean	3.95	Very Good

The mean refers to the average value used to determine the overall performance of the system

based on the Alpha Testing results (see Table 2). The study obtained an overall weighted mean of 3.90, interpreted as “Very Good,” indicating that the system performed well during the initial evaluation phase under the ISO/IEC 25010 standards.

Among the criteria, Reliability received the highest score of 4.19, followed by Usability (4.13) and Maintainability (4.12), all rated as “Very Good.” Other criteria such as Compatibility, Security, Functional Suitability, and Performance Efficiency also received “Very Good” ratings.

Overall, the results show that the system is functional, stable, and acceptable for further testing and improvement.

Based on the results shown in Table 3, the system obtained an overall weighted mean of 3.95, interpreted as “Very Good.” Among the criteria, Reliability received the highest rating of 4.08, followed by Functional Suitability (4.02) and Compatibility (3.98). The remaining criteria, including Usability, Performance Efficiency, and Security, also received “Very Good” interpretations.

Overall, the results indicate that the system performed well during beta testing and met user expectations in terms of functionality, stability, and usability. These findings confirm that the system is acceptable for deployment and is capable of supporting efficient crime and incident information management for the PNP in Mabalacat City.

DISCUSSION

The deployment phase marked the successful implementation and release of the Web-Based Crime and Incident Information Management System for the Philippine National Police (PNP) in Mabalacat City into a live and fully functional environment. The system was deployed using a reliable web hosting service through Hostinger, ensuring that it is accessible, stable, and secure for authorized users. The official domain of the system, <https://pnpmabalacat.online>, serves as the central platform where police personnel and authorized users can access, manage, and utilize the system’s features for crime and incident reporting, record management, and case monitoring.

During this phase, the researchers ensured that all system components were properly transferred from the local development environment to the live server. This included the migration of the database, configuration of server settings, integration of security protocols, and final system testing to confirm that all functionalities

were working correctly in the production environment. Security measures such as data encryption, secure login authentication, and controlled user access were implemented to protect sensitive information and ensure the integrity of crime and incident records.

The deployment also included setting up regular backup procedures to prevent data loss and maintain system reliability. These backups ensure that all records can be restored in case of system failure or unexpected errors. In addition, server monitoring tools were utilized to track system performance, detect potential issues, and maintain smooth operation of the platform.

The transition from a local development setup to a live web-based system significantly improved accessibility and usability. Users are now able to access the system anytime and anywhere, provided they have internet connectivity and proper authorization. This flexibility allows the PNP personnel in Mabalacat City to efficiently encode, update, and retrieve crime and incident data in real time, improving response time and decision-making processes.

Overall, the deployment phase successfully fulfilled the primary objective of the study, which is to enhance the digital operations of the PNP Mabalacat City through a centralized, secure, and efficient web-based system. The live implementation of the system represents a major step toward modernizing crime and incident management, promoting faster data processing, improved transparency, and more effective law enforcement service.

ACKNOWLEDGMENTS

The achievement of this research project could not have occurred without the invaluable guidance, support, and input from numerous individuals who kindly shared their time, expertise, and help. Above all, we express our gratitude to God for giving us wisdom, strength, and direction during this research study.

We would like to express our heartfelt appreciation to our Technical Adviser/Instructor, **Ms. Ritchell Z. Escoto, MIT** for her unwavering guidance, patience, and encouragement throughout this process. Her expert insights and valuable feedback have been instrumental in helping us tackle challenges and improve the quality of this research. Additionally, we would like to thank **Dennis L. Tacadena, DIT**, Dean of the Institute of Business and Computing Education (IBCE), for his approval and support of this study,

particularly concerning its importance to the residents of Mabalacat City and the Police Station.

We also extend our gratitude to our Alpha testers, IT professionals who offered their insightful assessments and suggestions regarding the system's performance. Likewise, we appreciate our Beta testers, BS Information Technology students from Mabalacat City College, for their enthusiastic involvement and valuable feedback that significantly helped in the system's validation.

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EmurgenTrack: A Web and Mobile-Based Community Emergency System for the CDRRMO of Mabalacat City

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ABSTRACT

This study presents EmurgenTrack, a web and mobile-based emergency reporting and response system developed for the City Disaster Risk Reduction and Management Office (CDRRMO) of Mabalacat City. The system addresses challenges caused by manual documentation and fragmented reporting channels by providing a centralized platform for incident reporting, real-time coordination, and information dissemination. Developed using the Modified Waterfall Model and implemented with React, React Native, Firebase, and Google Maps, the system underwent alpha and beta testing with residents, responders, and IT experts. Evaluation based on ISO 25010 standards yielded high ratings in functionality, usability, security, performance, and overall user experience, demonstrating EmurgenTrack's effectiveness in improving emergency response efficiency and community preparedness in Mabalacat City.

Keywords: Emergency reporting system, Web and mobile application, Community-based emergency response, Emergency management, Disaster preparedness, CDRRMO

INTRODUCTION

Emergency situations require fast reporting, accurate information, and coordinated response to minimize loss of life and property. In Mabalacat City, Pampanga, the City Disaster Risk Reduction and Management Office (CDRRMO) serves as the primary agency responsible for disaster preparedness, response, and recovery. Despite the availability of mobile devices and internet connectivity, emergency reporting in the city is still carried out through fragmented channels such as phone calls, text messages, social media platforms, radios, and walk-in reports. This fragmented approach often results in delayed responses, unorganized documentation, limited situational awareness, and difficulty in tracking incidents in real time.

With the advancement of web and mobile technologies, many local government units have started adopting digital emergency management systems to improve communication and coordination between communities and responders. These systems have proven effective in centralizing incident reporting, enhancing response time, and supporting data-driven decision-making. However, Mabalacat City lacks a localized, integrated emergency system specifically designed to support the operational needs of its CDRRMO and the reporting needs of its residents.

To address these challenges, this study developed EmurgenTrack, a web and mobile-

based community emergency system for the CDRRMO of Mabalacat City. The system aims to provide a centralized platform where residents can report emergencies using GPS-based location tracking and multimedia attachments, while responders and administrators can monitor, manage, and analyze incidents in real time. Through EmurgenTrack, the study seeks to enhance community participation, improve emergency coordination, and strengthen disaster preparedness in Mabalacat City.

Objective of the Study

The study aimed to develop a mobile app and web-based application entitled "EmurgenTrack: A Web and Mobile-Based Community Emergency System for the CDRRMO of Mabalacat City" to enhance community-based emergency operations through the City Disaster Risk Reduction and Management Office (CDRRMO) in Mabalacat City.

In line with this, the study aimed to achieve the following specific objectives:

1. To conduct requirement gathering through interviews, document analysis, and review of related literature and systems with CDRRMO personnel and community representatives.
2. To identify and specify the software and hardware requirements necessary for the development and implementation of the EmurgenTrack system.
3. To design the EmurgenTrack system using storyboards, wireframes, use-case diagrams, and data flow diagrams to ensure usability, functionality, and accessibility.
4. To develop the system with core features for incident reporting, real-time alerts, incident

management, responder coordination, and resource monitoring.

5. To test and evaluate the system using ISO 25010 standards to ensure compliance with international software quality requirements.

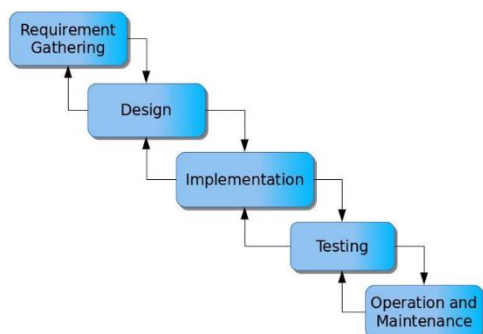
6. To deploy the EmurgenTrack system within the Mabalacat City CDRMO and the local community.

By achieving these objectives, the study introduced a centralized, technology-driven solution that enhanced incident reporting, responder coordination, and emergency management in Mabalacat City. Furthermore, the EmurgenTrack system demonstrated its potential to serve as a scalable model for other communities seeking to strengthen disaster preparedness and response through innovative, community-based digital platforms.

METHODOLOGY

The study followed the Software Development Life Cycle (SDLC) using the Modified Waterfall Model. This model was appropriate for structured systems such as EmurgenTrack, which required clear documentation, stakeholder collaboration, and phased deliverables. The SDLC approach, together with analysis diagrams and data collection tools, guided the researchers throughout the development of the system and application. The SDLC involved sequential steps such as gathering requirements, designing the system, implementing the code, conducting testing, deploying the software, and carrying out maintenance activities. This structured yet flexible approach ensured that the system met the operational needs of Mabalacat City's CDRMO while maintaining a systematic and organized development process.

Figure 1
Modified Waterfall Model

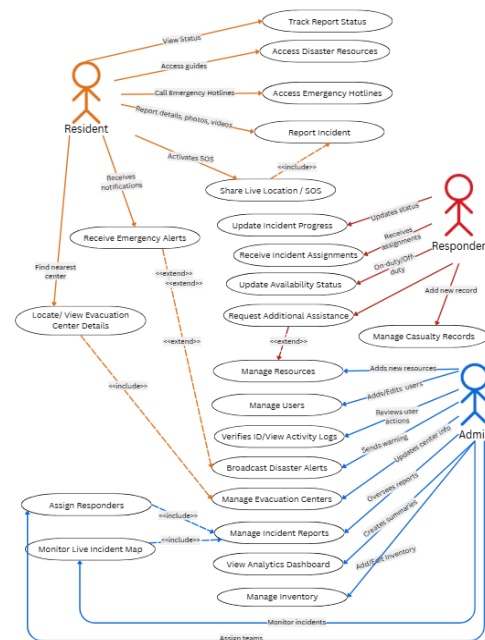


Requirements Gathering

The results of the requirements gathering and analysis phase served as the foundation for the

development of EmurgenTrack: A Web and Mobile-Based Community Emergency System for the CDRMO of Mabalacat City. This phase involved interviews, observations, and consultations with CDRMO personnel and selected community members to identify the system's functional and non-functional requirements. The findings ensured that the system aligns with the operational needs of the CDRMO and the usability expectations of end users. EmurgenTrack was designed to support emergency report submission, real-time data synchronization, notifications, mapping, and analytics through both web and mobile platforms. The study also identified the necessary hardware and software requirements to ensure smooth development, deployment, and testing, including compatible computing devices, stable internet connectivity, and modern development tools and frameworks such as React, React Native, Firebase, mapping APIs, and cloud deployment services to support system functionality, performance, and scalability.

Figure 2
Use Case Diagram



Design

During the design phase, the researchers utilized various visual and analytical tools to model the structure, functionality, and user interactions of the EmurgenTrack system. These tools included the storyboard, wireframe, use

case diagram (see Figure 2), entity relationship diagram (ERD) (see Figure 3), data flow diagram (DFD) (see Figure 4), flowchart, and Gantt chart, each serving a specific role in defining the system architecture and workflow. The storyboard and wireframe illustrated user navigation and interface layout for both web and mobile platforms, ensuring usability and intuitive design. Use case diagrams identified key user roles and system interactions, while the ERD and DFD established a clear and secure database structure and data processing flow essential for real-time emergency response. Flowcharts detailed the logical sequence of core system operations, and the Gantt chart guided project scheduling and task management. Collectively, these design tools ensured alignment with the operational requirements of the CDRMO, user needs of the community, and project timelines, providing a solid foundation for the successful development of the EmurgenTrack system.

Figure 2
Use Case Diagram

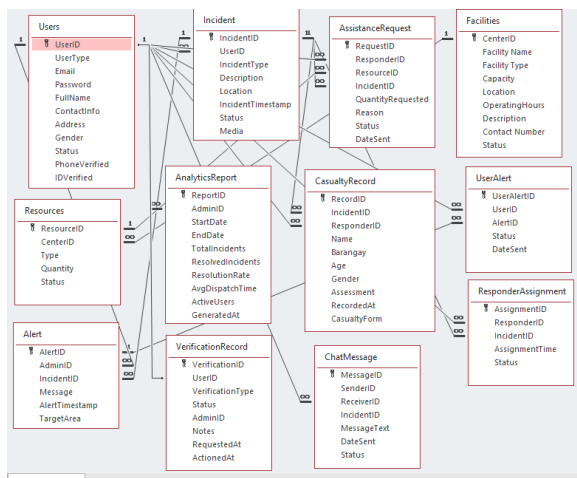
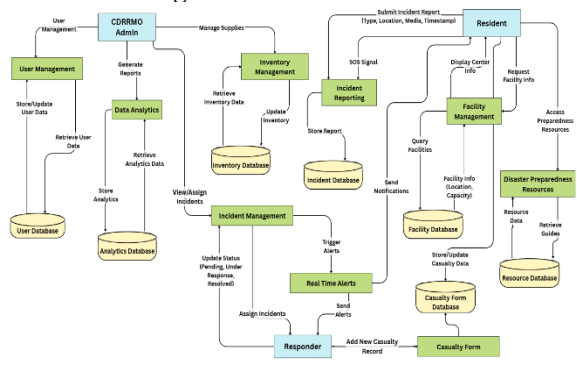


Figure 3
Data Flow Diagram



visualization features were integrated using Leaflet, Google Maps API, and Recharts to support incident location tracking and data analytics. The mobile applications for residents and responders were developed using React Native and Expo, enabling cross-platform deployment and features such as incident reporting, real-time location sharing, and alert notifications. Firebase was utilized across both platforms to provide real-time database synchronization, cloud storage, user authentication, and push notifications. The system was deployed through Vercel, ensuring reliable hosting and continuous deployment, while the mobile application was made available to Android users via the Google Play Store. Overall, the implementation successfully integrated these technologies to deliver a functional, scalable, and reliable emergency management system that supports the operational needs of the CDRMO and enhances public safety in Mabalacat City.

Testing

The EmurgenTrack system underwent a comprehensive testing and evaluation process that included unit, integration, system, alpha, and beta testing to ensure functionality, reliability, and readiness for deployment. Individual system components such as incident reporting, user authentication, GPS-based tracking, notifications, and the administrative dashboard were first validated through unit testing, followed by integration testing to confirm proper interaction between web and mobile modules. System testing was then conducted across different devices and network conditions to assess performance, responsiveness, and usability in real-world scenarios. Alpha testing involved selected IT professionals, while beta testing included residents of Mabalacat City and CDRMO personnel, using convenience sampling to gather practical and relevant feedback. Evaluation data were collected using a validated survey instrument based on the ISO 25010 Software Product Quality Model, covering key attributes such as functional suitability, usability, security, performance, and scalability. Ethical standards were strictly observed through informed consent, data privacy compliance under RA 10173, and adherence to research integrity principles. Data gathered from testing were analyzed using descriptive statistical methods, including frequency distribution, percentage, weighted mean, and a five-point Likert scale (see Table 1), to interpret user feedback and assess system quality. The results confirmed that EmurgenTrack met its intended objectives and complied with ISO

25010 standards, demonstrating its effectiveness in improving community-based emergency reporting, coordination, and response efficiency in Mabalacat City.

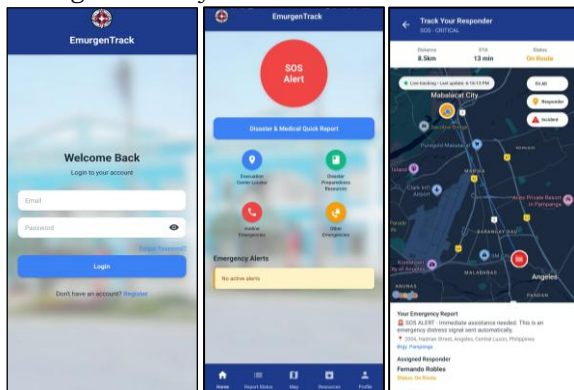
Table 1
The 5-point Likert Scale – level of agreement

Response Category	Numerical Value	Range	Verbal Interpretation
Strongly Agree	5	4.21 – 5.00	Highly Effective
Agree	4	3.41 – 4.20	Effective
Neutral	3	2.61 – 3.40	Moderately Effective
Disagree	2	1.81 – 2.60	Ineffective
Strongly Disagree	1	1.00 – 1.80	Critically Ineffective

Deployment

Following the successful completion of testing, the EmurgenTrack system was deployed to its designated hosting environment and transitioned into the operational and maintenance phase (see Figure 4). The platform was made accessible to target users, including community members and CDRRMO personnel, allowing full adoption for emergency reporting and response coordination. During deployment, system performance and operational activities were continuously monitored to ensure reliability and proper functionality. Routine maintenance was conducted to address technical issues, apply system updates, and implement security patches, while user feedback was reviewed to identify areas for improvement. These activities ensured data integrity, system security, and sustained performance, allowing EmurgenTrack to remain responsive and aligned with the evolving needs of emergency response and disaster preparedness operations in Mabalacat City.

Figure 4
EmurgenTrack system



RESULTS

The Alpha and Beta testing phases were two critical stages in the evaluation process that ensured the system's quality, performance, and dependability. During the Alpha testing phase, the researchers conducted an internal assessment focused on verifying core functionalities, identifying bugs, and validating whether the system met its intended requirements. This phase adhered to the ISO 25010 quality standards, which emphasize Functional Suitability, Compatibility, Usability (Interaction Capability), Security, Security & Trust, Maintainability & Scalability, Adaptability & Accessibility, Performance & Real-world Usefulness. The evaluation during this stage was primarily performed by the development team to ensure that all modules, interfaces, and data processes were functioning according to design specifications.

The Beta testing phase followed once the system reached a stable version and was ready for real-user interaction. It involved selected participants from the intended user group to test the system under realistic operating conditions. This

phase aimed to gather feedback on user experience, assess performance consistency, and ensure that the system operated securely and efficiently across different devices and environments. The insights obtained from both testing phases provided a comprehensive understanding of the system's strengths and areas for improvement, forming the foundation for refining its overall functionality, usability, and reliability.

The Alpha Test results (see Table 2) indicate that the EmurgenTrack system delivered highly effective performance based on the ISO 25010 software quality criteria, achieving an overall weighted mean of 4.73, verbally interpreted as "Highly Effective." Among the evaluated criteria, Usability (Interaction Capability) (4.85) received the highest score, showing that users found the interface intuitive, smooth, and easy to navigate during the initial testing phase. High scores in Functional Suitability (4.80) and Reliability & Performance Efficiency (4.75) confirm that the system consistently performed its intended functions and operated efficiently during use.

Likewise, strong ratings in Security (4.70) demonstrate that the system's protective measures were dependable, ensuring user data safety throughout the testing process. Maintainability & Scalability (4.65) also reflected the system's ability to adapt, improve, and remain stable as requirements evolve. Overall, these results show that the EmurgenTrack

system achieved a reliable, secure, and user-centered performance during the alpha testing stage, demonstrating strong compliance with ISO 25010 standards and effectively meeting early user requirements.

Table 2
Overall Evaluation Results – Alpha Test Summary

ISO 25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.80	Highly Effective
Compatibility	4.60	Highly Effective
Reliability & Performance Efficiency	4.75	Highly Effective
Usability (Interaction Capability)	4.85	Highly Effective
Security	4.70	Highly Effective
Maintainability & Scalability	4.65	Highly Effective
Overall Weighted Mean	4.73	Highly Effective

The Beta Test results (see Table 3) demonstrate that the EmurgenTrack system performed exceptionally well based on the ISO 25010 software quality criteria, achieving an overall weighted mean of 4.67, verbally interpreted as “Highly Effective.” Among the evaluated criteria, Function Suitability (4.79) received the highest score, confirming that the system effectively performs its intended functions in real-world use. High ratings in Usability (4.62) and Adaptability & Accessibility (4.72) indicate that users found the interface intuitive, responsive, and accessible across various situations. Likewise, strong scores in Security (4.62) and Reliability & Performance Efficiency (4.57) highlight the system’s dependable, stable, and secure operation. Overall, these findings affirm that EmurgenTrack delivers a user-centered, reliable, and efficient experience, demonstrating strong compliance with ISO 25010 standards and effectively meeting the needs of community users.

Table 3
Overall Evaluation Results – Beta Test Residents (30 Respondents)

ISO 25010 Criteria	Mean Score	Verbal Interpretation
Function Suitability	4.79	Highly Effective
Usability (Interaction Capability)	4.62	Highly Effective
Performance & Real-world Usefulness	4.57	Highly Effective
Security & Trust	4.62	Highly Effective
Adaptability & Accessibility	4.72	Highly Effective
Overall Weighted Mean	4.67	Highly Effective

A separate assessment was conducted with five CDRRMO personnel, who evaluated the system using criteria tailored to its operational and

technical needs. The group recorded an overall weighted mean of 4.62 (see Table 4), also verbally interpreted as “Highly Effective.” Function Suitability achieved the highest score (4.84), indicating strong alignment between system functionality and emergency management workflows. Performance & Real-World Usefulness (4.64) confirmed that the system can support emergency response tasks and enhance field operations. High scores in Usability (4.56) and Security & Trust (4.56) further validated the system’s intuitive design and secure handling of sensitive data. Adaptability & Accessibility (4.48) also performed well, confirming that the system is flexible enough to support various operational settings.

Table 4
Overall Evaluation Results – Beta Test CDRRMO Personnel (5 Respondents)

ISO 25010 Criteria	Mean Score	Verbal Interpretation
Function Suitability	4.84	Highly Effective
Usability (Interaction Capability)	4.56	Highly Effective
Performance & Real-world Usefulness	4.64	Highly Effective
Security & Trust	4.56	Highly Effective
Adaptability & Accessibility	4.48	Highly Effective
Overall Weighted Mean	4.62	Highly Effective

DISCUSSION

The development of EmurgenTrack: A Web and Mobile-Based Community Emergency System for the CDRRMO of Mabalacat City aimed to provide an efficient digital platform that enhances emergency reporting, coordination, and response within the community. The study addressed existing challenges in emergency management, such as delayed incident reporting, fragmented communication, and limited real-time situational awareness between residents and emergency responders. In response, the researchers designed a user-centered system that integrates real-time reporting, GPS-based tracking, alert broadcasting, and centralized monitoring to support effective disaster risk reduction and emergency response operations. Results from the Alpha and Beta testing phases showed that EmurgenTrack consistently achieved Highly Effective ratings across all ISO 25010 criteria. High evaluations in functional suitability, usability, security, and performance indicate that the system effectively performs its intended functions and is accessible to both community users and emergency management personnel. Feedback from residents and

CRRMO personnel further confirmed the system's reliability, operational relevance, and readiness for real-world deployment.

In relation to the sustainable development goals, EmurgenTrack supports SDG 3 (Good Health and Well-being), SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action). Overall, the findings demonstrate that EmurgenTrack successfully met its objectives and provides a reliable, technology-driven solution that enhances public safety and disaster risk management in Mabalacat City.

ACKNOWLEDGEMENTS

The successful completion of this capstone project would not have been possible without the guidance, support, and contributions of individuals and institutions who generously shared their time, expertise, and encouragement throughout the process.

First and foremost, the developers extend their utmost gratitude to Almighty God for providing them with wisdom, strength, and perseverance throughout every stage of this project.

The team would like to express sincere appreciation to Mrs. Lovely Ruth Valdez-Santos, our Technical Adviser, and Ms. Ritchell Z. Escoto, MIT, for the continuous guidance, constructive feedback, and unwavering support that helped in improving the system and overcoming technical challenges. Special thanks are also given to Engr. Dennis L. Tacadena, DIT, Dean of the Institute of Business and Computing Education (IBCE), for granting the necessary approval to conduct the study and for supporting the development of this system. Your encouragement and trust have been instrumental in moving this project forward. Appreciation is also expressed to the City Disaster Risk Reduction and Management Office (CRRMO) of Mabalacat City for its valuable contributions and support, which significantly facilitated the research process and improved the project's outcomes. The developers likewise acknowledge the valuable contributions of the Alpha Testers, composed of Information Technology professionals, whose expert insights and technical suggestions significantly enhanced the system's performance and functionality. Gratitude is also extended to the Beta Testers, who actively participated in the testing phase. Their honest feedback and evaluations were vital in refining the system and ensuring its usability. Lastly, the developers express deep appreciation

to every member of the project team. Everyone's dedication, effort, and collaboration were essential in bringing this system to completion. To all who contributed and supported this endeavor, your guidance and encouragement are appreciated.

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FitSecure: Online Management System with Biometric Secured Locker Services for Rooftop Fitness Gym

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ABSTRACT

FitSecure: Online Management System with Biometric Secured Locker Services for Rooftop Fitness Gym addresses operational inefficiencies and security issues commonly encountered in fitness facilities, particularly problems related to locker misuse, lost keys, forgotten PINs, and unauthorized access. The system integrates an online gym management platform with an IoT-based biometric fingerprint locker to enhance security, efficiency, and user convenience. The study aimed to design, develop, and evaluate a prototype system capable of managing gym operations while providing secure locker access through fingerprint authentication. The Software Development Life Cycle (SDLC) using a modified waterfall model guided system development. Alpha and beta testing were conducted, and system performance was evaluated using ISO 25010 quality standards. Results indicated high levels of functional suitability, usability, security, and reliability. FitSecure improved locker security, streamlined administrative tasks, and enhanced user experience, contributing to safer and more efficient gym operations while supporting Sustainable Development Goals related to health, innovation, and productivity.

Keywords: Gym Management System, Biometric Security, Smart Locker, IoT, Fingerprint Authentication.

INTRODUCTION

Maintaining physical and mental well-being has become increasingly important in modern society, and gyms play a vital role in promoting healthy lifestyles. Regular physical activity reduces the risk of chronic illnesses and improves mental health by alleviating stress and anxiety. Gyms also serve as social spaces that encourage motivation and personal development among members (Anytime Fitness, 2025). As the fitness industry continues to evolve, the integration of technology has become essential in improving operational efficiency and member satisfaction. Gym management systems automate processes such as membership tracking, scheduling, and billing, enabling gym owners to focus on service quality and business growth (GymMaster, 2022). Despite these advancements, security concerns—particularly regarding locker usage—remain prevalent in many fitness facilities. Traditional locker systems that rely on keys or PIN codes are prone to problems such as lost keys, forgotten combinations, and unauthorized access. These issues were observed at the Rooftop Fitness Gym located along Dau MacArthur Highway, where

members reported missing personal belongings and improper locker usage. Biometric locker systems, which utilize fingerprint authentication, provide a more secure and user-friendly alternative by ensuring that only authorized users can access assigned lockers (LocketGo, 2023). This study introduces FitSecure: Online Management System with Biometric Secured Locker Services for Rooftop Fitness Gym. The project aims to integrate a web-based gym management system with a fingerprint-secured locker solution to address operational inefficiencies and security concerns. By combining automation, biometric authentication, and real-time monitoring, FitSecure seeks to enhance safety, efficiency, and overall user experience.

General Objective

To develop FitSecure: Online Management System with Biometric Secured Locker Services for a rooftop fitness gym, enhancing accessibility, ensuring secure locker usage, streamlining staff management, and providing real-time member monitoring to improve efficiency, security, and user convenience.

Specific Objectives

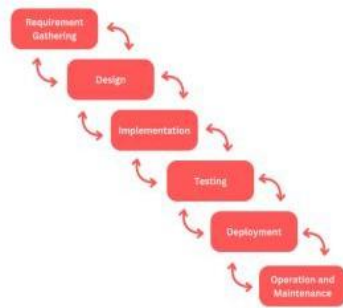
- Collect data from gym members and existing systems to guide development.

- Identify necessary hardware (ESP32, AS608 Fingerprint Sensor, LCD, Relay Module, PCB, etc.) and software tools (VS Code, Arduino IDE, MySQL).
- Design the system using diagrams like Flowcharts, Block Diagrams, and Circuit Diagrams.
- Develop features including:
 - Fingerprint-based keyless access with manual backup
 - User activity logging
 - Multi-user access with time limits
 - Web-based remote monitoring and notifications
- Conduct Alpha and Beta Testing to ensure reliable functionality.
- Evaluate performance using ISO 25010 standards, covering functionality, efficiency, usability, reliability, security, maintainability, and portability.

METHODOLOGY

The development of FitSecure followed the Software Development Life Cycle (SDLC) using a modified waterfall model (see Figure 1) to ensure systematic planning, design, implementation, and evaluation.

Figure 1
Modified Waterfall Model



Requirements Gathering

Data were collected through interviews and observations involving gym members and staff of Rooftop Fitness Gym. The objective was to identify existing problems in locker usage, membership management, and administrative operations. Findings revealed frequent issues such as lost locker keys, forgotten PINs, manual record-keeping errors, and lack of centralized information dissemination.

System Design

System architecture and processes were illustrated using flowchart (see Figure 2), block diagram (see Figure 3), and circuit diagram (see Figure 4). The biometric locker component was designed using hardware components such as the ESP32 Dev Board, AS608 Fingerprint Sensor, LCD Display, Relay Module, jumper wires, and PCB. The online management system was structured into two interfaces: the admin panel and the user interface.

Figure 2
Flowchart

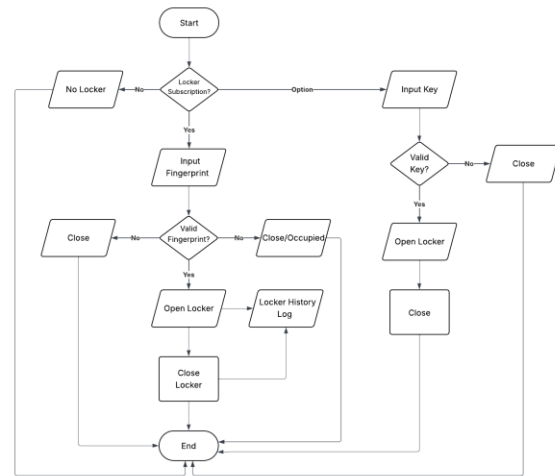
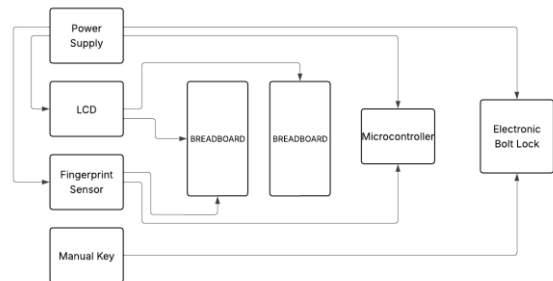


Figure 3
Block Diagram

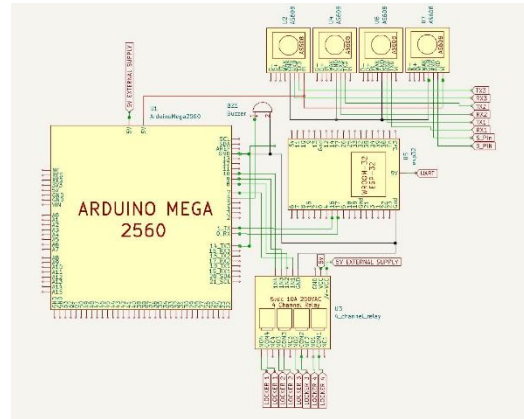


Implementation

The system was developed using Visual Studio Code and Arduino IDE for programming, with MySQL as the database management system. The admin interface enables inventory and sales management, real-time activity monitoring, fingerprint registration, manual locker override, and announcement posting. The user interface provides features such as locker subscription,

locker access, weight tracking, trainer information, and nutritional tips. Fingerprint authentication enables keyless locker access with a manual key backup for emergency use.

Figure 4
Circuit Diagram



Testing

Alpha and beta testing were conducted to assess system functionality and reliability. Alpha testing involved IT experts evaluating system performance and security, while beta testing included selected gym users. The system was evaluated using ISO 25010 quality standards, focusing on functional suitability, usability, performance efficiency, compatibility, reliability, security, maintainability, and portability.

RESULTS

Testing results demonstrated that FitSecure performed effectively across all evaluation criteria. Alpha and beta testing showed high ratings in functional suitability, Compatibility, Interaction Capability, usability, and security, confirming that the system met its intended objectives (see Table 1). The biometric locker system successfully prevented unauthorized access, while the online management platform reduced manual workload and improved information accuracy. The prototype supported up to forty registered users, with twelve to fifteen participants involved in testing. Despite having only four physical lockers, the system efficiently regulated locker access through time limits and availability monitoring. Overall findings indicate that FitSecure enhanced operational efficiency, security, and user satisfaction within the gym environment.

Table 1
Summary of Alpha and Beta Test Result

ISO25010 Criteria	Mean Score (Alpha Test)	Verbal Interpretation (Alpha Test)	Mean Score (Beta Test)	Verbal Interpretation (Beta Test)
Functional Suitability	4	Excellent	3.45	Very Good
Compatibility	4	Excellent	3.59	Excellent
Interaction Capability	4	Excellent	3.47	Very Good
Security	4	Excellent	3.50	Excellent
Usability	4	Excellent	3.44	Very Good
Overall Mean Score	4	Excellent	3.50	Excellent

The thorough evaluation findings for the physical project and website's Alpha and Beta tests, focusing on the relevant ISO 25010 standards, are displayed in the table and list. Security (3.50) and Compatibility (3.59), these two criteria got the same score and the highest rating from both alpha and beta test result, which actively demonstrate that, the safeguard and compatibility in every type of device was absolute great. Ll. Functional Suitability (3.45) was the next because of its unique features. It suits every variant of situation. Lll. Interaction Capability (3.47) and Usability (3.44), when it comes in Interaction capability, user experience meets their expectation, having a workable and related project in their daily lifestyle really helps the user. On the other side, based on the table's markings, usability also got an exceptional rating of

3.44. This rating clearly states that all the user of the project really likes it and very convenient in their lives. Nevertheless, the overall score indicated that this project could live by itself with all the suggestions and feedback of every alpha and beta that tested it. The verbal interpretation was excellent, showcasing the project's continuous improvements and adherence to ISO 25010 standards.

DISCUSSION

The results demonstrate that integrating biometric security with an online gym management system effectively addresses common locker-related and administrative issues. Fingerprint-based authentication eliminated problems associated with physical

keys and PIN codes, while automated monitoring improved accountability and fair locker usage. The system aligns with Sustainable Development Goals, particularly SDG 3 (Good Health and Well-Being) by promoting a safe fitness environment, SDG 8 (Decent Work and Economic Growth) through operational efficiency, and SDG 9 (Industry, Innovation, and Infrastructure) via the adoption of modern digital technologies. Although the prototype was limited in scale, its performance confirms the feasibility of expanding the system for larger deployments.

Scope and Limitations

The FitSecure: Online Management System with Biometric Secured Locker Services is designed to improve gym operations and user experience while aligning with SDGs 3 (Health), 8 (Economic Growth), and 9 (Innovation). It provides secure biometric lockers, real-time monitoring, and a centralized online platform with two interfaces:

- Admin side: Manages sales, inventory, activity logs, locker overrides, fingerprint registration, and announcements.
- User/browser side: Offers locker access, subscriptions, weight tracking, trainer info, and nutritional tips.

The prototype supports up to 40 subscribers, with 12–15 sample users participating in evaluation. Only four physical lockers are available, limiting simultaneous use. Each user can register up to three fingerprints, access lockers once per day for two hours, and must wait 10–12 hours before reusing.

The study focuses on prototype development and assessment, not full commercial deployment. It uses fingerprint authentication only and excludes technologies like RFID, facial recognition, or mobile apps, as well as broader gym management features (e.g., payroll, CCTV, or equipment automation). Evaluation emphasizes user experience, security, and locker management, with a limited sample that does not reflect the entire gym population.

CONCLUSIONS

The study successfully developed and evaluated FitSecure: Online Management System with Biometric Secured Locker Services for Rooftop Fitness Gym. The system improved locker security, streamlined gym operations, and

enhanced user convenience through biometric authentication and automation. FitSecure demonstrates how IoT and web-based technologies can be effectively applied to address real-world challenges in fitness facility management. Future enhancements may include mobile application integration, support for additional biometric modalities, and scalability for full commercial deployment.

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GradWay: A Capstone Management System for Computing Studies of Mabalacat City College (MCC)

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ABSTRACT

This study presents GradWay, a web-based Capstone Management System developed for the Bachelor of Science in Information Technology (BSIT) program at Mabalacat City College, aligned with Sustainable Development Goals (SDGs) 4, 9, and 16. The system digitalizes and streamlines capstone processes such as defense scheduling, adviser and panel assignment, consultation tracking, document submission, progress monitoring, and rubric-based grade computation to enhance efficiency, transparency, and coordination among students, advisers, and teachers. It was developed using the Modified Waterfall Model of the SDLC with technologies such as React.js, React Router, Tailwind CSS, TypeScript, and Firebase to ensure a responsive, role-based platform. System evaluation involved alpha testing by three IT experts and beta testing with BSIT students based on ISO 25010 quality standards, yielding an overall mean of 4.81 for alpha testing and 4 for beta testing, both interpreted as “Excellent,” confirming the system’s reliability, usability, and effectiveness in supporting the end-to-end capstone process and demonstrating its potential to modernize capstone management through improved communication, automated academic tasks, and structured workflows.

Keywords: Scheduling System, Document Management System

INTRODUCTION

Managing capstone projects in higher education poses significant challenges, especially for instructors tasked with overseeing multiple student groups, organizing defense schedules, coordinating with academic stakeholders, and ensuring the timely submission and assessment of academic outputs. At Mabalacat City College (MCC), these difficulties are particularly evident in the manual handling of critical tasks such as scheduling defenses, tracking document submissions, managing consultation feedback, computing final grades, and monitoring the overall progress of capstone groups. These responsibilities, often handled without the support of an integrated system, can lead to miscommunication, delays, and errors in academic evaluation. Globally, universities face increasing pressure to modernize academic workflows due to the expansion of digital learning environments. As highlighted by Osei (2021), adopting centralized, web-based capstone management systems significantly enhances the documentation process, strengthens communication between students

and advisers, and automates administrative workflows.

Regionally and locally, the challenge is more evident in institutions like Mabalacat City College (MCC), particularly within its Institute of Computing Studies. Faculty members continue to rely on manual processes, spreadsheet-based grade computations, email-driven document submissions, and individually arranged consultations, resulting in fragmented monitoring and delays in academic evaluation. Local faculty also report issues such as the manual collection of administrative and academic fees, the lack of integrated tracking for consultation notes, and difficulties in retrieving student progress records. These challenges affect not only faculty efficiency but also students’ ability to receive timely feedback and meet project deadlines.

At MCC, these challenges manifest in the manual handling of critical tasks such as scheduling capstone defenses, tracking document submissions, managing consultation feedback, computing final grades, and monitoring the overall progress of capstone groups. Without the support of a unified system, these responsibilities become time-consuming and prone to oversight.

Bedi and Dey (2021) highlight how academic management systems can improve the efficiency and reliability of student project handling by digitizing proposal submission, feedback logging, and evaluation processes. Locally, the absence of such a system at MCC contributes to organizational inconsistencies, delays, and increased workload for both faculty and students.

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Objective of the Study

The general objective of this study is to develop GradWay: A Capstone Management System for Computing Studies of MCC, a centralized, web-based platform that will streamline and automate the end- to-end management of capstone projects. The system aims to enhance the efficiency, accuracy, and transparency of academic processes related to scheduling,

consultation tracking, document submission, grading, and progress monitoring for students, capstone teachers, panelists, and technical advisers at Mabalacat City College.

- To gather comprehensive information, standards, and best practices essential for designing and developing the GradWay Capstone Management System
- To identify and define the hardware and software requirements necessary for developing the GradWay system
- To design the system architecture using visual documentation and tools that support clarity and maintainability.
- To develop the GradWay web application with the following core modules and features
- To test the system rigorously
- To deploy the GradWay system in a controlled academic environment

Limitation

While GradWay is designed to modernize and streamline the management of capstone projects within Mabalacat City College (MCC), the system functions within certain limitations due to institutional policies, technical boundaries, and the scope of the project.

The system is specifically developed for the Institute of Computing Studies and is not intended for use by other academic departments or programs within MCC. As such, it only supports processes related to Capstone 1 (Title Defense) and Capstone 2 (Final Defense) and does not apply to research, thesis, or practicum requirements in other disciplines unless further adapted.

GradWay does not integrate directly with third-party applications or external services, such as plagiarism scanning tools or grammar checking platforms. Instead, the system provides status indicators for these tasks, which must be completed and updated manually by assigned students. This reliance on external processes may affect real-time tracking and automation.

Moreover, fee monitoring and financial reports are limited to the manual input of fee data by authorized personnel. Any discrepancies in panel honoraria, guest payments, or adviser compensation must be reconciled outside of the platform. GradWay does not integrate directly with third-party applications or external services, such as plagiarism scanning tools or grammar checking platforms. Instead, the

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Moreover, fee monitoring and financial reports are limited to the manual input of fee data by authorized personnel. Any discrepancies in panel honoraria, guest payments, or adviser compensation must be reconciled outside of the platform.

To maintain data security and accountability, only officially designated students, teachers, and technical advisers may log in and access the system using personal accounts. While this ensures role-based security, it may present challenges for users unfamiliar with the digital platform during the initial adoption period.

Also, the platform's performance and accessibility are contingent on stable internet connectivity and device compatibility. Users with outdated browsers, low-performance devices, or limited internet access may encounter usability issues, especially when uploading large files or accessing detailed documents and schedules. Furthermore, the system restricts file uploads to a maximum of 300MB per document, which may limit the submission of exceptionally large files. User adoption and digital literacy are also limiting factors. Capstone faculty and advisers who are used to manual tracking or spreadsheet-based systems may experience a learning curve during the transition to GradWay. Although training and documentation will be provided, early usage may be prone to data entry errors and incomplete records.

Additionally, the system does not include a dark mode version or page, limiting visual comfort for users who work in low-light environments or prefer darker interfaces. The absence of this feature may cause eye strain during extended usage, especially for users accessing the system at night or in dimly lit areas. Incorporating a dark mode option in future updates could improve accessibility, reduce visual fatigue, and enhance the overall user experience.

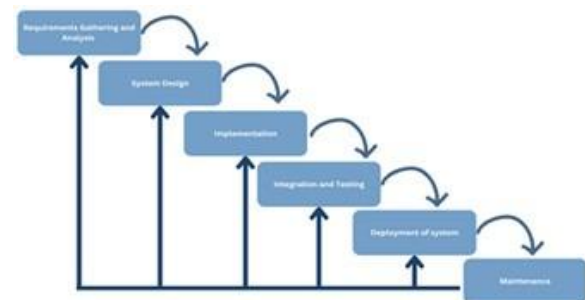
Finally, while the system includes validation fields and status indicators, its functionality is still dependent on accurate and timely input from users. Incorrect scheduling, incomplete document uploads, or failure to update consultation logs may lead to inaccurate tracking or delays in academic processes.

METHODOLOGY

The researchers adopted the Modified Waterfall Model (see Figure 1) for the Software Development Life Cycle (SDLC) methodology in developing the GradWay system. This model provides a linear yet adaptable process that enables each phase to be completed with thorough documentation and approval before proceeding to the next.

At the same time, it allows for limited iteration to revisit previous stages when needed, making it ideal for academic systems where clarity, structure, and validation are essential.

Figure 1
Modified Waterfall Model Requirement Gathering



The requirement gathering process for the GradWay system was a collaborative and iterative activity that involved various stakeholders at Mabalacat City College. The development team initiated the process through brainstorming sessions to identify the essential features needed to support capstone project management. These sessions focused on determining system roles, academic workflows, and critical problems such as the lack of centralized defense scheduling, inconsistent consultation tracking, and inefficient grading and feedback mechanisms.

Design

In the design phase of GradWay: A Capstone Management System for Computing Studies of MCC, the researchers employed a comprehensive set of modeling tools to conceptualize and structure the system architecture, functionality, and interface. The Use Case Diagram (see Figure 2), Data Flow Diagram (DFD) (see Figure 3), Entity-Relationship Diagram (ERD) (see Figure 4), Flowchart, Gantt Chart, Storyboard, Data Gathering, and Wireframe collectively define the structure, processes, and development plan of

the GradWay system for the Institute of Computing Studies at Mabalacat City College. The Use Case Diagram outlines user roles and system functions such as document submission, grading, and scheduling, while the DFD illustrates how data flows across processes like uploads, consultations, and grade computation. The ERD establishes the database structure and relationships among entities such as users, groups, and submissions, and the Flowchart details the step-by-step logic of key operations including approvals and scheduling. The Gantt Chart presents the project timeline from planning to deployment, ensuring proper task management. The Storyboard and Wireframe visualize user interaction and interface design for modules like dashboards, submissions, and consultations, while the Data Gathering documents the research process through interviews and consultations that informed system requirements. Together, these tools ensure that GradWay is well-structured, efficient, and aligned with academic and administrative needs.

Figure 2
Use Case Diagram



Implementation

In the build and development phase of GradWay: A Capstone Management System for Computing Studies of MCC, the researchers will implement the technical specifications and architectural designs established during the design phase. GradWay is envisioned as a responsive, web-based application accessible via desktop and mobile browsers to accommodate a broad range

of users including students, capstone teachers, and technical advisers. The implementation approach is grounded in modular development and follows best practices in web development to ensure system maintainability, scalability, and usability.

Figure 3
Data Flow Diagram (DFD)

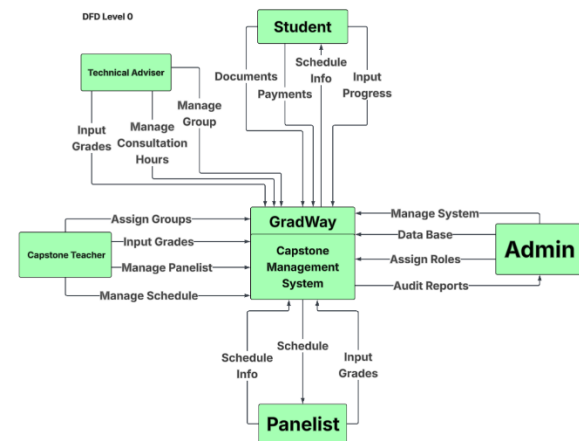
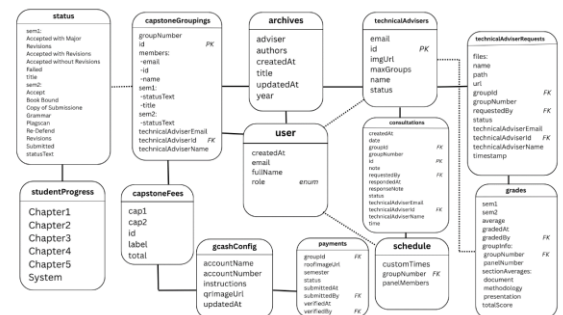


Figure 4
Entity- Relationship Diagram (ERD)



Firebase will be the primary integrated development environment (IDE) for both front-end and back-end coding. It provides powerful extensions, Git integration, syntax highlighting, and debugging capabilities, which streamline the coding workflow and improve productivity during system development. React.js, a PHP-based web framework, will be used to build the backend of GradWay. React.js's MVC (Model-View-Controller) architecture ensures separation of concerns between the data (Model), user interface (View), and business logic (Controller), which promotes maintainability and

collaborative development. React.js's built-in functionalities such as authentication scaffolding, RESTful routing, Eloquent ORM for database interaction, and Blade templating will accelerate development and improve code organization.

The front end will be developed using Vite, Tailwind CSS, and JavaScript. To enhance responsiveness and design consistency across devices, the researchers will utilize Tailwind CSS, a utility-first Tailwind CSS framework that allows for rapid UI development without writing custom Tailwind CSS from scratch. JavaScript will be used to implement interactive components such as dynamic status updates, progress indicators, and modal windows, contributing to a user-friendly and intuitive experience.

For the database layer, the researchers will use React Router to manage the system's relational data. GradWay will store data such as user credentials, capstone group information, consultation logs, defense schedules, document submissions, grading records, and fee tracking data. React Router's structured query language and relational integrity support will ensure data accuracy, consistency, and efficient access.

A local development environment will be created using TypeScript, which bundles Apache (web server), React Router (database), and PHP (backend scripting), allowing the development team to simulate the server environment and test the system locally before deployment.

To support the interface design and mockups during the prototyping stage, tools like Heroicons React or JSZip will be used. These tools enable the visualization of UI/UX elements such as dashboards, forms, and navigation menus, which guide the development of responsive wireframes and ensure that the system's visual flow matches user expectations.

Although development is in the initial phase, the strategic selection of these tools and technologies ensures that GradWay will be implemented as a robust, secure, and user-centered academic management platform. The system will not only meet the technical requirements of the capstone process but also enhance communication, document tracking, and administrative efficiency within the Institute of Computing Studies at Mabalacat City College.

Testing

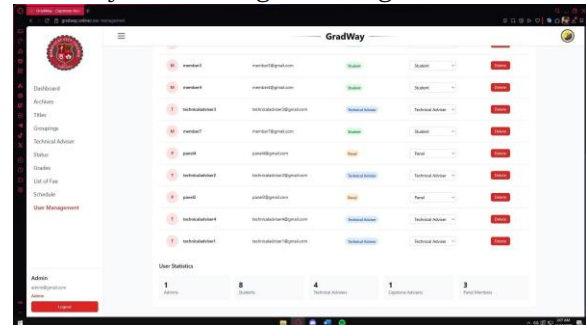
The Alpha and Beta testing phases were essential in evaluating GradWay: A Capstone

Management System for Computing Studies of MCC, based on the ISO 25010 Software Quality Model, which addresses Functional Suitability, Interaction Capability, Security, and Flexibility.

During Alpha Testing, three (3) IT experts assessed the administrator interface and core system modules to verify compliance with functional and performance requirements. Using structured questionnaires and guided demonstrations, their evaluations identified minor issues and provided recommendations for system refinement prior to deployment.

The Beta Testing phase, which involved a broader audience from Mabalacat City College, focused on evaluating Functional Suitability, Compatibility, Interaction Capability, and Security. Participants performed actual academic tasks such as title submission, consultation tracking, grade viewing, and schedule monitoring. These assessments provided a detailed understanding of the system's functionality, security measures, and overall user experience, forming the foundation for the more in-depth analyses presented in the following sections.

Figure 5
GradWay User Management Page



Operation and Maintenance

After the completion of the verification and testing phases, the operation and maintenance stage of the GradWay system was formally initiated. The system was successfully deployed to its designated hosting environment, where it became accessible to students, faculty, and system administrators of the Institute of Computing Studies at Mabalacat City College (MCC) (see Figure 5).

Through continuous observation and iterative improvements, the researchers ensured that GradWay remained an effective, dependable, and

user-centered capstone management platform for the MCC computing community.

RESULTS

Alpha Test

The Alpha Testing involved one (1) IT professional from Shore 360 Clark, Angeles City, and two (2) faculty members from Mabalacat City College who have expertise in web-based application development and software evaluation. The evaluators were tasked to thoroughly examine the system's major modules, including the Administrator, Capstone Teacher, Technical Adviser, and Student interfaces, to verify system performance and ensure that all components worked according to design specifications.

Table 1
Alpha test result

Evaluation	Mean	Verbal Description
Functional Stability	4.89	Excellent
Interaction Capability	4.76	Excellent
Security	4.73	Excellent
Flexibility	4.81	Excellent
Total	4.81	Excellent

Table 2
Beta test result

Evaluation	Mean	Verbal Description
Functional Stability	4.05	Very Good
Interaction Capability	3.99	Very Good
Security	3.93	Very Good
Flexibility	3.98	Very Good
Total	4	Very Good

The alpha test results of GradWay: A Capstone Management System for Computing Studies of MCC, based on ISO 25010 standards, revealed outstanding system performance across the evaluated criteria Functional Suitability, Interaction Capability, Security, and Flexibility. The system effectively met all functional requirements, demonstrating seamless interaction between modules and strong adherence to data security protocols. Its flexible design allowed smooth adaptation across user

roles and operational contexts. With an overall mean score of 4.81, interpreted as "Excellent," the findings confirm that GradWay performs exceptionally well and is fully capable of supporting the academic and administrative workflows for which it was developed (see Table 1).

Beta Test

The Beta Testing of GradWay: A Capstone Management System for Computing Studies of MCC started on November 7, 2025. It was conducted with two (2) IT professionals and twenty-eight (28) students from the Institute of Computing Studies at Mabalacat City College. Before the evaluation, the researchers gave a short introduction and live demonstration of the system to help the participants understand its main features. The testing, based on the ISO 25010 Software Quality Model, focused on Functional Suitability, Interaction Capability, Security, and Flexibility. After using the system, participants answered a structured questionnaire to rate its performance, ease of use, and reliability in actual use. The results of the survey and the detailed findings of the beta testing are shown in the following tables and discussion (see Table 2).

The Beta Testing phase, which involved a broader audience from Mabalacat City College, focused on evaluating Functional Suitability, Compatibility, Interaction Capability, and Security. Participants performed actual academic tasks such as title submission, consultation tracking, grade viewing, and schedule monitoring. These assessments provided a detailed understanding of the system's functionality, security measures, and overall user experience, forming the foundation for the more in-depth analyses presented in the following sections.

The comprehensive evaluation results of GradWay: A Capstone Management System for Computing Studies of MCC, based on the ISO 25010 Software Quality Model, are presented in Appendices K and L. Functional Suitability received outstanding ratings in both phases, with the Alpha Test scoring 4.89 and the Beta Test achieving 4.05, showing excellent functionality. Interaction Capability also performed strongly, with scores of 4.76 in the Alpha phase and 3.99 in the Beta phase, reflecting a smooth and user-friendly interface. Security obtained scores of 4.73 in Alpha and 3.93 in Beta, indicating secure operations with

minor areas for enhancement during wider user testing. Flexibility maintained excellent performance, with 4.81 in Alpha and 3.98 in Beta, confirming the system's adaptability across user roles and environments. The overall mean scores of 4.81 for the Alpha Test and 4. for the Beta Test were both interpreted as "Very Good," demonstrating GradWay's strong compliance with ISO 25010 standards and its effectiveness in delivering a reliable, secure, and user-centered capstone management system for Mabalacat City College.

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Green-Grain Hub: A Microcontroller-Based Waste to Rice Dispenser

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ABSTRACT

The Green-Grain Hub is a microcontroller-based waste-to-rice dispenser that promotes sustainable waste management by rewarding users with rice in exchange for properly disposed plastic bottles and tin cans. The project was developed utilizing the Modified Waterfall Model of the Software Development Life Cycle (SDLC), and it progressed in an organized manner from planning to evaluation. The ISO 25010 standards were used to evaluate system quality, considering functional suitability, performance efficiency, compatibility, interaction capability, reliability, security, flexibility, and safety. The alpha testing resulted in a mean score of 4.27, while the beta testing achieved 4.58, both falling under the “Excellent” descriptive rating. Furthermore, a repeated trial test proved the machine consistently dispensed approximately 100 grams of rice every transaction, assuring reliability and accuracy. The system was created to align with and assist the achievement of certain Sustainable Development Goals (SDGs), highlighting its importance and potential influence on community-centered environmental and food sustainability projects.

Keywords: Reverse Vending Machine, Waste-to-Rice Dispenser, Microcontroller, IoT Monitoring, and Recycling Incentive

INTRODUCTION

In today’s world, technological innovations are not only designed for convenience but also for addressing pressing environmental concerns. One of the most critical issues is the rapid increase of solid waste, particularly plastics and metals, which significantly contribute to pollution. The Philippines generates around 2.7 million tons of plastic waste annually, with a considerable portion ending up in oceans and waterways (World Bank, 2021). Aluminum cans also add to the country’s waste problem, as many of them are improperly disposed of or left unrecycled. Without effective waste management solutions, these materials continue to harm ecosystems and worsen pollution levels.

To help address these challenges, reverse vending machines (RVMs) have been developed in different countries. These machines promote recycling by allowing users to deposit recyclable materials, such as plastic bottles or cans, in exchange for rewards. Research has shown that reward-based recycling systems can significantly increase participation rates, making recycling more engaging and accessible to the public (Schnurr et al., 2018). However, most existing systems typically provide monetary tokens,

discounts, or small perks, which may not always be sustainable or aligned with local needs.

This project introduces the Green-Grain Hub: A Microcontroller-Based Waste to Rice Dispenser, a reverse vending machine designed to accept plastic bottles and aluminum cans through two separate slots. Unlike conventional RVMs, this machine provides rice as a direct reward for every deposited item. By offering rice—an essential staple food in Filipino households—the machine uniquely combines environmental advocacy with food security.

This approach not only motivates individuals to recycle but also provides a practical and meaningful benefit.

The implementation of this machine aims to make recycling more effective and rewarding in both academic and community settings. By encouraging individuals to return their plastic bottles and aluminum cans in exchange for rice, the project fosters sustainable waste management practices while also promoting social responsibility. Moreover, providing an immediate, tangible reward increases the likelihood of consistent participation, leading to long-term positive impacts on environmental conservation and resource recovery.

Through the Green-Grain Hub: A Microcontroller-Based Waste to Rice Dispenser, this project envisions a cleaner, greener, and more sustainable community. It highlights the role of technology in transforming waste into

opportunity, while addressing both environmental challenges and basic human needs.

Digging deeper, Plastic waste pollution is a growing global issue, especially in areas that are rapidly urbanizing. Improper disposal of plastic bottles causes severe environmental damage, clogs drainage systems, and harms local ecosystems (United Nations Environment Programme, 2018). To tackle this problem, many recycling programs, often with incentives, have been started around the world to promote responsible waste disposal. The high use of bottled drinks adds to this issue, creating an urgent need for effective waste management solutions.

According to the City Government of Mabalacat (2024), the composition of solid waste consists of 63.63% biodegradable, 14.09% recyclables, and 11.40% residuals with potential for diversion. These data are based on the City's 10-year Solid Waste Management Plan. This indicates that a significant portion of solid waste is not properly diverted, resulting in higher operational costs for the city. This situation highlights the need for more effective segregation and recycling systems, such as a community-based reverse vending machine that provides incentives for the proper disposal of plastic bottles and metal cans.

Globally, reverse vending machines (RVMs) are commonly used to encourage recycling through incentives. TOMRA introduced the first RVM in 1972, and over 100,000 devices have since been deployed worldwide, mostly in the United States, United Kingdom, and Australia (TOMRA, n.d.). Research has demonstrated that reward-based recycling programs effectively enhance recycling practices. For example, the RECICLOS program, a virtual reward token system in Spain, has successfully improved household recycling participation (Vilches et al., 2020). These examples demonstrate the potential for merging technology and incentive-based techniques to improve waste management practices.

Objective of the Study

This project aims to develop the "Green-Grain Hub" as a low-cost plastic bottle and metal cans recycling initiative in Mabalacat City, Pampanga.

1. To gather necessary data through Academic Studies, Existing Literatures, Online Articles.
2. To identify the required hardware and software components.
3. To design the system using the following diagram and analysis tools.
4. To develop Hardware Device with Essential Features.
5. To evaluate the system based on ISO 25010's Quality Standards: Functional Suitability, Performance Efficiency,

Compatibility, Interaction Capability, Reliability, Security, Flexibility, and Safety.

6. To deploy and implement the system in Mabalacat City, Pampanga.

Scope and Limitations

The Green-Grain Hub, a microcontroller-based waste to rice dispenser, focuses on sustainability and is developed in Mabalacat City, Pampanga. It promotes responsible waste disposal while offering rewards to the community. Users can deposit plastic bottles and aluminum cans into an automated dispenser, which gives them a measured amount of rice in return. By combining waste management with incentives, the project aims to reduce litter, encourage recycling, and support sustainable practices in the local community.

The dispenser has a fully automated microcontroller system that detects, receives, and processes the accepted waste materials. After verification, the system dispenses rice based on the deposited item. It also includes a monitoring mechanism to track the number of collected bottles and cans, as well as the amount of rice distributed. This feature helps organizers evaluate the project's impact on waste reduction and community involvement. To ensure proper waste handling, the project will partner with local waste management services and recycling organizations in Mabalacat City. These partnerships will make sure that all collected plastic bottles and aluminum cans are sanitized, repurposed, or recycled. Additionally, the project seeks to raise environmental awareness among residents through educational campaigns, promoting long-term sustainable habits.

Despite its many advantages, the Green-Grain Hub has certain limitations that need to be considered:

Restricted Waste Acceptance

The machine is designed to accept only plastic bottles and aluminum cans. It will not process other waste materials such as paper, food wrappers, or glass. Users must separate these items before using the dispenser.

Maintenance and Technical Reliability

Since the system depends on sensors, motors, and a microcontroller, it needs regular maintenance. Issues like calibration errors, sensor misidentification, or power interruptions may disrupt operations. A maintenance team will be necessary to keep it functioning consistently.

Rice Supply Availability

The dispenser's success relies on a reliable and steady rice supply. Any shortages caused by funding limitations, storage problems, or distribution delays may lead to inconsistent reward dispensing, which could lower user participation.

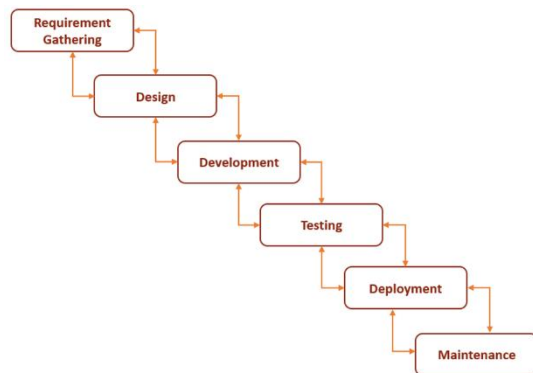
Limited Coverage

Initially, the dispenser will be deployed only in select areas within Mabalacat City. Expanding the system to other communities will require more funding, additional units, and logistical support, which may not be readily available.

METHODOLOGY

The study adopted a systematic approach of following a well-defined model for project development in order to streamline project execution. It explains how the strategies for requirement collection, system design and development, and other methods to realize the system were implemented. This includes integrating hardware such as Sensors and Microcontroller to software modules that manage control logic, monitoring, and user interfaces. The methodology is aimed at ensuring functionality of the system while meeting sustainability, usability, and eco-friendly design standards.

Figure 1
The Modified Waterfall Model



Requirements

The researchers conducted a thorough requirements gathering process to identify the essential needs for developing the Green-Grain Hub: A Microcontroller-Based Waste to Rice Dispenser. This phase was crucial in understanding how the system could effectively promote recycling behavior while providing a fair and automated reward system for users. The main goal was to pinpoint the key components necessary to design a user-friendly, efficient, and reliable IoT-based dispenser. This dispenser would turn recyclable waste, like plastic bottles and aluminum cans, into corresponding rice rewards. To accomplish this, the researchers worked with students, faculty, maintenance staff, and community members, who are the potential end users of the machine.

Hardware Requirements

The researchers analyzed the technical aspects required for developing the Green-Grain Hub: A Microcontroller-Based Waste to Rice Dispenser,

focusing on ensuring optimal functionality for a user-friendly and reliable microcontroller-based system. The desktop computer used for development featured the following specifications: the system is powered by an AMD Ryzen 5 3400G processor running at 3.70 GHz. For efficient multitasking and smooth handling of processes, the PC is equipped with 16.0 GB of Installed RAM (13.9 GB usable). Data storage is provided by a drive with 689 GB of capacity, and the system uses AMD Radeon(TM) RX Vega 11 Graphics, providing adequate performance for development tasks such as code compilation and system simulation. For testing the mobile application, a smartphone with robust specifications was employed; the device is a realme C30s running on Android version 12 (Go Edition) with the realme UI Go Edition. The phone utilizes an Octa-core processor and 2.0 GB of RAM. It has 32 GB of device storage. These specifications enabled effective testing of the vending machine's mobile interface, ensuring the application met user experience standards across various functions and displays under typical mobile device constraints.

Software Requirements

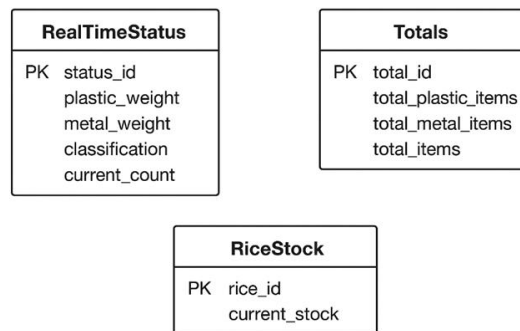
MIT App Inventor served as the primary development platform for creating the mobile interface utilized in the Green-Grain Hub: A Microcontroller-Based Waste to Rice Dispenser. With its intuitive, block-based programming environment and browser-based workspace, MIT App Inventor enabled a streamlined application development process suited for rapid prototyping and efficient system integration. The platform's compatibility with multiple operating systems, along with support for both Android and iOS devices, ensured flexible testing conditions that allowed the developers to refine the user interface, improve system responsiveness, and guarantee smooth communication between the mobile application and the microcontroller driven dispenser. Its reliability and ease of use contributed significantly to maintaining high standards of usability, functionality, and system performance critical factors in ensuring that the Green-Grain Hub operates effectively as an innovative waste to resource dispensing system. The microcontroller in the Green-Grain Hub: A Microcontroller-Based Waste-to-Rice Dispenser was programmed using the Arduino Integrated Development Environment (IDE). The IDE was appropriate for creating the automated waste detection and rice dispensing parts of the system because it offered a straightforward, dependable, and accessible platform for writing and uploading code to the device. Easy to understand and perfect for prototyping, the Arduino IDE uses a simplified programming language based on Arduino terminology. This made it possible for the researchers to effectively

build the dispenser's essential features, such as managing the dispensing mechanism, processing rewards, regulating motors, and reading sensor data. In order to ensure system accuracy and stability, the integrated Serial Monitor was also essential for debugging and real-time sensor output monitoring.

Design

The Green-Grain Hub system is engineered to facilitate automated bottle and can collection, paired with a reward system where users receive approximately 100 grams of rice for depositing 10 items. The architecture integrates input and output processing modules to ensure a seamless operation from item deposit to reward dispensing. Key hardware components in the input module include an infrared (IR) sensor for counting, capacitive and inductive sensors for item validation, a load cell with an HX711 for weight detection, and servo motors for flap operation. These sensors collaboratively ensure accurate data recording for each deposited item. The system is controlled by an Arduino Uno microcontroller, which processes data from the sensors, manages reward dispensing, and interacts with the user interface. The output module features a 16x2 LCD display for user feedback, a servo motor for rice dispensing, and an LED indicator for visual status updates. Additionally, the Entity-Relationship Diagram (see Figure 2) outlines the IoT monitoring system's database, consisting of three entities that operate independently. The RealTimeStatus entity keeps track of live data, including weights and item counts, while the Totals entity maintains cumulative counts of deposited items. The RiceStock entity monitors the remaining rice supply, starting at 5,000 grams and decrementing by 100 grams per completed transaction, thus maintaining a clear record of system usage and resource availability.

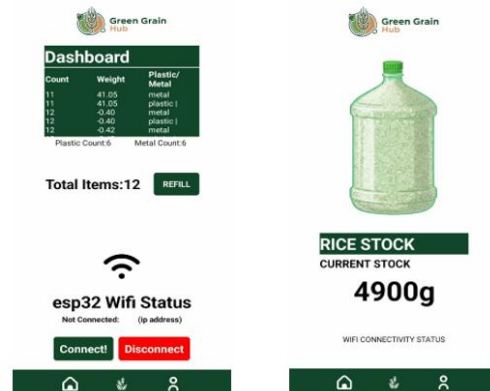
Figure 2
Entity-Relationship Diagram



Development

The development phase of the Green-Grain Hub system emphasized the integration and functionality of both hardware and software components to ensure reliability, maintainability, and user-friendliness, while adhering to ISO 25010 standards. Utilizing the Arduino Uno as the main controller, the system incorporated various sensors, including inductive and capacitive components, to distinguish between plastic and metal objects. The Arduino also managed the dispensing mechanism, which released rice in exchange for recyclable materials, and communicated with the ESP32 microcontroller to facilitate wireless data transfer to a mobile application via Wi-Fi. On the software front, the integration of the MIT App Inventor platform allowed the development of a mobile application that provided real-time monitoring and reporting of system activities. Key features included tracking the weight of deposited items, counting plastic and metal inputs, maintaining records of total collection, monitoring rice dispensing, and checking the remaining rice supply, thus enabling administrators to oversee recycling records and reward distribution effectively. Continuous testing during the development phase included sensor calibration for accurate item recognition and servo motor adjustments to ensure precise rice dispensing. Communication tests were conducted between the Arduino, ESP32, and the mobile application to validate the real-time transmission of data, leading to enhancements in system responsiveness and reliability. Ultimately, the development process transitioned the Green-Grain Hub from conceptual design to a functional prototype, ready for further evaluation and implementation.

Figure 3
Mobile App



Testing

The Green-Grain Hub system is engineered to facilitate automated bottle and can collection,

paired with a reward system where users receive approximately 100 grams of rice for depositing 10 items. The architecture integrates input and output processing modules to ensure a seamless operation from item deposit to reward dispensing. Key hardware components in the input module include an infrared (IR) sensor for counting, capacitive and inductive sensors for item validation, a load cell with an HX711 for weight detection, and servo motors for flap operation. These sensors collaboratively ensure accurate data recording for each deposited item. The system is controlled by an Arduino Uno microcontroller, which processes data from the sensors, manages reward dispensing, and interacts with the user interface. The output module features a 16x2 LCD display for user feedback, a servo motor for rice dispensing, and an LED indicator for visual status updates. Additionally, the Entity-Relationship Diagram outlines the IoT monitoring system's database, consisting of three entities that operate independently. The RealTimeStatus entity keeps track of live data, including weights and item counts, while the Totals entity maintains cumulative counts of deposited items. The RiceStock entity monitors the remaining rice supply, starting at 5,000 grams and decrementing by 100 grams per completed transaction, thus, maintaining a clear record of system usage and resource availability.

Table 1
Likert Scale used by the Researchers

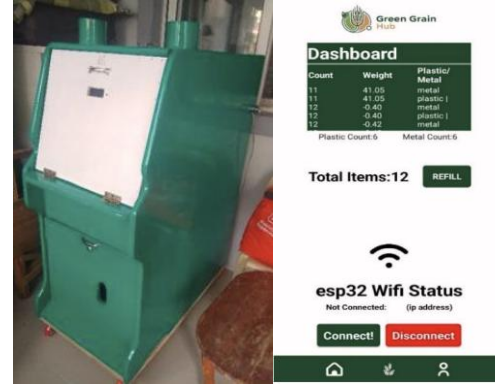
Response Category	Numeric Value	Range Interval	Verbal Interpretation
Strongly Agree	5	4.21–5.00	Excellent
Agree	4	3.41–4.20	Good
Neutral	3	2.61–3.40	Acceptable
Disagree	2	1.81–2.60	Marginal
Strongly Disagree	1	1.00–1.80	Poor

Deployment

The deployment phase marked the transition of the Green-Grain Hub from a refined prototype to a fully operational system for real-world use (see Figure 4). This stage focused on ensuring the proper integration and reliable performance of the hardware, software, and mobile application in compliance with ISO 25010 standards. System components such as sensors, actuators, and servo motors were calibrated for accurate waste detection and consistent rice dispensing, while stable communication between the Arduino Uno and ESP32 enabled real-time monitoring through the mobile application (see Figure 3). Controlled testing under real-use conditions confirmed smooth system synchronization, efficient operation, and

readiness for community adoption to promote sustainable recycling with immediate incentives.

Figure 4
Green-Grain Hub system



RESULTS

The Waste-to-Rice Dispenser was examined using ISO 25010 quality standards to determine functionality, efficiency, reliability, usability, and safety. Testing in both the Alpha (see Table 2) and Beta phases (see Table 3) revealed strong performance in all major areas, proving that the system works efficiently, delivers accurate feedback, and is safe and dependable for community usage.

The Alpha Test scored 4.30 for Functional Suitability, indicating that the system performed its fundamental operations satisfactorily but required more development. The Beta Test earned a higher average score of 4.58, suggesting smoother operations and more accuracy in real use. The Alpha Test scored 4.24 on Performance Efficiency, whereas the Beta Test earned 4.41, showing that the system responded faster and functioned more consistently.

The Compatibility rating increased from 4.37 in Alpha to 4.53 in Beta as the system grew more reliable in various testing situations. Interaction Capability also improved, jumping from 4.25 to 4.48, with beta testers noting better instructions and a more user-friendly interface. Improvements were also noticed in Reliability, with the score rising from 4.21 in Alpha to 4.46 in Beta, showing that the system performed more consistently throughout Beta.

The Alpha Test earned 4.19 in Security, whereas the Beta Test received a better grade of 4.44, indicating greater confidence in the system's security against unwanted access. The Flexibility score grew from 4.24 to 4.51, indicating that the system adapted better throughout Beta testing. The Safety category also improved from 4.27 in Alpha to 4.53 in Beta, providing a safer experience for users.

Overall, the Alpha Test had an average score of 4.27, whereas the Beta Test had a higher overall mean of 4.58. This rise indicates that the system improved considerably following changes, resulting in higher performance, usability, and reliability throughout community testing.

Table 2
Summary of Alpha Test

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.30	Excellent
Performance Efficiency	4.24	Excellent
Compatibility	4.37	Excellent
Interaction Capability	4.32	Excellent
Reliability	4.25	Excellent
Security	4.21	Excellent
Flexibility	4.19	Good
Safety	4.24	Excellent
Overall Mean Score	4.27	Excellent

Table 3
Summary of Beta Test

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.51	Excellent
Performance Efficiency	4.41	Excellent
Compatibility	4.51	Excellent
Interaction Capability	4.53	Excellent
Reliability	4.47	Excellent
Security	4.50	Excellent
Flexibility	4.53	Excellent
Safety	4.52	Excellent
Overall Mean Score	4.58	Excellent

Table 4
Repeated Trial Test Result

Trial No.	Rice Dispensed
1st Dispense	102 grams
2nd Dispense	111 grams
3rd Dispense	105 grams
4th Dispense	95 grams
5th Dispense	105 grams
6th Dispense	112 grams
7th Dispense	121 grams
8th Dispense	99 grams
9th Dispense	103 grams
10th Dispense	100 grams
Overall Mean	105.30 grams

The researchers used a repeated trial test (see Table 4) with 10 consecutive transactions to assess the consistency and dependability of the rice distribution system. Each transaction entailed placing 10 verified plastic bottles or tin cans into the Reverse Vending Machine, which then delivered the matching rice payout. The ten trials' reported dispense outputs were as follows: 102 g, 111 g, 105 g, 95 g, 105 g, 112 g, 121 g, 99 g, 103 g, and 100 g. These findings demonstrate that the dispensing module worked

properly across all tries, with no jams or failures. The outputs varied from 95 g to 121 g, demonstrating slight variability in the quantity administered.

The total quantity dispensed across all trials was 1053 grams, with an average of 105.3 grams each transaction. This shows that the dispenser delivers somewhat more than 100 grams every operation while keeping a relatively constant distribution pattern. Overall, the repeated trial test shows that the RVM's dispensing mechanism is reliable throughout several usage. Although some minor discrepancies were discovered, these variances are acceptable for a prototype system. The results show that the dispenser can operate continuously, and further improvements—such as optimizing the servo angle or improving the chute design—may increase accuracy.

DISCUSSION

The study focused on the development and evaluation of the Waste-to-Rice Dispenser, a system designed to promote proper waste segregation while providing rice rewards to encourage community participation. The system was tested by the proponents who conducted Repeated Trial Test and was evaluated in two phases: the Alpha Test, conducted online with initial users, the Beta Test, conducted face-to-face at the Mabalacat Municipal Hall involving municipal personnel, residents, and students. Both evaluations were guided by ISO 25010 quality standards, assessing attributes such as Functional Suitability, Performance Efficiency, Compatibility, Interaction Capability, Reliability, Security, Flexibility, and Safety. The results indicated that the system performed well across all key categories. In the Alpha Test, the overall mean score was 4.27, reflecting good initial functionality and usability. After improvements based on user feedback, the Beta Test achieved a higher overall mean of 4.58, demonstrating enhanced performance, reliability, and user satisfaction. Moreover, the system aligns with Sustainable Development Goals 2, 9, and 12, promoting responsible consumption and production while providing supplemental food support through its rice rewards mechanism and also fostering infrastructure, industrialization and innovation.

Based on the study, it can be concluded that the Waste-to-Rice Dispenser is an effective and functional system that achieves its primary objectives of promoting proper waste segregation and providing rice rewards to encourage community participation. The Alpha and Beta tests showed consistent improvements, indicating that the system performs reliably and meets the intended functional requirements. Users found the system easy to operate, and the

interface provided clear instructions and feedback, confirming its usability and practicality in real-world settings.

The system also demonstrated strong performance in terms of efficiency and reliability. The Beta Test, in particular, showed higher scores across all ISO 25010 quality attributes compared to the Alpha Test, suggesting that the refinements made after initial feedback effectively enhanced the system's responsiveness and stability. These improvements ensured that the dispenser could handle multiple items and operate smoothly under community testing conditions.

Another conclusion is that the Waste-to-Rice Dispenser effectively supports environmental sustainability and community awareness. By encouraging proper waste disposal and recycling, the system aligns with Sustainable Development Goal 12 (Responsible Consumption and Production). The rice reward mechanism further motivates users to participate, creating a tangible link between sustainable behavior and social benefit.

In addition, the project contributes to food security, addressing SDG 2 (Zero Hunger) at a local level. The rice rewards provide supplemental food support to the community, particularly benefiting residents and students who participate in the program. This dual impact demonstrates the system's capacity to combine technological innovation with social responsibility, making it a valuable tool for community development.

Finally, the study concludes that the Waste-to-Rice Dispenser is ready for wider implementation and can serve as a model for similar initiatives in other localities. With proper guidance, user training, and maintenance, the system can sustainably promote both environmental and social goals. The high overall ratings in both Alpha and Beta testing indicate that the system is reliable, efficient, and user-friendly, making it a practical and impactful solution for communities seeking to encourage recycling while addressing basic needs.

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INTELLICODE: Learning Tool & Personalized Coding Assessment

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ABSTRACT

This study developed Intellicode: Learning Tool & Personalized Coding Assessment, a web-based Learning Management System (LMS) designed to address fragmented learning experiences in programming education caused by general-purpose platforms like Microsoft Teams. Tailored for the BSIT program at Mabalacat City College, Intellicode integrates course delivery, coding practice, automated assessment, and digital credentialing into a unified platform. It features a built-in multi-language code editor, an AI-powered code checker with real-time feedback, a secure coding exam environment, and automated issuance of verifiable certificates. Guided by the iterative prototyping model and evaluated using ISO/IEC 25010 standards, Intellicode achieved “Excellent” ratings in both Alpha (M = 4.82) and Beta (M = 4.87) testing, confirming high functionality, usability, and security. Enhancements such as OTP verification and improved authentication strengthened reliability and user experience. Aligned with UN SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure), Intellicode promotes technology-driven instruction, efficiency, and engagement in programming education, effectively meeting its development objectives.

Keywords: Learning Management Systems, Content Management Systems, Information System

INTRODUCTION

Rapid technological advancement continues to reshape higher education, compelling academic institutions to adopt digital tools that enhance instructional quality and student outcomes. This transformation is particularly critical in Information Technology (IT) education, where industry standards evolve rapidly and traditional, teacher-centered approaches often fail to meet learners’ needs. Learning Management Systems (LMS) have therefore become central to modern instruction, providing a unified platform for course delivery, assessment, progress tracking, and learning analytics that supports flexible and learner-centered education (Articulate, 2025; Docebo, 2024; WpReset, 2024).

The COVID-19 pandemic accelerated global LMS adoption and established these systems as essential infrastructure for educational continuity (Alturki & Aldraiweesh, 2021). Beyond emergency use, LMS platforms now underpin blended and online learning by integrating content management, communication, assessment, and analytics into a single environment (Khan & Qudrat-Ullah,

2021). Empirical studies indicate that structured LMS engagement is associated with improved academic performance, increased participation, and more effective feedback mechanisms (Al-Mamary, 2022). At a national and international level, LMS deployment has become a foundational component of scalable digital education ecosystems (OECD, 2023). Despite these benefits, conventional LMS platforms and general collaboration tools remain inadequate for programming education. Local evidence from Mabalacat City College (MCC) reveals that Bachelor of Science in Information Technology (BSIT) students experience fragmented learning workflows, delayed feedback, and limited opportunities for iterative coding practice when using mainstream platforms such as Microsoft Teams. Most LMSs lack integrated coding environments, automated code evaluation, real-time debugging feedback, and fine-grained tracking of programming mastery, requiring instructors to rely on manual grading or disconnected external tools. These limitations hinder timely feedback and weaken the development of computational thinking, particularly in large classes.

MCC has actively pursued digital transformation through smart classroom initiatives, industry partnerships, and flexible learning infrastructures that support hybrid and inclusive education (MCC, 2024; Huawei, 2025).

The institution currently utilizes Microsoft Teams as its official LMS due to its accessibility and collaboration features (Mahmud & Wong, 2023). However, to further strengthen programming instruction within the BSIT program, there is a growing need for a specialized platform that integrates coding practice, assessment, and certification within a coherent learning environment.

This study proposes Intellicode: Learning Tool and Personalized Coding Assessment, a programming-focused LMS designed to address these gaps. Intellicode integrates a secure, browser-based coding workspace with a built-in IDE supporting Java, Python, and C, alongside AI-assisted code evaluation that delivers immediate, context-specific feedback. The platform enables instructors to design mastery-based learning modules with prerequisite sequencing, automate coding assessments, and issue verifiable digital certificates aligned with institutional and national quality standards. Students benefit from structured practice, real-time feedback, transparent progress tracking, and integrated certification, while administrators gain oversight through course approval workflows and system-wide analytics.

The development of Intellicode aligns with the Commission on Higher Education's (CHED) microcredential framework under CMO No. 1, Series of 2025, which emphasizes outcomes-based, stackable, and industry-aligned digital credentials mapped to the Philippine Qualifications Framework. By embedding microcredential assessment and certification within the LMS, Intellicode supports competency-based education and workforce readiness. Moreover, the study contributes to the United Nations Sustainable Development Goals, particularly SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure), by strengthening institutional digital infrastructure and enhancing access to high-quality, technology-driven programming education (UNESCO, 2024; UN DESA, 2025).

Objectives of the study

The general objective of this study is to design and develop "Intellicode: Learning Tool & Personalized Coding Assessment", a web-based Learning Management System tailored for IT education. Specifically, this study aims to achieve the following objectives:

1. To gather relevant requirements and stakeholder insights through literature review and interviews.

2. To identify the hardware and software technologies needed to support Intellicode's core features.
3. To design the system using tools like the VTOC (Visual Table of Contents), Storyboards, System Flow Charts, Use Case Diagrams, and Gantt Charts.
4. To develop a multi-user system that caters to the specific requirements of administrators, instructors, and students within an educational environment.
5. To test all functionalities, security safeguards, and usability through unit, integration, and user trials.
6. To evaluate the system against ISO/IEC 25010 quality standards using validation questionnaires and tools.
7. To deploy the Intellicode LMS in a pilot environment with training, monitoring, and support.

METHODOLOGY

Intellicode was developed using the Prototyping Model of software development. In this iterative approach, a working prototype of the system is built, tested, and refined repeatedly until it evolves into an acceptable final product (Bennett, 2024). This model is especially suitable because the project's detailed requirements emerged gradually as stakeholders provided feedback. Rather than finalizing all requirements upfront, the team created early prototypes of key features (such as the coding exercise interface) to gather user feedback and clarify expectations. This iterative, trial-and-error method between developers and clients ensures that the end product closely aligns with user needs. In practice, the prototyping methodology reduced the risk of developing features that did not meet end-user expectations and allowed the developers to incorporate changes at multiple stages (Geeksforgeeks, 2023). The following sections correspond to the typical phases of the prototyping model: requirements gathering, quick design, prototype building, user evaluation, prototype refinement, and finally implementation and maintenance.

Figure 1
Prototyping Model

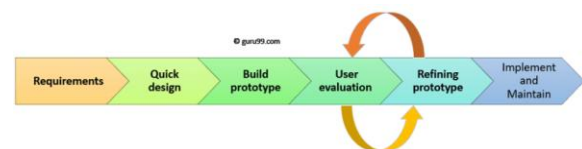


Figure 2
Visual Table of Contents (VTOC)

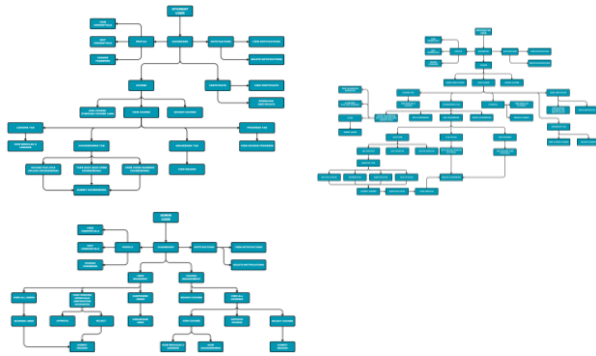
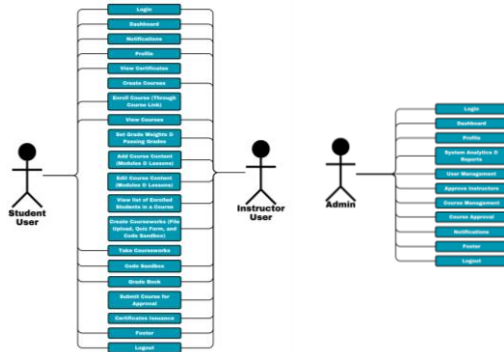


Figure 3
Use Case Diagram



Requirements

During the requirements phase, the research team established the functional, technical, and pedagogical foundations of Intellicode through a structured workflow with clearly defined roles covering project management and UI/UX design, system analysis and full-stack development, quality assurance and testing, and documentation and research. A mixed-method data-gathering approach was employed, combining an extensive review of peer-reviewed literature, government policies, and industry reports on Learning Management Systems, programming education, adaptive learning, and software quality standards, with particular reference to the ISO/IEC 25010 quality model. Academic sources were drawn from Google Scholar, ERIC, IEEE Xplore, ACM Digital Library, and Scopus, while local regulatory alignment was ensured through the review of CHED Memorandum Order No. 1, Series of 2025. To ground system requirements in actual instructional needs, structured interviews and focus group discussions were conducted with the BSIT Dean, instructors, and IT students of

Mabalacat City College using validated questionnaires. These consultations identified limitations of existing platforms such as Microsoft Teams, Cisco NetAcad, and Huawei portals, including fragmented access, delayed coding feedback, and the lack of unified progress tracking, which directly informed Intellicode's specifications.

System development and testing were conducted using workstation and laptop environments capable of supporting full-stack web development, local servers, and integrated development environments. The system was implemented using a modern web technology stack comprising TypeScript and Next.js for the frontend, NestJS for the backend, Prisma for schema validation, and PostgreSQL via Supabase for database management. Deployment utilized Vercel for the frontend and DigitalOcean for backend services. Core features were supported by the Monaco Editor for the in-browser coding environment, Gemini AI for automated code evaluation, SMTP services for email notifications, and PDFShift for digital certificate generation. This combination of hardware and software resources ensured a scalable, secure, and maintainable platform aligned with the instructional and assessment requirements of programming education.

Design

Following the requirements analysis, the Quick Design phase established the structural and functional blueprint for the Intellicode system. A Visual Table of Contents (VTOC) (see Figure 2) defined the hierarchical organization of features across the Admin, Instructor, and Student interfaces, ensuring that core modules such as authentication, course creation and approval, student enrollment, secured browser-based assessments, AI-assisted code evaluation, grade management, analytics, and certificate issuance were logically structured and aligned with the system's instructional objectives. Storyboards were then developed to illustrate key user workflows for each role, including course and lesson management, assessment submission and evaluation, administrative approvals, and student progress tracking. These visual representations supported early usability validation, allowing refinement of navigation flow and interface consistency prior to development.

To further detail system behavior, system flowcharts were used to model internal process logic and data movement, particularly for coding submission and evaluation workflows involving frontend, backend services, and data storage. Use case diagrams complemented this by clearly defining role-based interactions and access boundaries for Admins, Instructors, and Students, serving as a reference for implementation and testing. Project execution

was managed through a Gantt chart that outlined major milestones, timelines, and responsibilities, enabling effective progress tracking and resource allocation. Collectively, these design artifacts provided a concise, user-centered blueprint that guided prototype development while ensuring accuracy, efficiency, and alignment with the project's educational goals.

Development

The Build Prototype phase focused on transforming Intellicode's finalized design specifications into a functional and interactive learning management system. Guided by the approved requirements and design artifacts, development followed a modular and iterative approach aligned with software engineering best practices. Emphasis was placed on maintainability, scalability, and security through structured coding standards, version control, and continuous testing. This phase resulted in a working prototype that integrated core LMS functionalities, including course management, programming assessments, AI-assisted grading, progress tracking, and certificate generation. Intellicode was implemented using a modern full-stack web architecture. The frontend was developed with Next.js and TypeScript to ensure responsive design, fast rendering, and an intuitive user interface, while the backend utilized NestJS to manage authentication, business logic, and data processing. PostgreSQL served as the primary database, integrated through Supabase to support secure and efficient data handling, with Prisma employed for schema validation and data consistency. To support programming activities, the Monaco Editor was embedded as a browser-based coding environment, and Gemini AI was integrated to automate code evaluation and feedback generation. Additional services such as SMTP for email verification and notifications, and PDFSHIFT for generating certificates and downloadable reports, enhanced system usability and communication.

The prototype implemented distinct, role-based portals for administrators, instructors, and students. Administrators were provided with centralized tools for user management, course approval workflows, system monitoring, and real-time analytics to support institutional oversight and quality assurance. Instructors were equipped with features to create and manage courses, organize content into modules and lessons, configure secure assessments, evaluate submissions using AI-assisted feedback, manage gradebooks, and issue or revoke certificates. Students interacted with a unified learning environment that enabled course enrollment via invitation links, access to structured learning materials, participation in

coding exercises and assessments through a secured browser, real-time progress tracking, and certificate downloads upon course completion.

Beyond core role-specific functions, advanced LMS capabilities were integrated to enhance instructional effectiveness and academic integrity. These included an embedded coding sandbox for hands-on practice, an AI-powered code checker to improve assessment consistency and efficiency, manual yet traceable certificate issuance to ensure credential accuracy, and a secured browser mechanism to prevent academic misconduct during examinations. By the end of the Build Prototype phase, Intellicode delivered a stable and feature-complete prototype ready for user testing and evaluation, providing a strong foundation for refinement and final deployment based on stakeholder feedback.

Testing

The Alpha and Beta testing phases were conducted to evaluate Intellicode's performance, usability, and security, guided by the ISO 25010 quality model. Key attributes assessed included Functional Suitability, Interaction Capability, Security, and Flexibility. During Alpha Testing, an internal evaluation was performed by the research team to verify that all system modules—including authentication, course management, coding assessments, AI-based evaluation, grading, analytics, and certificate issuance—operated correctly and efficiently. The team also assessed system responsiveness, data integrity, and adaptability across different user workflows, documenting and resolving any bugs or inconsistencies to ensure core stability and alignment with instructional objectives.

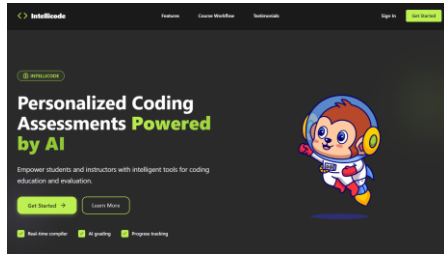
Following Alpha Testing, Beta Testing involved a broader group of users, including MIS personnel, instructors, and students, to gather real-world feedback under actual usage conditions. Evaluators assessed system usability, navigation, responsiveness, and security across academic operations such as course enrollment, content delivery, and coding submissions. Feedback from this phase informed refinements to the user interface, workflow efficiency, and overall reliability. The combined results of Alpha and Beta testing confirmed that Intellicode was functionally complete, secure, and user-friendly, demonstrating its readiness for deployment in an educational setting.

The Likert scale is a rating system that is used in questionnaires and is designed to measure respondent's attitudes, opinions, or perceptions. After the calculations, each mean score of each survey tool sub-criteria and criteria, the researcher used the Likert scale to interpret the result into its corresponding verbal interpretation.

Table 1
5-point Likert Scale

Response Categories	Numeric Value	Range / Interval	Verbal Interpretation
Strongly Agree	5	4.21 - 5.00	Excellent
Agree	4	3.41 - 4.20	Very Good
Neutral	3	2.61 - 3.40	Acceptable
Disagree	2	1.81 - 2.60	Marginal
Strongly Disagree	1	1.00 - 1.80	Poor

Figure 4
Intellicode Landing Page



Implementation

Intellicode (see Figure 4) is deployed and accessible via <https://intellicode-mcc.vercel.app/>, providing a secure platform for administrators, instructors, and students. It features OTP-secured access, course creation, an embedded coding environment, and verifiable certificate issuance. By supporting technology-enhanced learning, mastery-based progression, and formal recognition of achievement, Intellicode advances SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure), strengthening the institution's digital education capabilities.

RESULTS

Intellicode's alpha evaluation (see Table 2), grounded in the ISO/IEC 25010 quality model, yielded consistently *Excellent* results across the assessed criteria. Functional Suitability received the highest mean score of 4.88, with a verbal indication of *Excellent*, demonstrating strong alignment with the system's major features, including the complete set of functions that cover all specified tasks and support the intended users' objectives. This rating reflects that the system provides accurate outputs when used by its target users and that its functionalities effectively facilitate the accomplishment of required tasks and learning goals. In contrast, Security obtained the lowest mean score of 4.78, though still verbally interpreted as *Excellent*. This rating indicates that the system ensures data accessibility only to authorized users, protects the system and data from unauthorized modification or deletion

whether due to malicious actions or system errors and upholds the reliability of user identity verification. The slightly lower score was primarily attributed to the alpha testers' uncertainty regarding the system's resistance to potential penetration, as they are not cybersecurity specialists. While they believed the platform provides reliable verification methods to confirm user identity, they could not fully assess its robustness against sophisticated security threats. Aggregating these outcomes, Intellicode achieved an overall mean score of 4.82, interpreted as *Excellent*, signifying that the platform is technically sound and ready for subsequent testing phases with only minor refinements anticipated.

Table 2
Overall Evaluation Results - Alpha Test

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.88	Excellent
Interaction Capability	4.81	Excellent
Security	4.78	Excellent
Flexibility	4.81	Excellent
Overall Mean Score	4.82	Excellent

Table 3
Overall Evaluation Results - Beta Test

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.89	Excellent
Interaction Capability	4.84	Excellent
Security	4.88	Excellent
Flexibility	4.86	Excellent
Overall Mean Score	4.87	Excellent

In the ISO/IEC 25010-based beta evaluation (see Table 3), Intellicode sustained and strengthened its *Excellent* performance across all criteria, achieving an overall mean score of 4.87. Functional Suitability obtained the highest mean rating of 4.89, is rated with a verbal indication of *Excellent* with strong alignment with the system's features, and all beta testers agreed that this criterion was fully met. They affirmed that the Intellicode dashboards and core functional components provide accurate results when used by the intended users, demonstrating that the system effectively supports required tasks and aligns precisely with user objectives. Interaction Capability, while receiving the lowest score in the beta evaluation, remained verbally indicated as *Excellent* with strong alignment with the system's existing interaction features. All beta testers believed that the user interface presents

system functions and information in an inviting and motivating manner that encourages continued user engagement. However, they noted that there is still room for improvement in making the interface more visually dynamic and engaging to further elevate the overall user experience.

The increase in overall scores from the alpha to the beta phase especially in Security reflects the development team's direct compliance with recommendations provided by the alpha testers. Enhancements such as implementing OTP verification for instructor registration and password resetting significantly strengthened user authentication and contributed to higher confidence in the system's security measures. These improvements, aligned with ISO 25010 standards, positively influenced the evaluators' perception of system robustness. Collectively, the gains recorded during beta testing indicate that Intellicode has matured into a refined, stable, and deployment-ready platform suitable for broader academic adoption.

DISCUSSIONS

The findings of this study demonstrate that Intellicode effectively addresses the gaps in programming education at Mabalacat City College by providing a unified, secure, and user-centered LMS. The system's features, including in-browser coding exercises, AI-assisted evaluation, OTP-secured authentication, and automated certificate issuance, directly respond to stakeholder needs identified during the requirements analysis. High user acceptance and positive alpha and beta testing outcomes indicate that the system delivers strong functional performance, intuitive navigation, and reliable interaction quality, validating the design decisions guided by the prototyping model. Incremental improvements, such as the integration of OTP verification, significantly enhanced system reliability and security, highlighting the importance of iterative development in educational technology. Intellicode's implementation also aligns with broader educational and technological goals. By facilitating structured digital learning pathways and promoting skill mastery in programming, the system contributes to UN SDG 4 (Quality Education). Concurrently, the adoption of a scalable web architecture, secure digital processes, and AI-driven learning tools supports SDG 9 (Industry, Innovation, and Infrastructure), advancing institutional innovation and infrastructure development. These outcomes underscore the system's dual impact on improving instructional efficiency and fostering technological advancement in higher education.

Future considerations, such as integrating Microsoft account authentication, enhancing mobile responsiveness, and adding gamification or test bank modules, could further strengthen Intellicode's usability, engagement, and administrative efficiency. Such enhancements would not only expand functionality but also ensure sustainability and adaptability in evolving academic contexts. Overall, the study confirms that Intellicode represents an effective, innovative, and reliable solution for enhancing IT education, demonstrating measurable benefits in both learner engagement and institutional digital capability.

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IproTech: Microcontroller-Based Location Tracking with Temperature Alarm and Monitoring User Interface for Construction Workers

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ABSTRACT

Construction sites require timely hazard awareness and dependable incident response. This study developed IproTech, an IoT-based smart hardhat and web monitoring dashboard that integrates RFID time-in/out, SOS and summon signaling, fall/impact detection, heat monitoring, and GPS tracking to enhance worker safety and site oversight. The project followed a modified Waterfall Model of the SDLC, ensuring a systematic approach to requirements, design, implementation, and evaluation. Design artifacts (system architecture, block diagram, ERD, flowcharts, and Storyboard) guided the end-to-end integration of ESP32-based sensing with a Firebase-backed Next.js dashboard. The system was evaluated through alpha testing with four (4) IT experts and beta testing with thirty (30) site participants (laborers and engineers) from Polarr Azanje, Angeles City. Both phases used ISO/IEC 25010-aligned criteria emphasizing Functional Suitability, Performance Efficiency, Compatibility, and Reliability. Results indicate high performance and user acceptance: the alpha test achieved an overall mean of 4.92 (Excellent), while the combined beta cohort achieved an overall mean of 4.80 (Excellent). Qualitative feedback highlighted rapid alert propagation, clear dashboard visibility, and stable device-cloud behavior; recommended refinements included increased battery headroom, refined fall-threshold tuning, enhanced heat-status indicators, expanded logs, and lighter helmet materials. In conclusion, IproTech demonstrates a robust, user-centered, and field-ready safety solution that aligns with construction workflows, providing reliable real-time monitoring and actionable visibility for supervisors and teams.

Keywords: Internet of Things, Embedded Systems, Real-Time Safety Monitoring

INTRODUCTION

A safe and healthy workplace is important for both employees and employers because it supports overall well-being and productivity. When companies fail to provide proper safety measures, they expose their workers to unnecessary risks and possible harm. This lack of attention to safety not only puts employees in danger but can also create long-term problems for the organization itself. Among all the other industries, construction accidents are a leading cause of traumatic head injuries in the construction industry. This sector continues to encounter serious safety challenges worldwide. According to the International Labour Organization (ILO), construction accounts for approximately 200,000 fatal accidents; these alarming numbers are consistently ranking high in terms of workplace injuries and fatalities annually, placing it among the most dangerous industries. Reports say that construction is still

one of the most dangerous fields, along with agriculture, forestry, and manufacturing (ILO, 2023). Other factors include unsafe working conditions, exposure to extreme environments, communication lapses, and delays in emergency response. There's conventional safety that supported reducing disastrous accidents from risk scenarios in the workplace. Although the fact that modern construction is becoming more complicated shows how limited these methods are.

Based on recent studies, substantial construction-related research is driven by avoidable incidents such as lacking hazard risk awareness and neglect of monitoring. Almost instantaneous data for safety officer, engineer, foreman, and skilled worker. As a result of this, industries globally are embracing Internet of Things (IoT) technologies to strengthen occupational safety. Internet of Things (IoT) systems provide continuous monitoring of environmental conditions such as work location and temperature while also transmitting constant alerts to safety officers and teams

(Kuhar, Sharma, Hooda, & Verma, 2021; SREP, 2024). These innovations not only enhance environmental safety but also improve compliance with safety regulations and support data-driven decision-making, making construction operations more efficient and resilient.

Traditional building has rapidly expanded in the Philippines and is crucial to the country's development, stating that it is currently growing at an annual rate of 11.8% (Research and Markets, 2025). However, safety concerns plague this growth; in 2024, 2,309 injuries were reported in the sector (Team H., 2024). In Central Visayas nearly half of work-related incidents were in the construction sector (Ppiguero, 2025). Common incidents are falls, falling objects, extreme heat, improper use of equipment, and disorganized equipment after using it for work. Senate records show that contractors must be held responsible for workplace accidents involving their employees (Senate of the Philippines, 2023). The lack of enforcement of safety regulations and reliance on outdated monitoring practices further worsen risks. Advanced technology solutions are needed to solve these challenges, shown to improve workplace safety and accident prevention.

Angeles City in Pampanga is home to several construction companies that are competing for infrastructure projects (Dun & Bradstreet, 2024). While this competition drives economic activity, it also increases pressure on firms to meet fast deadlines, regularly at the expense of worker safety. Delays in sending response communication during emergencies, limited visibility of worker conditions, and lack of immediate hazard detection remain pressing concerns.

Addressing these challenges requires solutions that are not only advanced but also responsive to local conditions. While global Internet of Things (IoT) innovations provide new ways to improve safety, they must be adapted to fit the realities of the Philippine construction industry.

The IproTech Hardhat: Microcontroller-Based Portable Location Tracking System with Temperature Alarm and Monitoring Notification was developed to meet this need by offering a practical and affordable IoT-based approach.

The system was designed to monitor both worker safety and site conditions while also sending timely alerts and updates whenever hazards are detected. Through wireless data transfer, it provides foremen, engineers, and safety officers with the ability to respond more quickly and effectively during emergencies. More than just

protective equipment, the IproTech Hardhat marks a step forward in advancing a safer and more sustainable construction industry. By lowering risks and helping prevent accidents, it not only strengthens emergency response but also promotes safer practices across construction sites.

Objectives of the Study

To design, implement, and evaluate IproTech: Microcontroller-Based Location Tracking with Temperature Alarm and Monitoring User Interface for Construction Workers as an integrated, field-ready safety solution that enhances worker protection and site oversight. The system combines GPS for real-time location, RFID-Based worker Identification, temperature sensing for heat-risk detection, and visual/audible alerts (LED/buzzer) for hazard signaling, presented through a web-based monitoring interface. The study aligns its evaluation with ISO/IEC 25010—emphasizing functional suitability, performance efficiency, compatibility, and reliability—with particular focus on fault tolerance, data integrity, and readiness for broader deployment. The development process prioritizes robustness, adaptability, and user privacy to deliver a dependable solution that improves usability and overall user experience.

Specific Objectives

In line with this, this study aimed to achieve the following specific objectives:

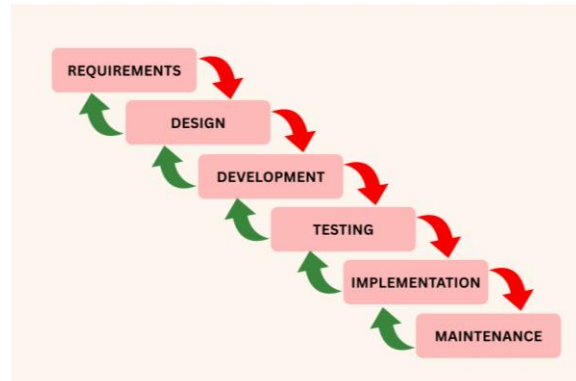
1. To gather information from existing users, related research articles, and previous capstone projects to evaluate how similar hardhat systems have performed.
2. To identify the specific hardware components and software tools necessary for developing the system.
3. To design the overall system, including diagrams that represent its structure and workflow.
4. To construct and configure the ESP32 microcontroller for application development.
5. To develop the system with the planned safety features such as GPS tracking, alerts, and monitoring functions.
6. To test the system through developer testing, followed by alpha and beta testing phases.
7. To assess the performance of the system using the ISO 25010 quality standards.
8. To deploy the finalized system in an actual or simulated construction site environment for pilot implementation,

user orientation, and refinement based on real-world feedback.

METHODOLOGY

This chapter described the research strategy and design for the IProTech Smart Hardhat. It featured an SOS warning system with a dedicated emergency button for rapid alerts to the safety officer/admin via the web dashboard. The device integrated a temperature-humidity sensor (DHT22), accelerometer and 3-axis gyroscope (IMU), vibration sensor (SW-420), buzzer, RGB LED module, OLED status display, GPS tracking module, and RFID for time-in/time-out. A 4010 cooling fan is also included and automatically activates when a high internal temperature is detected to protect the electronics. A Next.js/Firebase safety officer admin web app provided employee monitoring, attendance, live mapping, and alert management. This chapter also discussed the ethical issues considered and the actions taken to ensure that the study's findings are valid and accurate.

Figure 1
Modified Waterfall Method



The researchers made use of the modified waterfall model as the Software Development Life Cycle (SDLC) methodology to develop IProTech: Microcontroller-Based Location Tracking with Temperature Alarm And Monitoring User Interface For Construction Workers this section described the SDLC phases and analytical diagrams that were used for this project. SDLC phases include requirements gathering, system design, software and hardware implementation, system testing, deployment, and maintenance.

Requirements

To gain a better understanding of construction site safety and the perspectives of construction

workers and site managers, the process involved locating and conducting interviews with employees, supervisors, and safety officers in Angeles City, Pampanga. These interviews provided valuable insights into how construction projects are managed, the common safety challenges they face, their daily work routines, and feedback on tools that can address their needs. Thorough research was also carried out using credible online sources and information acquired from the interviews to validate the requirement evaluation. Discussions about the IProTech system were conducted face-to-face; the topics in these meetings ranged from improvements in features, hardware modules, and functionalities. Technical advisors and references from past capstone projects and related IoT-based safety systems provided further guidance. Task assignments were evenly distributed among the researchers, ensuring that responsibilities matched their technical strengths. These collaborations were important toward completing IProTech: A Microcontroller-Based Location Tracking with Temperature Alarm and Monitoring User Interface for Construction Workers.

Design

The researchers utilized design tools in the design phase to illustrate the system's functionality effectively. The storyboard was developed to represent frames or panels that illustrate the interaction flow of the IProTech application and the smart hardhat. Each panel represented a step, mapping out how the user interacts with the system to optimize the interface and reflect expected user behavior.

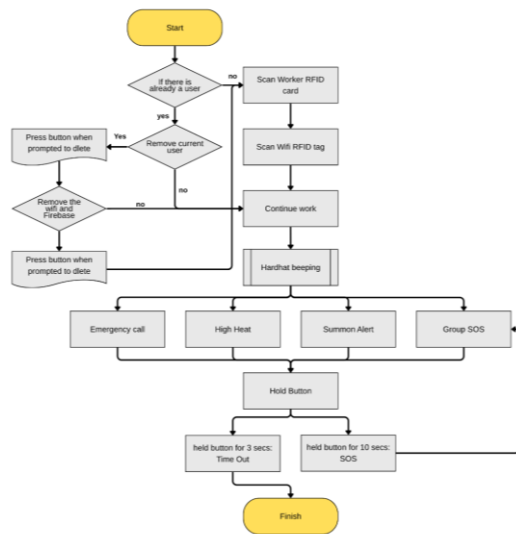
The system architecture diagram illustrated the layered structure of IProTech, showing how worker devices transmit data through the ESP32 and sensors to the real-time database, where the web dashboard accesses and processes it.

The entity-relationship diagram (ERD) mapped out the data relationships between entities in the system, such as Workers, Alerts, Notifications, Attendance Logs, and Device Status. It clarified the database structure supporting the monitoring dashboard and mobile interface, ensuring consistent and reliable data handling.

The storyboard illustrated the user interaction and screen flow of IProTech's safety monitoring. It detailed sequences such as time-in/time-out, heat and fall notifications, SOS button workflows, and alert acknowledgment on the dashboard, ensuring the application's screens and prompts followed an optimized sequence for construction site safety.

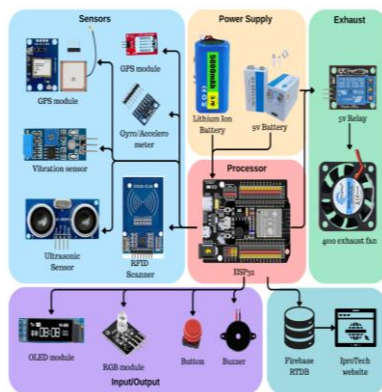
The flowchart illustrated the logic and process flow of IProTech's safety monitoring. It detailed conditional paths such as heat detection, fall alerts, and emergency button sequences, ensuring the application's functions followed an optimized sequence for construction site safety.

Figure 2
Iprotech Flowchart Diagram



The block diagram outlined the overall architecture of the IProTech system, showing the interaction between major hardware and software components such as the ESP32 microcontroller, GPS module, DHT sensor, vibration module, buzzer, and monitoring interface. This diagram provided clarity on how components integrate and how safety data flows across the system.

Figure 3
Iprotech Block Diagram



The Visual Table of Contents (VTOC) served as a structured map that aligned user requirements with system functions, modules, and specific hardware or software elements. It provided a top-down view of how each requirement was fulfilled through technical implementation, ensuring that every part of IProTech traced back to a defined user goal. This ensured transparency, consistency, and completeness throughout the design process.

Finally, The Gantt chart presented the timeline of the IProTech project, including research, design, acquisition of hardware, prototype development, system testing, and deployment. It provided a clear structure for managing tasks and meeting milestones on schedule.

Development

The development phase is an important part of the design and implementation of IProTech: A Microcontroller-Based Location Tracking with Temperature Alarm and Monitoring User Interface for Construction Workers, while ensuring alignment with ISO/IEC 25010 quality views (Functional Suitability, Performance Efficiency, Compatibility, and Reliability). The researchers use both hardware and software tools as key resources to support proper design, implementation, and verification of the system.

As the development phase progresses, the researchers acquire and assemble the hardware components for the smart hardhat. The finalized bill of materials includes an ESP32 (30-pin) with an IProTech Shield, RFID for time-in/time-out, NEO-6M GPS, DHT22 for temperature (optional humidity), SW-420 vibration sensor (with optional IMU), RGB LED indicators, SFM-27 buzzer, a 0.91" OLED display, a 4010 exhaust fan (relay/MOSFET-controlled for component cooling on high heat), and a USB Type-C charging/power module. Mechanical fixtures and wiring harnesses are prepared to withstand vibration, dust, and heat typical of construction sites.

The development phase for the software involves using an application framework compatible with the chosen microcontroller and the monitoring needs of safety officers. Firmware is authored for the ESP32 using the Arduino IDE, implementing non-blocking sensor polling, debounced event logic (SOS, fall/impact, heat), automatic fan control tied to DHT22 thresholds, offline buffering with idempotent replay, and Wi-Fi reconnection routines. The monitoring interface is built with Next.js (instead of plain React) and integrates Firebase Realtime Database and Firebase Authentication. The web app is usable on any device with internet access and provides role-based views, Leaflet mapping for real-time

GPS, alert feeds, attendance/session logs, and acknowledgment workflows.

The software and hardware are seamlessly integrated within the smart hardware and the monitoring interface. A fast, secure connection—using Wi-Fi with authenticated access to Firebase—links the device and dashboard for notifications, data display, and control. Security rules, serverless API routes, and SSR/ISR in Next.js help ensure responsive loading, correct authorization, and predictable data handling.

The researchers then ensure that all components—including GPS, DHT22, vibration/IMU, RFID, LEDs/buzzer, OLED, and the 4010 fan—operate as intended. Any errors or problems (e.g., false positives from vibration, heat sensor bias, or reconnect edge cases) are logged, analyzed, and resolved during development through threshold tuning, hysteresis/debouncing, sensor placement adjustments, and firmware refinements.

To identify and assess functionality issues in the system or hardware, different tests are carried out. Bench tests verify sensor accuracy, end-to-end latency (event→dashboard), battery endurance, and recovery after Wi-Fi or power loss; field scenarios exercise SOS, fall/impact triggers, heat alerts with automatic fan actuation, RFID attendance, and mapping/acknowledgment flows. In addition, ISO/IEC 25010-aligned evaluations are used to surface unknown or unaccounted-for issues under realistic conditions.

Once the researchers successfully test, identify problems, and resolve issues, proper documentation—including wiring diagrams, firmware versions, configuration profiles, API schemas, security rules, and test scripts—serves as a valuable resource for subsequent phases, future maintenance, and reproducibility of the IProTech system.

Testing

After the development of the IProTech system was completed, it underwent both alpha and beta testing. This stage evaluated the system's overall functionality, accuracy, and performance. During the testing phase, the validity of the questionnaires was also assessed to ensure reliable data collection. The methods for gathering, evaluating, and processing the data, along with the sampling techniques and devices used, were clearly described.

To verify that the results of the study were unbiased and unaffected by the researchers, the respondents, or the evaluation setting, the ISO 25010 questionnaire underwent validity testing.

Implementation:

The deployment phase described in this study

formed part of the actual implementation of IProTech: A Microcontroller-Based Location Tracking with Temperature Alarm and Monitoring User Interface for Construction Workers. After the system was fully developed, it was deployed at a construction site in Pampanga to assess whether it met its intended objectives, particularly in terms of functionality, usability, reliability, and adherence to software quality standards such as those outlined in ISO/IEC 25010.

The implemented IProTech system included real-time location tracking via a GPS module; temperature (and optional humidity) monitoring for heat-stress detection using the DHT22; vibration/impact sensing (with an IMU) for fall alerts; and a responsive web dashboard (Next.js + Firebase, mobile-friendly) for centralized monitoring, notifications, and RFID-based attendance. Additional on-helmet features included an SOS/summon button for rapid escalation, RGB LEDs for role/status indication, a buzzer for audible cues, an OLED for on-device feedback, and an automatically controlled 4010 fan to cool internal electronics during high-temperature conditions.

During deployment, selected construction workers, foremen, engineers, and safety officers used the system in a real-world setting, allowing the researchers to gather feedback and evaluate performance (e.g., alert latency, GPS accuracy, usability, and endurance). This pilot phase was essential for identifying adjustments to thresholds, user interface elements, and power management before considering any broader or long-term implementation.

Maintenance

After system implementation, the maintenance phase was carried out as a planned component to ensure the continuous functionality and reliability of the IProTech system. A comprehensive maintenance strategy was established, which included scheduled inspections of both hardware and software components to detect and address potential issues before they affected system performance.

The maintenance plan involved routine system diagnostics, firmware and software updates, and preventive measures to reduce the likelihood of malfunctions. Particular attention was given to critical features such as the GPS module, DHT sensor, vibration detection system, and notification controls within the monitoring dashboard to ensure they remained operational and up to date. An administrative monitoring interface supported the identification and resolution of technical issues in real time,

promoting efficient system management and data integrity.

Although the maintenance activities followed deployment, their prior inclusion in the project design reflected the researchers' foresight and commitment to ensuring long-term system sustainability, safety, and user satisfaction.

RESULTS

This section presents the findings from the implementation and evaluation of the IproTech system. The results show how the smart hardhat and monitoring dashboard addressed the project's aims of improving worker safety through real-time tracking, hazard alerts, and responsive site oversight. Data from system testing, participant feedback, and feature validation are analyzed against the research questions. The discussion connects these findings to related work on IoT safety wearables and construction-site risk management, underscoring IproTech's contributions to incident prevention, safety visibility, and practical digital innovation in construction settings.

Table 1
Overall Evaluation Results - Alpha and Beta
(Combined Laborers + Engineers)

ISO 25010 Criteria	Verbal Interpretation (Alpha)	Mean Score (Alpha)	Verbal Interpretation (Beta – Combined)	Mean Score (Beta – Combined)
Functional Suitability	Excellent	4.84	Excellent	4.82
Compatibility	Excellent	5.00	Excellent	4.81
Performance Efficiency	Excellent	5.00	Excellent	4.78
Reliability	Excellent	4.88	Excellent	4.79
Overall Mean Score	Excellent	4.92	Excellent	4.80

Testing Results

The Alpha and Beta testing stages were important parts of evaluating the IproTech system. During the Alpha test, the researchers carefully checked the administrator dashboard and device-cloud features using ISO/IEC 25010-aligned criteria focused on Functional Suitability, Compatibility, Performance Efficiency, and Reliability. The Beta test involved a wider group of participant testers and end users and domain experts and likewise centered on Functional Suitability, Compatibility, Performance Efficiency, and Reliability. Together, these activities provided a clear picture of how the system works in practice, how stable and responsive it is under typical operating

conditions, and the overall user experience—supporting the detailed analysis in the next sections.

The detailed evaluation results from both the Alpha test (IT experts) and the Beta tests (Laborers and Engineers) are consolidated below. All cohorts yielded Excellent ratings on the ISO/IEC 25010 criteria applied to IproTech.

The Alpha test—conducted with IT professionals in controlled conditions—registered very high marks, confirming architectural soundness and implementation quality. The laborer and engineer Beta tests reproduced these outcomes under realistic job-site use, sustaining Excellent ratings in every category. Minor refinements identified (battery headroom, fall-threshold tuning, heat-status clarity, and expanded logging) are already feasible within the current hardware/firmware and dashboard configuration. Collectively, these results affirm that IproTech meets its core safety and monitoring objectives and is ready for broader field deployment.

Meanwhile in the beta test, The platform delivered outstanding results during the laborer beta test, achieving an overall average rating of 4.79, classified as “Excellent.” Scores reflected the system's complete and dependable core functions—including heat monitoring, fall and impact detection, time-in/out, and location tracking—along with responsive dashboard updates, stable device-cloud synchronization, and consistent operation with proper recovery after temporary interruptions. These findings demonstrate that IproTech's design and workflows are well-aligned with day-to-day laborer needs under realistic site conditions. Engineers likewise rated IproTech as Excellent across all criteria. Perfect Compatibility scores (5.00) highlighted stable operation with multiple hard hats and other wireless equipment on-site, while high ratings for Reliability (4.85) and Performance Efficiency (4.84) confirmed timely alerts, rapid SOS response, and smooth dashboard updates even under intermittent connectivity. Functional Suitability (4.72) also remained strong, with feedback identifying minor refinements—such as adjusting fall-event thresholds and improving heat-status clarity—that are fully achievable within the existing firmware and UI framework. Engineers' technical observations emphasized the most-valued hardhat features (SOS, summon, temperature alarms) and dashboard capabilities (attendance/time-in/out, GPS/site-wide view, SOS monitoring). No blocking issues were encountered. Suggested enhancements included more comprehensive logs for post-incident

analysis, lighter helmet materials for greater comfort, and explicit “high-heat” status indicators on the dashboard to support proactive safety interventions.

DISCUSSION

A systematic design approach—using system architecture, block diagrams, ERD, flowcharts, storyboards, a visual table of contents, and a Gantt chart—guided the translation of field requirements into implementable features. On the device side, firmware integrates sensor polling, button/alert logic, and robust reconnection routines. On the cloud and dashboard side, Firebase Authentication, Realtime Database, and Hosting enabled secure role-based access, low-latency data updates, and reliable deployment. The dashboard presented live maps, alert feeds, logs, and role-aware views for supervisors.

Conclusion

Based on the findings, the researchers conclude that the project successfully met all of its specific objectives. IproTech demonstrated reliable performance across its core functions, including RFID time-in/out, SOS and summon features, fall and impact detection, heat monitoring, and GPS location tracking. The dashboard effectively displayed worker identity, status, and alerts, and the system achieved high functional suitability during both alpha and beta testing, indicating strong alignment with real-world construction-site workflows. Performance results were likewise excellent, with field users noting timely alert delivery and responsive dashboard updates under typical network conditions. The ESP32 microcontroller managed concurrent tasks smoothly, validating the project’s emphasis on real-time behavior. Compatibility ratings were also excellent, as the system operated without interference alongside existing site wireless equipment and supported multiple hard hats simultaneously. Its data model and API payloads proved flexible enough to accommodate diverse user roles and team structures. Reliability testing further confirmed IproTech’s robustness, with excellent scores reflecting its stable operation and ability to automatically recover after temporary Wi-Fi or power interruptions while maintaining accurate data synchronization. Instances of duplicate or missing entries were minimal and linked to rare edge conditions that can be resolved through debouncing and idempotency improvements. The project’s strong outcomes can also be attributed to its methodical engineering process, which employed architecture diagrams, block diagrams, ERD, flowcharts, storyboards, and a detailed Gantt chart to guide development. The

chosen hardware and software stack—ESP32, Firebase, and Next.js/React—proved well suited for a low-latency, field-deployable safety system. With excellent overall ratings in both alpha and combined beta testing, IproTech demonstrates clear readiness for continued field use. The few recommended improvements are incremental and feasible within the current system architecture, involving targeted firmware refinements, interface updates, and minor hardware enhancements. Overall, the results validate IproTech as a robust, user-centered, and scalable safety and monitoring solution that effectively addresses critical construction-site needs while remaining practical for student-led implementation and future expansion.

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I-TUNGKOD”: A Smart Assistive Cane with Ultrasonic Proximity Sensing, GPS Tracking, and Emergency Communication Features

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ABSTRACT

The study entitled “I-TUNGKOD: A Smart Assistive Cane with Ultrasonic Proximity Sensing, GPS Tracking, and Emergency Communication Features” aims to provide a technological solution to enhance the mobility and safety of visually impaired individuals. The system integrates ultrasonic sensors for obstacle detection, a water sensor for wet surfaces, a HuskyLens for object recognition, and a GPS module paired with a SIM800L GSM module for real-time location tracking and emergency communication. Using an ESP8266 as the central controller, the cane provides timely alerts to the user through a buzzer, ensuring safe navigation in various environments. The evaluation of the system was conducted using ISO 25010 standards across functional suitability, compatibility, usability, and portability. Results from the alpha and beta testing phases showed that the system performs its intended functions reliably, with particularly high scores in functional suitability, compatibility, and portability. Usability was rated positively but identified as an area for improvement, suggesting enhancements in feedback mechanisms and sensor prioritization. Overall, the findings indicate that the I-TUNGKOD smart cane is an effective assistive device that promotes independence, safety, and confidence among visually impaired users. Recommendations include optimizing sensor integration, improving user interaction, and expanding GPS features to further enhance the system’s functionality and reliability.

Keywords: Internet of Things, Smart Cane, Embedded System, Mobile Application

INTRODUCTION

Visual impairment presents significant challenges that can make daily life and navigation more difficult. Individuals with total blindness or low vision often encounter difficulties in mobility, balance, and environmental awareness, which are further compounded by the lack of accessible infrastructure. These challenges place visually impaired individuals at a higher risk of accidents and falls, affecting their ability to move independently in both indoor and outdoor environments. Beyond physical safety, vision loss may also lead to social isolation, reduced well-being, and increased dependence on family members or caregivers for daily activities.

Many visually impaired individuals rely on assistive devices such as white canes, Braille tools, and electronic travel aids to support their mobility. However, access to advanced assistive technologies remains limited. According to the World Health Organization, a large portion of the visually impaired population lacks access to appropriate assistive devices due to high costs and limited availability. This gap between need and access highlights the importance of

developing affordable and accessible smart assistive devices that can improve autonomy and safety.

Vision impairment is a major global public health concern, with at least 2.2 billion people worldwide experiencing near or distance vision impairment. Alarming, around 1 billion of these cases could have been prevented or remain unaddressed, reflecting significant gaps in access to eye care services. Many individuals, especially in resource-limited settings, face daily challenges related to mobility, independence, and safety. A smart assistive device such as I-TUNGKOD, which can detect obstacles, track location, and send emergency alerts, can provide essential support and help reduce the real-world impact of vision loss.

The Philippines is experiencing rapid growth in smartphone usage, reflecting global trends toward increased digital connectivity. This growing familiarity with technology among Filipinos presents an opportunity to integrate assistive devices with mobile capabilities. However, visually impaired Filipinos still face significant barriers in accessing assistive devices due to cost and limited availability. Although PhilHealth’s initiative to cover prescription glasses, crutches, canes, and wheelchairs starting in January 2025 marks progress, a

substantial gap between accessibility and demand remains. This situation emphasizes the need for more advanced and affordable mobility support systems for visually impaired individuals.

Local initiatives have also attempted to address accessibility challenges. For instance, on March 13, 2025, Mabalacat City, led by Mayor Cris Garbo, provided financial assistance to 175 persons with disabilities to help them acquire essential assistive devices. While such efforts are commendable, visually impaired individuals continue to face mobility limitations due to the lack of innovative and technologically enhanced support tools.

Traditional canes, although widely used, provide limited functionality and lack advanced safety features that could significantly enhance user independence and security. To address these pressing needs, this study introduces "I-TUNGKOD: A Smart Cane with Ultrasonic Proximity Sensing, GPS Tracking, and Emergency Communication Features." This smart assistive cane integrates ultrasonic sensors for obstacle detection, GPS technology for real-time location tracking, and a one-button emergency alert system for immediate assistance. By combining these technologies with mobile connectivity, I-TUNGKOD aims to help visually impaired individuals navigate their environment more safely, reduce the risk of accidents, and maintain independence. Furthermore, it provides reassurance to caregivers by enabling faster emergency response and location monitoring.

This research aligns with several United Nations Sustainable Development Goals (SDGs), which provide a global framework for promoting inclusivity and sustainable development.

The study particularly supports SDG 3: Good Health and Well-being by enhancing mobility safety and reducing accident-related risks among visually impaired individuals. Through the development of the I-TUNGKOD smart assistive cane, equipped with ultrasonic sensors, GPS tracking, and emergency communication features, the system aims to improve user safety, promote independence, and support overall well-being.

Furthermore, this study contributes to SDG 9: Industry, Innovation, and Infrastructure by demonstrating how technological innovation can be applied to address real-world accessibility challenges. The integration of smart technologies into traditional mobility aids reflects the importance of developing inclusive and adaptive infrastructure for vulnerable populations.

In addition, the study supports SDG 4: Quality Education by encouraging research-based learning and innovation in assistive technology. The development of the I-TUNGKOD system provides valuable insights and learning opportunities for students, researchers, and future developers in the field of intelligent assistive devices, helping to build capacity for continued technological advancement.

Objectives of the Study

This study aims to develop and implement an advanced IoT-enabled assistive device called "I-TUNGKOD: A Smart Cane with Multi-Sensor Detection, Object Recognition, and Emergency Communication Features" to enhance mobility, safety, and independence for elderly users in the Philippines. The system will be built using an ESP8266 as the main processing unit and will feature a dedicated mobile application developed using Flutter for cross-platform compatibility and optimal user experience.

Specific objectives include:

- To gather information through internet and library research, interviews, academic journals, government sites, and published news articles.
- To identify hardware and software developmental requirements.
- To design the system using diagrams and analysis tools.
- To create a microcontroller-based IoT Smart Cane prototype.
- To connect to a mobile phone.
- To develop and interconnect hardware prototype and mobile application.
- To test the developed Smart Cane Prototype and System.
- To evaluate the developed IoT system using the ISO25010 Model in terms of Functional Suitability, Performance Efficiency, Interaction Capability, and Flexibility.
- To deploy the developed IoT Smart Cane System.

Scope and Limitations

This study aims to develop and implement "I-TUNGKOD: A Smart Cane with Multi-Sensor Detection, Object Recognition, and Emergency Communication Features." The research encompasses comprehensive data collection through library research, academic journals, and online scholarly sources to establish a solid foundation for developing the advanced assistive device. Information gathered from credible academic publications, government databases, and consultations with technical advisers ensures that the system development is

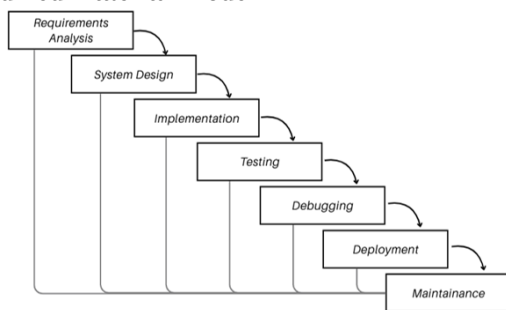
grounded in current technological capabilities and best practices in assistive technology. Much of the literature and secondary data focused on localized Philippine contexts, which, while valuable, may limit the global generalizability of the findings. Identifying the hardware and software requirements allowed the researchers to specify components and technologies suitable for developing the prototype. However, the process was influenced by resource and availability constraints. Certain advanced or commercial-grade hardware was not accessible during development, and software configurations had to be simplified.

METHODOLOGY

This section details the methodology and design employed in the development of the I-TUNGKOD smart assistive cane. It outlines the Software Development Life Cycle (SDLC) method utilized, the analysis diagrams, and the research instruments used to collect data for the development of both the Smart Assistive Cane prototype and its accompanying mobile application.

The Modified Waterfall Model was selected for the development of the Smart Assistive Cane prototype and mobile application. This model provides a systematic flow of development processes, incorporating flexible, iterative phases that ensure comprehensive documentation and design evaluations. This approach was chosen to guarantee the quality, consistency, and maintainability of the IoT system and mobile application.

Figure 1
Modified Waterfall Model



Requirement Analysis

During the requirement analysis phase, the developers gathered information pertinent to the proposed Smart Assistive Cane IoT prototype. This involved extensive internet and library research to generate ideas for the capstone project. Sources included online libraries, published research journals, government

websites, reputable non-governmental organizations, books, and discussions with a technical advisor. This thorough research method, utilizing an array of reliable sources, ensured that prototype development was based on current technological capabilities, met its requirements, and considered specific user needs.

Specific tasks were allocated, ideas distributed, and activity calendars set up to ensure the smooth and effective execution of the capstone project. The development team roles were divided based on skills, specializations, and interests to optimize collaboration and workload distribution. For instance, one researcher focused on literature reviews, while another designed the research methodology and data collection tools.

Others were responsible for data analysis, project documentation, and logical flow analysis of diagrams. This division of duties facilitated effective collaboration, reduced individual workload, and ensured accuracy and timely completion of each task.

The Smart Assistive Cane prototype was constructed using a variety of hardware and software techniques. The development environment included a laptop with 24 gigabytes of RAM, an i5 processor, and Windows 11. The back-end code was compiled using C++ and Python programming, and uploaded to the Arduino board using the Arduino IDE and Visual Studio Code. Key components identified for the prototype included the NEO-6M GPS Module, ESP32, Arduino IDE, GitHub for version control, and Canva for visual design. These components were chosen to ensure effective system development and operation. The ESP8266 microcontroller facilitated connectivity and data transfer, while the GPS module was used for location tracking and real-time monitoring via a mobile application. The microcontroller and its sensors were programmed using the Arduino IDE, and Visual Studio Code served as a version control system for team collaboration.

System Design

In the system design phase, various design tools were utilized to illustrate the functionality of the IoT system. The prototype and mobile application design were developed using a system architecture diagram (see Figure 2), storyboard, block diagram (see Figure 3), and Gantt chart. The system architecture diagram was instrumental in mapping out the relationships among system components, visualizing workflows, user interactions, and hardware integration, thereby ensuring a

systematic approach to system development. A block diagram detailed the electronic parts and connections of the system. The storyboard included panels or frames depicting the mobile application's flow and user experience. A Gantt chart was used to estimate task durations and track progress, ensuring timely completion.

The system's operational process begins with system boot, initializing hardware and software components. Upon activation, the system checks for user input. If input is provided (e.g., pressing a button), the system processes the command, applies feature toggles, and updates settings. Subsequently, or if no input is given, the system enters continuous monitoring, performing sensor scans and collecting environmental data. The collected data is processed by an AI module for obstacle or threat recognition. If a potential hazard is identified, an alert is generated and delivered to the user via multi-modal feedback (haptic vibration, audio signals, or app notifications). If no threat is detected, the system proceeds with location updates, sending real-time positional information to the mobile application for caregivers and emergency contacts.

This continuous loop ensures constant scanning, processing, and appropriate response to user commands or environmental changes, maintaining user safety and situational awareness.

Figure 2
Architecture Diagram

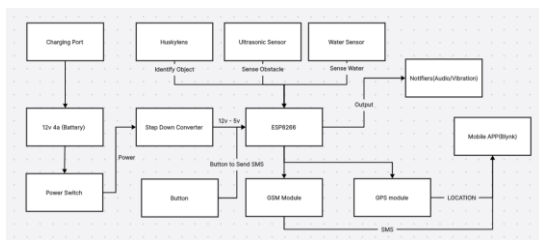
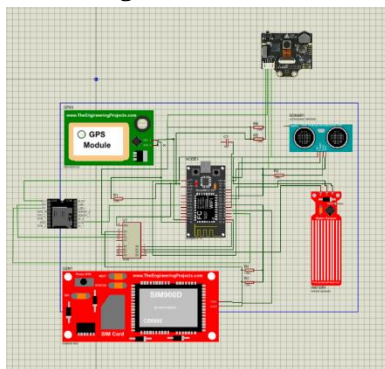


Figure 3
Block Diagram



Implementation

The implementation phase focused on translating the logical design into an operational prototype. The "I-TUNGKOD" Smart Assistive Cane was developed by integrating hardware and software components to ensure effective functionality under real-world conditions.

One major feature implemented was the ultrasonic proximity sensing system, designed to detect obstacles within a 5–10-meter range. Ultrasonic sensors connected to the ESP8266 microcontroller provided real-time distance measurements, activating a buzzer or vibration motor upon obstacle detection. Previous research has demonstrated the effectiveness of ultrasonic sensors in assistive devices, significantly improving safety and mobility for elderly individuals.

The GPS tracking feature utilized the NEO-6M GPS module, providing real-time location data transmitted to the caregiver's smartphone via the Blynk mobile application. The application displayed the user's location on a live map, along with supplementary details such as speed, direction, and satellite connectivity. The integration of GPS in assistive technologies is crucial for remote monitoring and prompt emergency response.

An emergency communication system was also incorporated, featuring a dedicated button that, when pressed, automatically transmitted a distress message with the user's location to a predefined contact. This safety feature enhances emergency response times and provides reassurance for users and caregivers.

Hardware and mobile application integration were achieved through Wi-Fi communication. The ESP8266 was programmed via the Arduino IDE to manage sensor data and trigger appropriate responses. Real-time data were transmitted to the Blynk application over the internet, enabling continuous monitoring of the user.

To ensure reliability, each system component underwent unit testing to verify individual functionality, followed by integration testing to confirm seamless communication between hardware and software. Adopting a structured implementation and testing approach under the Modified Waterfall SDLC model promotes system quality and functionality in assistive technologies.

By the conclusion of this phase, a fully operational prototype of the "I-TUNGKOD" Smart Assistive Cane was developed, ready for evaluation.

Testing

In this phase, the system was modified based on recommendations from the panel and technical/capstone advisers. The entire study was evaluated to ensure the system met its requirements. Opinions and proposals from the panels were examined and incorporated to improve the developed system.

A survey tool, created and anchored with the ISO25010 Software Product Quality Standard criteria, was used for alpha and beta testing to identify and fix bugs or issues. The survey questionnaire (see Appendix X in original document) was designed to assess the quality of the constructed system based on ISO25010 model's functional appropriateness, interaction capability, security, and flexibility.

The ISO25010 questionnaire underwent validity testing to ensure impartiality. Pre-testing procedures included seeking expert advice from Dennis L. Tacadena, DIT (Capstone Instructor) and Ritchell Z. Escoto, MIT. The tests were assessed for alignment with criteria sub-criteria, and test results were correlated with ISO 25010 criteria. The constructed questionnaire was evaluated, and scores were correlated with the test using sampling method, frequency distribution, mean scores, and Likert Scale.

Sampling Method

Purposive sampling, a non-probability sampling technique, was employed to select participants based on specific characteristics relevant to the study's objectives. This method is suitable for research targeting individuals who can provide meaningful and expert feedback on the system.

For the alpha testing phase, three Information Technology (IT) professionals were purposively chosen to assess the technical performance of the "I-TUNGKOD" smart assistive cane, focusing on functionality, security, and user interface. For the beta testing phase, at least thirty (30) visually impaired target users and their caregivers from Mabalacat City were selected. These respondents, directly affected by mobility limitations, offered valuable insights on usability, practicality, and user satisfaction. This sampling technique ensured that the evaluation was based on informed perspectives from users and professionals with relevant experiences, aligning with usability testing and iterative design improvement. Purposive sampling is also time-efficient and cost-effective, particularly in developmental research where specific feedback from target users is more critical than generalization to a wider population.

All participants were thoroughly briefed on the study's objectives, procedures, and potential risks. They were assured of voluntary

involvement and the freedom to decline participation or withhold personal information. The research team emphasized that all data collected would be used solely for academic purposes and handled with strict confidentiality, in full compliance with the Data Privacy Act of 2012. The formal administration of the questionnaire took place in Mabalacat City from October 6 to October 27, 2025. Respondents received a simple orientation explaining the evaluation's purpose and clear instructions on completing the checklist.

Debugging

The I-Tungkod device is envisioned as an assistive technology prototype intended for individuals who are blind, visually impaired. While the project is still at the planning and conceptual stage, its deployment strategy has been designed based on anticipated features and insights from related technologies. Initial deployment is projected to begin with small-scale pilot testing in collaboration with barangays and visually impaired associations. Prior to this, prototype testing and debugging would ensure that critical components such as ultrasonic sensors, vibration motors, and buzzers perform as expected.

Deployment

During deployment, participants would be provided with orientation sessions and user manuals to guide them in operating the device. Feedback from this phase would serve as the basis for further refinements.

Additionally, even though I-Tungkod is hardware-based, the development team plans to make its Arduino code, wiring diagrams, and user documentation publicly available through platforms like GitHub. This open-access approach fosters transparency and encourages other developers or academic institutions to replicate or improve the project in the future.

Maintenance

Though still at the conceptual stage, maintenance strategies for I-Tungkod have been outlined as part of future planning. Preventive maintenance is envisioned to involve quarterly inspections of hardware components such as sensors, battery packs, and wiring integrity to prevent malfunctions and ensure device safety. Corrective maintenance would allow users to report malfunctions, after which repairs or component replacements would be carried out promptly.

To ensure continuity and traceability, a digital maintenance log is recommended to record inspection results, repairs, and part replacements. Furthermore, the publication of technical resources, including source codes and

schematics, would ensure that future teams can maintain, update, or enhance the device, thus extending its lifecycle and usability.

Figure 4
Prototype test



Table 2
Overall ISO 25010 Evaluation Results

ISO 25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.30	Very great extent
Compatibility	4.47	Very great extent
Usability	4.25	Very great extent
Portability	4.21	Very great extent
Overall Mean Score	4.12	Very great extent

RESULTS

This section presents the results and outcomes of the study, aligned with its objectives. It includes the analysis and interpretation of the alpha and beta testing conducted on the developed application prototype. All data were carefully computed and analyzed, and the findings are presented in a clear, organized, and understandable manner.

Requirement Gathering and Analysis

The researchers gathered all necessary information for the Smart Assistive Cane IoT prototype through extensive online and library research. Reliable sources included online libraries, published research journals, government websites, non-governmental organizations, and books. Consultations with a technical advisor also contributed to this phase. The thorough evaluation findings for the Hardware System Alpha and Beta tests, focusing on the relevant ISO 25010 standards, are displayed in Appendix H and I (in the original document). Functional Suitability scores were high for both phases, with the alpha test receiving a score of 4.34, while the beta score was 4.25, indicating exceptional functionality.

Compatibility showed strong results in both tests; the alpha phase scored 4.3, while the beta phase was 4.64, giving the beta phase the highest mean score. Usability maintained great extent scores, with the alpha phase at 4.2 and the beta phase at 4.03. Portability exhibited notable improvement, increasing from 4.32 in the alpha test to 4.10 in the beta test. The overall mean score increased from 4.29 in the alpha test to 4.25 in the beta test, both of which can be verbally interpreted as "Excellent," showcasing the platform's continuous improvement and adherence to ISO 25010 standards.

Table 3
Alpha Test Results (ISO 25010 Criteria)

ISO 25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.34	Very great extent
Compatibility	4.3	Very great extent
Usability	4.2	Very great extent
Portability	4.32	Very great extent
Overall Mean Score	4.29	Very great extent

Table 4
Beta Test Results (ISO 25010 Criteria)

ISO 25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.25	Very great extent
Compatibility	4.64	Very great extent
Usability	4.03	Very great extent
Portability	4.10	Very great extent
Overall Mean Score	4.25	Very great extent

Deployment and Maintenance

The I-Tungkod device is being developed as a smart assistive technology prototype, designed to support individuals who are blind, visually impaired, or elderly. The project has a clear vision for deployment, drawing inspiration from similar technologies and anticipating the unique needs of its future users. The initial rollout is expected to begin with small-scale pilot testing, in close collaboration with local barangays and visually impaired associations. This approach ensures that the device is introduced within trusted community settings, allowing for meaningful feedback and real-world insights.

To maintain the device's safety and reliability, preventive maintenance will be scheduled quarterly, focusing on key hardware components like sensors, battery packs, and wiring. Corrective maintenance procedures will be in place for reporting malfunctions, enabling prompt repairs or part replacements. A digital maintenance log is recommended for long-term sustainability, serving as a record of inspections,

repairs, and component updates, ensuring transparency and continuity across maintenance cycles. Additionally, publishing technical resources such as source codes and schematic diagrams will enable future developers and technical teams to maintain, improve, or expand the device's capabilities, extending the I-Tungkod's lifecycle and reinforcing its role as a community-driven innovation.

This study aligns with several Sustainable Development Goals (SDGs), notably SDG 3: Good Health and Well-being, by aiming to improve mobility safety and promote independence among elderly users. It also supported SDG 4: Quality Education through efforts to enhance technological literacy and raise awareness about assistive innovations, fostering inclusive learning environments. Furthermore, the study contributed to SDG 9: Industry, Innovation, and Infrastructure by emphasizing the importance of research and technological advancement in addressing healthcare challenges and promoting inclusive development.

DISCUSSION

This section concludes the study by reflecting on the results gathered from testing the IoT prototype and mobile application. It also shares the developers' personal insights and practical suggestions for refining the system, offering future researchers a thoughtful starting point for further work.

Summary of Findings

The development and evaluation of the I-TUNGKOD: A Smart Assistive Cane with Ultrasonic Proximity Sensing, GPS Tracking, and Emergency Communication Features revealed that the system is highly effective in assisting visually impaired users. Evaluation was conducted using ISO 25010 standards during both the alpha and beta testing phases, focusing on functional suitability, compatibility, usability, and portability. The results demonstrated that the cane performs its intended functions reliably, with functional suitability scoring 4.34 in the alpha test and 4.25 in the beta test. This indicates that the system consistently provides timely and accurate alerts for obstacles, water hazards, and objects detected by the HuskyLens, while the GPS and SIM800L modules ensure effective emergency communication.

In terms of compatibility, the system scored 4.20 during the alpha phase and 4.03 in the beta phase. These high scores reflect that the cane's hardware and software components work seamlessly together, including the ESP8266

controller, sensors, GSM module, and DFPlayer mini. The slight differences between phases suggest minor refinements were made during beta testing to improve integration. Portability was also rated highly, with scores of 4.11 for both tests, confirming that the cane is lightweight, ergonomic, and easy to handle, ensuring comfort for users of various ages and physical abilities.

Usability, while still rated positively at 3.81 for both alpha and beta tests, was identified as an area for improvement. Although the system's functionalities are reliable, users could benefit from more intuitive feedback mechanisms, such as adjustable buzzer alerts, voice prompts, or vibration signals to differentiate between obstacles, water hazards, or detected objects. Prioritizing sensor alerts so that only the most critical signals are presented at a time could also reduce user confusion and improve overall effectiveness.

Conclusion

The development and evaluation of the I-TUNGKOD Smart Assistive Cane demonstrate that integrating ultrasonic sensing, AI-driven object recognition, and real-time GPS tracking provides a viable and highly effective solution for the mobility challenges faced by the visually impaired. Based on the rigorous testing against ISO 25010 standards, the study concludes that the system excels in functional suitability and compatibility, as evidenced by the consistently high mean scores across both alpha and beta testing phases. The seamless interaction between the cane's hardware and software components ensures reliable performance in diverse environments.

Recommendations

Based on these findings, several recommendations are proposed. First, enhancing the user interface and feedback system will improve usability and user experience, making the cane easier to operate in different environments. Second, optimizing sensor integration by implementing a priority-based alert system will ensure users receive the most relevant information without being overwhelmed. Third, expanding GPS functionality to include continuous route logging and notifications to multiple caregivers could improve safety and monitoring. Finally, maintaining a modular and updatable design will allow future enhancements, such as mobile app integration or additional assistive features, without requiring major hardware modifications. In conclusion, the I-TUNGKOD smart cane has proven to be a reliable, compatible, and portable assistive device. With the recommended

improvements in usability and sensor management, it has the potential to become an even more effective mobility aid, enhancing the independence, safety, and overall quality of life of visually impaired individuals.

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KANDADO: An IoT-Based Public Locker System with Randomized QR Codes

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ABSTRACT

KANDADO is an IoT-based public locker system developed to address lost keys, prolonged occupancy, weak monitoring, and complaint-handling issues in existing lockers at Mabalacat City College. The system integrates an ESP32-based controller, shared QR scanner, sensors, electronic locks, and a LAN-hosted web application that uses randomized, time-bound QR/PIN codes, presence sensing, and detailed audit logs to ensure secure and accountable locker usage. Developed using the Modified Waterfall Model and evaluated under ISO/IEC 25010 criteria, covering Functional Suitability, Performance Efficiency, Compatibility, Interaction Capability/Usability, Reliability, Security, Flexibility, and Safety, the system obtained overall mean scores of 4.95 in Alpha testing, 4.91 in Beta-MIS testing, and 4.86 in Beta-Student testing, all interpreted as “Excellent,” indicating that KANDADO is a viable and robust locker solution for the MCC main campus.

Keywords: IoT, Smart Locker, QR Code Authentication, Web-Based System, ISO/IEC 25010, Campus Infrastructure

INTRODUCTION

Storage systems in educational institutions play a key role in safeguarding students’ belongings, reducing the daily burden of carrying materials, and helping keep restricted items out of sensitive facilities such as laboratories. For decades, traditional key-based lockers have addressed this need, but as enrollments and campus sizes grew, schools increasingly encountered practical problems such as lost or duplicated keys, damaged locks, unauthorized access, and the administrative overhead of manual key issuance and troubleshooting. In response, networked or “smart” lockers emerged in many countries, offering centralized control, reporting, and, in some cases, remote support (Snaile Lockers, 2023). Early implementations often relied on RFID cards or biometric authentication, which, while effective, add per-door hardware and wiring, introduce recurring credential issuance and replacement, and raise privacy and compliance concerns in settings with minors or young adults, alongside higher maintenance loads that can erode day-to-day usability (Alzhrani et al., 2023; Chittoor et al., 2023). Many schools in the Philippines still provide limited or no secured storage for students, so learners carry their personal items and course materials throughout the day, creating avoidable security risks, reducing comfort and mobility, and sometimes discouraging participation in laboratory-based or extra-curricular activities that require

temporarily stowing belongings. These global and local experiences underline the need for secure locker solutions that balance usability, security, cost, and data protection, and that are feasible to deploy and maintain within the infrastructure, staffing, and budget constraints typical of Philippine public schools and colleges. Mabalacat City College (MCC) is a local government-funded higher education institution in Mabalacat City, Pampanga, serving around 4,500 students across its main campus in Barangay Dolores and its extension campus in Barangay Dapdap (Mabalacat City College, 2025). The college has grown from a small institution with a single classroom into a multi-campus community-oriented college aligned with regional industry needs, yet its storage facilities remain largely traditional and loosely managed. Metal locker units at the main campus, located in areas such as the Institute of Hospitality and Tourism Management (IHTM), the Institute of Business and Computer Education (IBCE) office, and the library—are designed for built-in locks or personal padlocks, but many compartments are left open or have mechanisms that are no longer used or maintained. Access is first-come, first-served, with no formal assignment, centralized monitoring, or time limits, so security depends entirely on whether students bring and consistently use their own locks. In practice, this results in unsecured compartments, prolonged occupancy that reduces fairness of access, the absence of clear indicators showing which lockers are available, and no reminders or alerts to guide responsible use, leading some students to leave bags on top of or under the lockers or to avoid using them

altogether. Administrators, particularly those in the MIS office, face recurring operational challenges such as unauthorized access, limited usage tracking, extended occupancy, and difficulty resolving complaints. These conditions highlight the need for a more secure, organized, and technology-supported locker management system like KANDADO, which can provide controlled digital access, time-bound usage, clear status indicators, and centralized monitoring tailored to MCC's context and resources.

Objective of the study

The primary objective of this study was to develop an efficient and secure locker system, "KANDADO: An IoT-Based Public Locker System with Randomized Time-Bound QR Codes," implemented via a web application with short, time-bound QR/PIN access, server-validated replay protection, and an integrated admin dashboard for real-time monitoring, notifications, and administrative control. In line with this, the study aimed to achieve the following specific objectives:

1. To gather information, requirements, and contextual data from related literature and from student and administrator surveys at Mabalacat City College.
2. To identify and specify the essential hardware and software requirements for KANDADO, including the ESP32 microcontroller, shared QR scanner, indicators and sensors, web application, server, and database.
3. To design the locker system and web application using visual and analytical tools such as storyboards, block diagrams, flowcharts, use case diagrams, and an Entity Relationship Diagram (ERD) to ensure proper planning and alignment with user needs.
4. To construct and integrate the embedded controller and peripherals, connecting the ESP32, shared QR scanner, sensors, and LAN server for locker control.
5. To develop a user web application and admin dashboard capable of generating randomized, time-bound QR codes with expiry, handling notifications, enforcing access control, and maintaining audit logs.
6. To integrate the IoT microcontroller and modules into a fully working locker system connected to the web application and MCC network.
7. To test the prototype through developer testing, alpha testing with IT experts, and beta testing with MIS administrators and students to ensure functionality, compatibility, and usability.
8. To evaluate the system's quality based on ISO/IEC 25010 criteria, including Functional Suitability, Performance Efficiency, Compatibility, Interaction Capability/Usability, Reliability, Security, Flexibility, and Safety.
9. To deploy and implement the system at Mabalacat City College Main Campus by:
 - a. Installing the physical locker and hosting the system on-site within the campus LAN for availing and scanning lockers; and
 - b. Making the user web application accessible off-campus for extensions, refunds, penalty compliance, and termination through a secured /api/extend endpoint via ngrok.

Together, these specific objectives support the successful development, evaluation, and deployment of KANDADO as a practical, secure, and campus-ready locker system for MCC.

METHODOLOGY

The study employed the Modified Waterfall Model, a structured but slightly flexible SDLC that allowed limited feedback between adjacent phases. The process began with requirements gathering, using surveys, informal interviews, direct observation of existing locker usage, and review of related literature and MCC policies. Feedback from students, staff, and MIS personnel helped identify key needs, including secure access, time-bound use, clear indicators, and reduced administrative burden.

In the design phase, the researchers used storyboards to map student and admin flows (avail, unlock, extend, refund, penalty), system and block diagrams to show how the ESP32, web server, and database interact over the MCC LAN, use case diagrams to define roles and permissions, flowcharts for locker/session logic, and an Entity Relationship Diagram (ERD) for the data model. A Gantt chart guides scheduling and progress tracking, helping keep the project aligned with requirements.

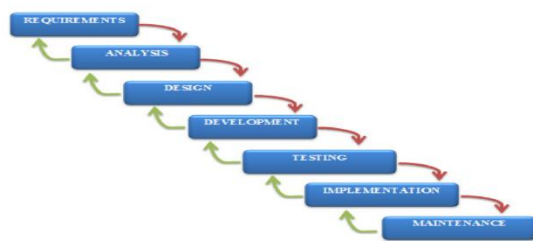
During development, the team implemented an ESP32-based controller to manage electronic locks, sensors, and indicator lights for each locker compartment, as well as a LAN-hosted web application for students and administrators. Visual Studio Code served as the IDE, with PHP,

Node.js, HTML, CSS, JavaScript, and MySQL used for backend, frontend, and database implementation. XAMPP provided the local web stack, while Composer and Git/GitHub supported dependency management and version control. Core features, QR/PIN generation and validation, time-bound sessions, extensions, refunds, penalties, and real-time locker status, were added incrementally and refined through internal tests.

For testing and evaluation, the researchers used a quantitative descriptive design and ISO/IEC 25010-based questionnaires. Developer testing was followed by alpha testing with four (4) IT experts, who focused on functional correctness, reliability, security behavior, and edge cases. Beta testing involved three (3) MIS administrators and thirty (30) students, who performed typical use cases on the actual locker prototype and the web interface. Feedback from both groups informed fixes and interface improvements, such as clearer legends and messages.

System quality was assessed using the ISO/IEC 25010 Software Quality Model, covering Functional Suitability, Performance Efficiency, Compatibility, Interaction Capability/Usability, Reliability, Security, Flexibility, and Safety. Descriptive statistics, particularly mean scores and their verbal interpretations, were used to summarize responses and evaluate system performance and user satisfaction. After pilot deployment at the MCC main campus, usage logs, incident reports, and informal feedback were monitored to confirm stable operation in real conditions and to identify areas for future enhancement.

Figure 1
Modified Waterfall Model



Requirements

The requirements-gathering phase identified the essential hardware and software needed to develop and test the KANDADO locker system as a complete IoT and web solution. On the hardware side, the system centered on ESP32 microcontrollers, 12 V electronic cabinet locks

driven by relay modules, a fixed QR scanner, a 3×4 or 4×4 matrix keypad for PIN fallback, ultrasonic sensors for presence detection, magnetic or limit switches for door status, tilt and vibration sensors for tamper detection, RGB status indicators, interior LED lights, a TFT/OLED display, and a UPS-backed power supply with buck converters and protective fuses, all housed in a four-compartment wooden locker enclosure. On the development side, a desktop computer with sufficient CPU, RAM, storage, and LAN connectivity, along with a tablet and smartphone, was used to test the web portal, QR workflows, and responsiveness across different screen sizes and devices.

The software requirements included Visual Studio Code as the main editor, XAMPP for local PHP, MySQL hosting, Arduino IDE for ESP32 firmware development, Composer for managing PHP dependencies, and Node.js with npm for backend services and JavaScript packages. Standard web technologies, HTML, CSS, JavaScript, PHP, and MySQL, were used to build the web application and admin dashboard, while ngrok provided a secure tunnel for the time-extension API endpoint during off-campus testing, and Git/GitHub supported version control and collaboration. This combination of hardware and software tools ensured that KANDADO could be developed, integrated, and validated in a realistic environment, with reliable LAN performance and consistent behavior on both desktop and mobile devices.

Design

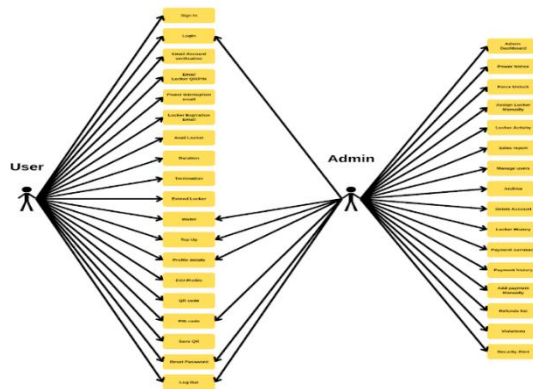
The design of KANDADO integrated inputs, processes, and outputs to form a cohesive locker management platform tailored to MCC. Inputs included the practical requirements and constraints gathered from students, MIS staff, and administrators such as the need to eliminate unsecured compartments and lost keys, enforce time-limited usage, and provide clear indications of locker status. Survey results and observations on current locker practices, security concerns, fairness of access, and preferred features (e.g., QR/PIN access, notifications, and audit logs) were translated into functional and non-functional requirements for user interaction, security, monitoring, and management.

The core processes encompassed requirements analysis, system design, and iterative development of the IoT controller and web application. Design artifacts such as storyboards, block diagrams, system architecture diagrams, flowcharts, use case diagrams, ERDs, a Gantt chart, and a visual table of contents were used to visualize user

flows (avail, unlock, extend, refund, terminate), hardware wiring, data relationships, and project timelines. These tools helped ensure that features like randomized time-bound QR/PIN generation, presence and door-state detection, automatic “on hold” behavior for items left inside, penalties and refunds, and real-time admin monitoring were consistently mapped from concept to implementation.

The system architecture combined a LAN-hosted PHP/Node.js-MySQL backend with the ESP32-based locker hardware and a browser-based interface for both users and administrators. The database managed entities such as users, lockers, sessions, QR codes, wallets, penalties, and alerts, while the user interface provided an accessible web portal where students could connect to the campus network, sign in, avail a locker, view and use their QR/PIN, and manage extensions and refunds. Administrators accessed a dedicated dashboard to view real-time locker states, perform remote lock and unlock actions, set Maintenance or Hold modes, and review histories and audit trails. By keeping all services LAN-restricted and exposing only a single secured /api/extend endpoint via ngrok, the design balanced usability and connectivity with security and control, resulting in a robust, campus-appropriate architecture for the KANDADO locker system.

Figure 2
Use Case Diagram



Development

The KANDADO system was developed as an integrated IoT and web-based locker platform. Hardware centered on ESP32 controllers (one main and slave units) programmed via the Arduino IDE to drive electronic locks, sensors, and RGB indicators. A shared QR scanner, keypad fallback, and TFT/OLED display formed the main control panel, while ultrasonic and tilt/vibration sensors monitored contents and

tamper events. Relay modules actuated 5 V cabinet locks and interior lighting, powered by a UPS with buck converters for 12 V and 5 V rails. Wiring and firmware were iteratively tested per locker before installation in a four-compartment wooden cabinet with a single top-mounted control panel.

Figure 3
System Architecture Diagram

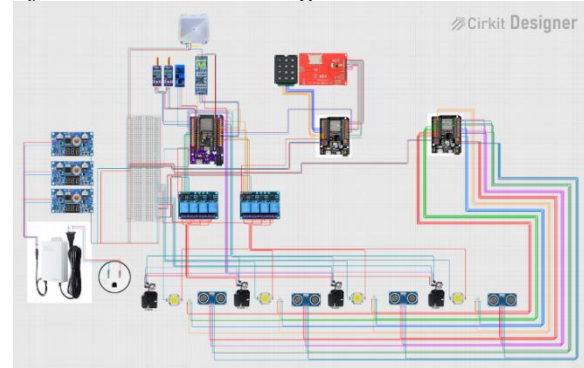


Figure 4
Kandado Locker System



The software operated as a LAN-hosted web application using PHP, JavaScript, Node.js, and MySQL via XAMPP, with version control on GitHub. The student portal supported registration/login, locker selection, and QR/PIN generation with countdowns, while the admin dashboard provided real-time status, overrides, and access to logs. Node.js services handled OTP creation and validation, notifications, and live updates between the server and controllers. For security, only a single /api/extend endpoint was exposed via ngrok for off-campus extensions, with all other services restricted to the MCC local network.

End-to-end testing covered QR/PIN access, session timing and expiry, notification flows, and administrator actions under normal and edge-case scenarios. Iterative fixes and refinements ensured that hardware and software functioned

reliably as a unified system and met the operational requirements of Mabalacat City College.

Figure 5
Kandado Locker System (Inside Main Panel)



Testing

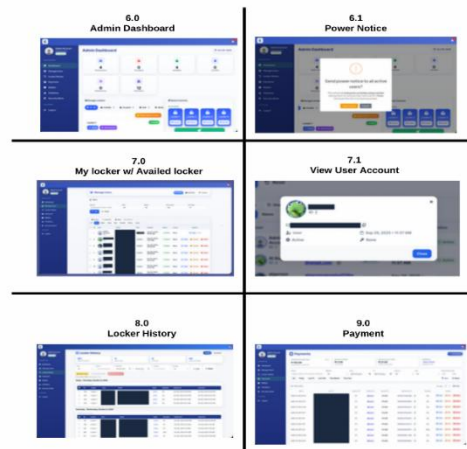
The testing phase for KANDADO was designed to be systematic and evidence-based, ensuring that the system's functionality, reliability, and usability were thoroughly evaluated. Developer testing came first to eliminate major bugs and integration issues, followed by formal alpha and beta testing cycles. A quantitative, descriptive approach was used, with structured questionnaires based on the ISO/IEC 25010 software quality model to capture user and expert feedback on the system's key attributes. Sampling combined purposive and convenience strategies. Alpha testing involved four (4) IT experts, selected purposively for their technical background and experience with systems evaluation. They examined the behavior of the web application and locker hardware, focusing on functional correctness, reliability, security behavior, and edge cases such as power loss, network interruptions, and invalid QR/PIN attempts. Their feedback led to refinements in error handling, interface wording, and indicator behavior before the system was exposed to end users.

Three (3) MIS administrators participated as beta-admin testers, assessing the dashboard, monitoring features, and administrative controls, while thirty (30) students from relevant institutes served as betastudent testers and performed typical scenarios such as availing lockers, unlocking via QR/PIN, extending sessions, ending use, and experiencing overdue flows. Feedback was gathered through structured questionnaires evaluating usability, clarity of indicators, perceived security, and overall satisfaction, complemented by observations during hands-on use.

Figure 6
Storyboard-User



Figure 7
Storyboard-Admin



To measure system quality, the researchers adopted the ISO/IEC 25010 software product

quality model, focusing on Functional Suitability, Performance Efficiency, Compatibility, Interaction Capability/Usability, Reliability, Security, Flexibility, and Safety. A 5-point Likert scale was used for all items, with numerical values and verbal interpretations as showed in Table 1.

Table 1
Likert Scale

Response Category	Value	Range	Verbal Interpretation
Strongly Agree	5	4.21–5.00	Excellent
Agree	4	3.41–4.20	Good
Neutral	3	2.61–3.40	Acceptable
Disagree	2	1.81–2.60	Marginal
Strongly Disagree	1	1.00–1.80	Poor

Deployment

The KANDADO system was deployed at the Mabalacat City College (MCC) main campus. The four-compartment locker cabinet, with its main control panel, was installed in a high-traffic, but supervised, area near existing offices to ensure visibility and accessibility for students and staff. The ESP32 controllers, relay modules, and sensors were connected to the campus power line through a UPS and buck converters, while the web application and database were hosted on an on-premise server within the MCC local area network. Only a single /api/extend endpoint was exposed via ngrok for off-campus time extensions; all other services and interfaces remained LAN-restricted, ensuring that locker operations and administrative controls were available only to devices connected to the MCC network.

Maintenance

Regular maintenance protocols were implemented during the testing phase of KANDADO to ensure its reliability and effectiveness. The researchers routinely monitored key aspects of the system, including lock and sensor behavior, QR/PIN access, indicator responses, and web application performance, and addressed issues promptly as they appeared. Periodic firmware and application updates were applied to resolve bugs and refine functionality. At the same time, test users were encouraged to report any concerns so that errors could be quickly investigated, corrected, and retested before wider use.

RESULTS

The KANDADO locker system underwent two central evaluation phases alpha and beta (see Table 2) guided by ISO/IEC 25010 quality characteristics. In the alpha test, conducted on

September 29, 2025, with four (4) IT professionals at MCC (MIS Lab), the system was assessed on Functional Suitability, Performance Efficiency, Compatibility, Interaction Capability, Reliability, Security, Flexibility, and Safety. As summarized in Table 8, mean scores ranged from 4.83 to 5.00, with an overall mean of 4.95 (Excellent). Compatibility (4.96), Interaction Capability (4.97), Reliability (4.97), Security (4.96), and Safety (5.00) all received *Excellent* ratings, and the targeted Security Test achieved a perfect 5.00, confirming robust access control, replay blocking, audit logging, and safe behavior under power loss. Minor issues in OTP/session validation, relay timing, error messages, and tamper thresholds were addressed before beta testing.

Table 2
Summary of Testing Results

ISO/Related Criteria	Alpha	Beta – Admin	Beta – Students
Functional Suitability	4.94	4.89	4.83
Performance Efficiency	4.91	4.87	4.75
Compatibility	4.96	5.00	4.82
Interaction Capability / Usability	4.97	4.91	4.94
Reliability	4.97	4.96	4.86
Security	4.96	4.95	4.96
Flexibility	4.83	4.72	—
Safety	5.00	5.00	4.73
Notifications (student-specific)	5.00	—	4.87
Fairness & Access (student-specific)	5.00	—	4.95
Security Test (targeted scenarios)	5.00	—	—
Overall Mean Score	4.95	4.91	4.86

The beta phase further validated KANDADO with actual end users on the campus LAN. From September 30 to October 6, 2025, three (3) MIS administrators and thirty (30) students (15 from IBCE, 15 from IHTM) executed realistic usage scenarios avail, unlock via QR/PIN, extend/end sessions, keypad fallback, indicator verification, and notification timing. As presented in Tables 9 and 10, the beta-admin group recorded an overall mean of 4.91 (Excellent), with all ISO/IEC 25010 criteria (Functional Suitability, Performance Efficiency, Compatibility, Interaction Capability, Reliability, Security, Flexibility, and Safety) scoring between 4.72 and 5.00. Students reported an overall mean of 4.86 (Excellent), with high ratings for Security (4.96), Usability (4.94), Fairness & Access (4.95), and Notifications (4.87), indicating that locker allocation felt fair, reminders were helpful, and the interface was easy to use on typical mobile devices.

The combined alpha and beta findings. Functional Suitability (4.94, 4.89, 4.83),

Performance Efficiency (4.91, 4.87, 4.75), Compatibility (4.96, 5.00, 4.82), Interaction Capability/Usability (4.97, 4.91, 4.94), Reliability (4.97, 4.96, 4.86), and Security (4.96, 4.95, 4.96) all achieved *Excellent* ratings for IT experts, MIS administrators, and students, respectively. Flexibility was rated 4.83 (alpha) and 4.72 (beta-admin), while Safety scored 5.00 for both alpha and beta-admin and 4.73 for students. Notifications and Fairness & Access, evaluated as student-specific criteria, also received *Excellent* marks. Overall mean scores of 4.95 (Alpha), 4.91 (Beta-Admin), and 4.86 (Beta-Students) confirm that KANDADO not only meets its functional requirements but also delivers efficient, usable, reliable, secure, and safe locker services consistent with ISO/IEC 25010 standards.

DISCUSSION

The development of KANDADO: An IoT-Based Public Locker System with Randomized Time-Bound QR Codes aimed to replace MCC's unsecured, loosely managed lockers with a secure, organized, and monitored storage solution. The study addressed key problems such as open compartments, lost keys, prolonged occupancy, and the absence of clear accountability by introducing QR/PIN-based access, time-limited sessions, presence sensing, status indicators, and an admin dashboard. Input from IT experts, MIS staff, and students helped shape KANDADO's features to align with actual campus practices and constraints, particularly its LAN-first environment and limited technical manpower.

The testing results show that KANDADO successfully meets these goals. Alpha and beta evaluations based on ISO/IEC 25010 produced overall mean scores of 4.95 (IT experts), 4.91 (MIS administrators), and 4.86 (students), all interpreted as *Excellent*. High ratings in Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, and Safety indicate that the system performs its intended functions smoothly on the MCC LAN and on typical student devices, while features such as replay blocking, clear indicator lights, and detailed audit logs strengthen security and fairness. Students reported that notifications and clear locker states supported responsible use, while administrators gained better visibility and control over locker operations, reducing manual supervision and simplifying complaint handling.

Looking forward, KANDADO can be further improved by adding optional two-factor authentication (e.g., OTP plus QR/PIN),

enhancing cabinet durability and environmental resistance, and integrating richer analytics for usage and incident patterns. Refinements such as more granular admin roles, expanded reports, and additional notification options could also increase flexibility. With these enhancements, KANDADO can evolve into an even more robust and adaptable campus locker system while continuing to support MCC's goals for safety, orderliness, and innovation.

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Kapanimpla: A Web-Based Ordering and Customization System for Silung Coffee

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ABSTRACT

Coffee plays an important role in daily well-being, supporting alertness, focus, and motivation while also fostering social connection. Silung Coffee, located in Brgy. Poblacion, Mabalacat City, was established to blend Kapampangan cultural heritage with modern coffee culture and to promote community engagement aligned with Sustainable Development Goals (SDGs) 4, 9, 11, and 12. This study developed a system intended to enhance the café's operational efficiency and service delivery. Using a structured development approach, the researchers conducted alpha and beta testing to assess the system's functional suitability, interaction capability, security, and flexibility. The alpha test produced an overall rating of 3.96, while improvements implemented afterward resulted in a higher beta test rating of 4.41. These results indicate that the system effectively met its performance criteria, demonstrating strong functionality, usability, security, and adaptability. Following comprehensive evaluation, the system was found to support Silung Coffee's goals of improving operational processes while advancing its cultural, educational, and sustainability-driven mission.

Keywords: Information System, Web-based Platform, Ordering System

INTRODUCTION

The coffee industry has evolved beyond consumption, becoming a key part of cultural, social, and economic life. Specialty cafés offer immersive experiences that highlight craftsmanship and storytelling, while also serving as hubs for community engagement and collaboration. Economically, the industry supports millions of jobs worldwide, with sustainable initiatives ensuring fair wages and ethical sourcing. Coffee is also important for cultural preservation with practices. As the coffee industry continues to grow, it will be imperative to navigate modernization, sustainability, and authenticity to manage coffee as a signifier of connection, identity, and economic growth.

In the Philippines, the coffee industry plays a significant role in both economic growth and cultural heritage. The country has a rich history of coffee cultivation, with regions such as Benguet, Batangas, and Bukidnon producing high-quality beans that support local farmers and businesses. Government initiatives and private sector collaborations have also contributed to the industry's growth by promoting

sustainable farming practices, providing financial support to coffee producers, and encouraging local cafés to showcase Philippine-grown coffee. These efforts not only boost the economy but also preserve the country's deep-rooted coffee traditions, allowing businesses to thrive while maintaining a strong cultural identity.

In today's competitive café industry, the importance of an efficient ordering system and food customization features cannot be overstated. With increasing customer demand for personalized experiences, providing a seamless and efficient way to customize orders is essential for improving customer satisfaction and operational effectiveness. A well-designed ordering and customization system enhances the customer experience by allowing them to tailor their orders to their preferences, reducing wait times, and improving accuracy in fulfilling orders. This also aids café businesses in streamlining their operations and meeting customer expectations, all while maintaining a strong sense of identity and cultural relevance.

The system will be designed to help Silung Coffee address its operational challenges by enabling customers to personalize their coffee orders according to their tastes, such as selecting milk type, adjusting

sweetness, or adding flavored syrups. The system offers an intuitive, user-friendly interface where customers can place their orders in advance, track their order status in real-time, and make secure online payments. It also provides tools to manage inventory, optimize order processing, and streamline café operations. By implementing Kapanimpla, Silung Coffee can enhance its customer service, reduce overcrowding and wait times, and further establish itself as a modern and efficient café, all while preserving its cultural identity and commitment to sustainability.

Objective of the Study

The general objective of the study is to develop a system entitled “Kapanimpla: A Web Based Ordering and Customization System” for Silung Coffee Shop.

In line with this, this study aims to achieve the following specific objectives:

- To gather information about the requirements for the ordering and customization system of Silung Coffee through interviews with the owner and brainstorming sessions.
- To identify the specific hardware and software components used to develop the website.
- To design the website using the following analysis, diagrams, and design tools throughout the development process:
- To create and develop Kapanimpla with the main feature ordering and customization of coffee.
- To evaluate the system using ISO 25010's Software Product Quality Standards for alpha and beta testing;
- To deploy and implement the system in Silung Coffee.

Limitation

This study is limited to the development and implementation of an online ordering and customization platform that enables customers to conveniently place and personalize their coffee orders. The platform is web-dependent, meaning it requires an internet connection for functionality.

This study is confined to a specific time frame and focuses solely on Silung Coffee. The system is not evaluated for its applicability to other coffee shops or industries. Factors beyond the scope of this study include internet connectivity, and staff training, which involves

equipping employees with the necessary skills to use and manage the platform effectively.

Additional limitations include the exclusion of long-term system maintenance, scalability for a larger customer base, and the implementation of cybersecurity protocols. The study does not cover potential technical downtimes, or the need for regular software updates and feature enhancements after deployment. Moreover, power interruptions are also considered an uncontrollable constraint that may affect the system's availability and performance during operation.

In the event of a power outage at Silung Coffee's location, the system's functionality may be compromised particularly if the local server, network, or staff devices are affected. This disruption may prohibit customers and staff from using the platform, processing orders, or updating order status in real time. Unless enough backup solutions like uninterruptible power supplies (UPS) or generators are in place, activities will have to temporarily switch to manual techniques, diminishing the system's efficiency and advantages. Power outages can potentially cause data loss or gaps if transactions stop in the middle of the process.

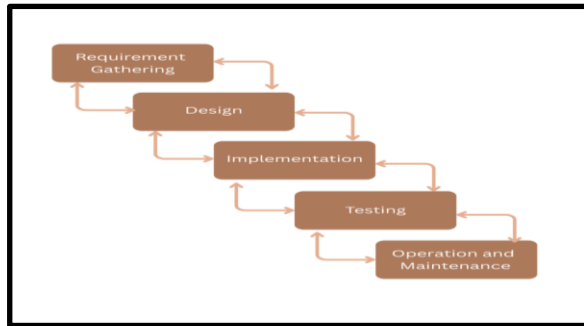
Since the administrator cannot observe or confirm the customer's identity when the senior citizen privilege request is submitted, the study will only be able to fulfil the customer's drink order if the user has a valid senior citizen/PWD ID.

The possibility of fraudulent or fake online orders is one of the system's limitations. There is no assurance that the person placing the order is real or plans to finish the transaction because the platform enables customers to place orders remotely. For Silung Coffee, this could lead to wasted ingredients, incomplete pickups, and inefficient operations.

METHODOLOGY

The researchers used the Modified Waterfall methodology (see Figure 1) to monitor the system's development. Each task was thoroughly discussed and the outputs of every development phase were documented. The researchers ensured that every task was executed to meet its specific goals, and that the final system accomplished the expected results.

Figure 1
Modified Waterfall Model



Requirement Gathering

The researchers will collaborate to gather ideas for creating an efficient coffee ordering and customization system through group discussions and brainstorming sessions.

For the system development, the researchers will use tools like Visual Studio Code 1.89 for both back-end and front-end programming. Cloud Firestore will be utilized as the database management system (DBMS) for cloud-based storage.

Canva will be used for prototyping and storyboarding the system's design. XAMPP will be used for its all-in-one package, allowing the researchers to build and test the web application on a local machine before deploying it to a live server. The system will run on a PC with a Microsoft operating system

Design

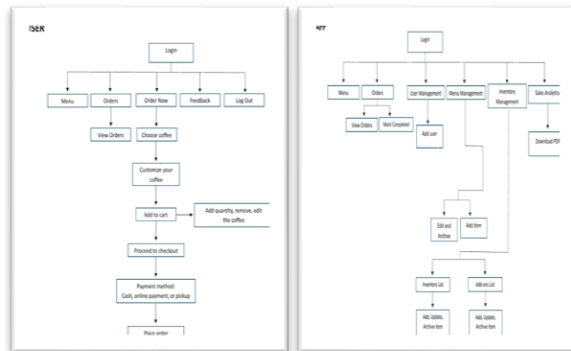
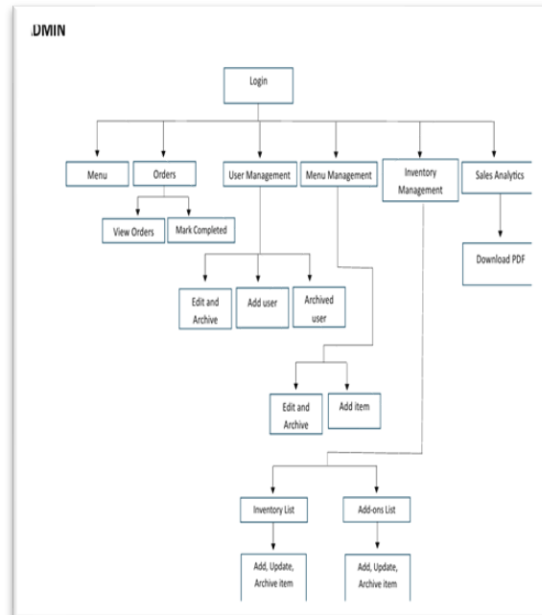
In this phase, the researchers used several analysis tools and diagrams to design and develop the Kapanimpla system: Storyboard, Visual Table of Contents (see Figure 2), Use Case Diagram (see Figure 4), Gantt Chart, and ERD.

The researchers utilized the Storyboard diagram to plan the user interface and ensure smooth flow and visualization throughout the application. This helped the developers visualize how the system should look and function before entering the development stage.

The Use Case diagram was created to define the system's features, scope, and how users will interact with it. This helped

outline the roles and interactions within the system.

Figure 2
Visual Table of Contents



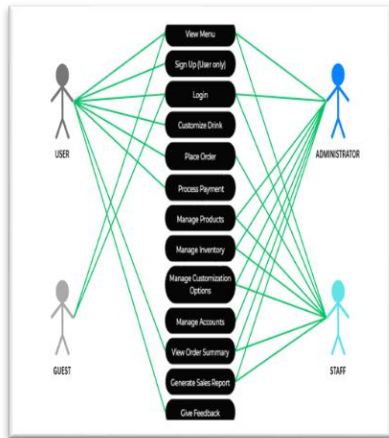
A Visual Table of Contents was also implemented to provide a structured overview of the system's main components and sections.

A Gantt Chart was used to create a detailed project timeline. This allowed the researchers to manage tasks, allocate resources efficiently, monitor progress, and anticipate potential challenges during development.

Lastly, an Entity-Relationship Diagram (ERD) was used to illustrate the system's database structure. This allowed the researchers to organize data relationships,

ensure efficient database design, and support accurate data flow throughout the development of the system.

Figure 3
Use Case Diagram



Implementation

The development of Kapanimpla, the web-based ordering and customization system for Silung Coffee, will be carried out by assigning specific roles to the researchers, ensuring an organized and efficient workflow. The front-end developer will focus on designing and developing an intuitive and visually appealing user interface (UI) that caters to both customers and the admin. This includes crafting key pages such as the product customization interface, digital menu, order summary, and the admin dashboard. The UI will follow responsive design principles to ensure compatibility across devices and will apply user experience (UX) best practices to streamline navigation and accessibility for a wide range of users. Meanwhile, the back-end developer will be responsible for implementing the server-side logic and managing the underlying database. This includes designing and maintaining tables for products, orders, customers, inventory, and customizations. The back-end will also incorporate features such as status updates, and customer feedback. The back-end developer will ensure secure data transactions, enforce business logic such as customization limitations, and maintain the system's performance even under concurrent user access.

Throughout this phase, both the front-end and back-end developers will collaborate closely to align the visual and functional aspects of the system with the specific requirements of Silung Coffee. This division of tasks, along with continuous communication, helps to streamline the development process while ensuring that the system meets the expectations of both the business owners and its customers. The implementation phase plays a key role in transforming Kapanimpla into a reliable, user-centered solution for efficient online ordering and coffee customization.

Testing

In this phase, the researchers conducted system testing to ensure the software met all specifications and was free of errors. The researchers used purposive sampling to select participants, as it allows the selection of individuals who are most familiar with the system, ensures more relevant feedback, and provides accurate information aligned with the objectives of the study.

The system underwent three types of testing: Alpha Testing for IT experts and Beta Testing for non-IT experts. For Alpha Testing, the researchers involved three IT experts to evaluate the system. For Beta Testing, thirty (30) end-users, including admin, staff and customers from Silung Coffee, were selected to test the system's functionality. The evaluation followed ISO 25010 standards, focusing on functional suitability, compatibility, interaction security, and flexibility.

This method was used to present how often specific responses or scores occurred in the study. The respondents' demographic data and other relevant answers were grouped into defined intervals or categories. These intervals were based on a range of possible values, allowing for organized data interpretation. The frequency represents the total number of respondents who fell into each of these predefined categories, helping to visualize patterns and trends in the data.

The Likert scale is a type of rating system commonly used in surveys and questionnaires to assess participants' opinions, attitudes, or behaviors. Respondents select from a range of predefined options, typically ranging from "strongly agree" to "strongly disagree," in response to a series of statements or questions. These responses are often

assigned numerical values to facilitate quantitative analysis of the collected data

Operation and Maintenance

This is the last phase of the Modified Waterfall Model, following the testing phase. In this phase, the software is delivered to the end users, and the project team ensures the software's continued operation and usability. This would be the path where the user may be able to report errors or any aspects of the system that need improvement for the rectification of the system that has been created. The researchers would do updates by monitoring the progress, errors, and the features and operations of the system. With this, the researchers developed a web-based system that the users could freely access and utilize at the domain repository website address of Silung Coffee online.

Alpha Test

The results of the alpha testing were shown in tables using frequency. The researchers carried out the alpha test by giving the system to three (3) IT experts and having them fill out a questionnaire. The testers were Mr. Frederick Santos, Mr. Aljon Quiambao, and Mr. Andrew Macapagal. They were asked to complete the form within ten (10) minutes after using and inspecting the system. The alpha testing and data collection began on October 11, 2025 until October 13, 2025. The Institute of Business and Computing Education. The researchers also provided a more detailed summary of the survey results.

Table 1
Alpha test result

Evaluation	Mean	Verbal Description
Functional Stability	4.29	Excellent
Interaction Capability	3.98	Good
Security	3.83	Good
Flexibility	4.16	Good
Total	4.06	Good

As shown in Table 1, The system underwent a thorough evaluation and proved high appropriate for its designated use, meeting various criteria such as functional suitability, interaction capability, security, and flexibility. Its functional suitability scored 4.29, indicating an good performance in fulfilling its goals and requirements. Interaction

capability, was rated good with a high score of 3.98, the system's capacity to support effective communication between systems and users. Security was determined to be strong, reflected by an good score of 4.16. The system showed good flexibility across various platforms and environments, earning a score of 3.96. These results suggest that the system is high recommended for its intended purpose. The researchers carried out a survey designed to evaluate the system's functional suitability, interaction capability, security, and flexibility. The researchers found that all these aspects were well achieved, giving the system a total rating of 3.96. As a result, the system was considered good, meaning it is functional, compatible with various devices and platforms, user-friendly, secure, and easily adaptable to new environments.

Beta Testing

The beta testing results were shown in tables using frequency. The researchers completed the beta test by giving the system to users and collecting their feedback through a questionnaire. Respondents were asked to fill out the form within ten (10) minutes after using and exploring the system. The beta testing and data collection took place from October 20, 2025 to October 22, 2025. The researchers also provided a more detailed summary of the survey results.

Table 2
Beta test result

Evaluation	Mean	Verbal Description
Functional Stability	4.56	Excellent
Interaction Capability	4.42	Excellent
Security	4.44	Excellent
Flexibility	4.22	Excellent
Total	4.41	Excellent

Table 2. The overall feedback from the respondents showed that they agreed with the ISO 25010 standards in the areas of Functional Suitability, Interaction Capability, Security and Flexibility. As shown in Table 8, the thirty (30) respondents in the beta test rated the system's functional suitability having an average weighted score of 4.56, which is classified as "Excellent". This high score is due to the system having complete functions, performing all tasks correctly, and offering the right features to help users complete their specific tasks. For interaction capability, the system scored

4.42, also rated as “Excellent”, showing it can enable effective communication between systems or users. The system’s security was rated “Excellent” resulting in a rating of 4.44, indicating that it is safe from vulnerabilities, threats, and unauthorized access. Additionally, the system’s flexibility scored 4.22, meaning it can easily operate on various platforms and environments. The researchers survey found that the system met all the required standards for Functional Suitability, Interaction Capability, Security, and Flexibility, achieving an overall score of 4.41. The survey concluded that the system performed very well in all these areas and was considered excellent overall.

Table 3
Comparison of Alpha and Beta test

Evaluation	Alpha Test	Verbal Description	Evaluation	Beta Test	Verbal Description
Functional Stability	4.29	Excellent	Functional Stability	4.56	Excellent
Interaction Capability	3.98	Good	Interaction Capability	4.42	Excellent
Security	3.83	Good	Security	4.44	Excellent
Flexibility	4.16	Good	Flexibility	4.22	Excellent
Total	4.06	Good	Total	4.41	Excellent

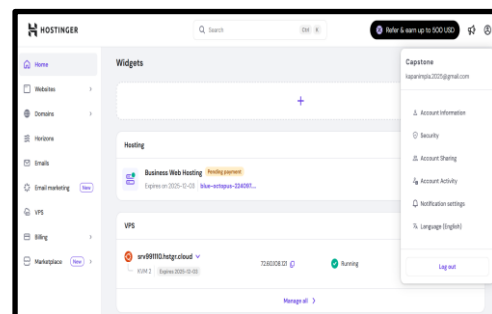
As shown in Table 3, it compares the results of the two tests carried out by the researchers on the system. A detailed comparison of the alpha and beta test results across different criteria gives clear insights into how the system’s performance has improved. In functional suitability, this analysis highlights specific enhancements made from the alpha to the beta phase. The alpha test scored 3.88, which was rated as “Good” and showed that it performs very well. The beta test score increased to 4.56, rated as “Excellent”, reflecting targeted initiatives to tackle these issues. This improvement likely came from enhanced features, bug fixes or added functions, making the system more reliable and user-friendly. Interaction capability showed a consistently high level of performance in both testing phases. It scored 3.98 in the alpha test and improved slightly to 4.42 in the beta test. This steady high rating suggests that the system’s ability to support smooth interactions was

already strong from the start, with only minor adjustments needed for fine-tuning. Security had similar results, starting with a high score of 3.83 in the alpha test and rising slightly to 4.44 in the beta test. This steady “Excellent” rating shows that strong security measures were in place from the beginning, ensuring data protection and system safety. The small improvement may be due to extra testing and fine-tuning to strengthen security and fix any minor issues found in the alpha phase. Flexibility remained very stable, rated at 4.16 in the alpha test and a slight increase to 4.22 in the beta test, it was rated as “Good” during alpha testing and improved to “Excellent” in beta testing. This consistency shows that the system serves as adaptable and performs well in different situations, suggesting a strong design that requires little adjustment. The alpha and beta test results show that the system functions as well-designed and carefully tested, with improvements made in areas like functional suitability, compatibility, interaction capability, security and flexibility.

Deployment

All of these were accomplished with the success of the web-based system that was allowed by the capstone adviser, technical adviser, beta tester, alpha tester and to the board of panelists. The researchers designed a web-based platform, Kapanimpla, which is hosted on the domain kanimpla.shop and can be accessed by customers to place and customize orders online (see Figure 4).

Figure 4
Deployment of the System



DISCUSSION

The objective of the study is to create a website for Silung Coffee order and

customize their coffee. The researchers gathered information through research, interviews, and surveys to determine the required hardware and software for the system. The researchers used tools like storyboards, use case diagrams, and a visual table of contents to design and map out the system's workflow. This approach helped make the development process more efficient and reduced the chances of errors.

The researchers successfully established a coffee system with roles for admin, staff, and customer. The system includes features such as order management, user management, menu management, inventory management, and sales report viewing. All of the project's objectives were met as planned. The primary goal throughout development was to create an environmentally friendly, socially beneficial, and economically possible solution, and the system met these objectives. The project team's work and dedication were key to achieving these goals. The system has also helped support sustainable development, as seen by the effective achievement of these objectives.

The system went through developer, alpha, and beta testing. The researchers evaluated it using ISO 25010 criteria, evaluating functional suitability, compatibility, interaction capability, security, and flexibility.

During development, researchers discovered limitations. The system was designed for Silung Coffee without considering its fitting into the coffee shop's existing operation. The study did not create a mobile application, but instead designed the system to function with mobile web browsers.

Through this work, the researchers provided useful resources for future studies. The system developed for Silung Coffee increased customer satisfaction, reducing wait times, and improving the operational efficiency.

ACKNOWLEDGEMENT

To begin with, the researchers are grateful to God for directing and bringing them on this educational journey. If it were not for his favor, this research would not have been possible.

The researchers would like to thank Mr. Khyle Alegre, researchers technical adviser, for her unwavering patience,

support, and guidance as they worked to complete this study.

Additionally, the Committee who were present during the oral examination phase of the research process. Their combined efforts, suggestions, and thoughts influenced the researcher's choice and the study.

Finally, the researchers express their gratitude to their families and friends for providing unwavering support, particularly in the form of financial aid, throughout their time as students.

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KHRIA: AI Ecommerce Website Builder

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ABSTRACT

KHRIA is an AI-powered website builder designed to help individuals and local businesses create their online platforms efficiently. Built using the Modified Waterfall Model, the system automates website generation, supports content and theme customization, integrates e-commerce tools, and provides AI-assisted features such as automated deployment and digital asset management. Alpha and beta testing, guided by ISO 25010, showed excellent results in functionality, usability, compatibility, and flexibility. KHRIA contributes to SDGs by promoting innovation, economic growth, and digital accessibility for small enterprises.

Keywords: AI Website Builder, E-commerce Platform, Digital Transformation, Website Generation, Small Business Empowerment, Artificial Intelligence, Online Presence, Web Development Automation, Sustainable Development Goals, User-Friendly Website Builder

INTRODUCTION

The COVID-19 pandemic accelerated the shift of businesses worldwide from traditional operations to digital platforms, prompting rapid adoption of e-commerce to sustain revenue amid lockdowns and social distancing (United Nations, 2021; Tribdino, 2021). In the Philippines, the Department of Trade and Industry (DTI) launched the Philippine E-Commerce Roadmap 2022 to boost consumer trust, enterprise engagement, and e-commerce's contribution to GDP (Retail Curated, 2021). Artificial Intelligence (AI) has further transformed online business operations by improving customer service through chatbots, inventory management, and personalized recommendations, enhancing business performance and customer experience (Zou & Cheshmehzangi, 2022; Adulyasak et al., 2023). Additionally, online banking and digital payment platforms like GCASH and PayMaya facilitated financial inclusion and promoted e-commerce growth (Afable, 2024; Pleno & Bulacan State University, 2024).

To address challenges in website development, the researchers developed KHRIA: AI E-commerce Website Builder, a platform that enables entrepreneurs and local business owners to easily create professional websites, integrate AI-powered chatbots, and deploy sites automatically. Thirty potential business owners

and Entrepreneurship students from Mabalacat City College participated as initial users, providing feedback to ensure that the platform meets practical business needs. Local businesses such as Third Motor Parts & Services, Sweet Escape, Café Haeven, Harvest Lounge, Sugar Rush Ice Cream, Seafood Lover, Edward Aviles Salon, Patrick Itura Shop, and IN and OUT, along with student ventures like Stylepreneur Beauty Products, leveraged KHRIA to enhance digital presence, streamline online orders, and reach wider audiences. Furthermore, KHRIA contributes to the United Nations Sustainable Development Goals (SDGs). The platform supports SDG 1: No Poverty by expanding market access and creating community-based jobs, SDG 8: Decent Work and Economic Growth by promoting entrepreneurship, innovation, and formalization of businesses, and SDG 9: Industry, Innovation, and Infrastructure by fostering sustainable digital infrastructure, modernizing business operations, and increasing industrial competitiveness (United Nations, 2023). By enabling affordable and accessible digital solutions, KHRIA empowers local businesses and students to succeed in the evolving digital economy while advancing inclusive and sustainable development. Several partner businesses, including Sweet Escape, Café Haeven, Third Motor Parts, Sugar Rush Ice Cream, Seafood Lover, Edward Aviles Salon, and student-led brands, demonstrated how limited online visibility.

Objectives of the study

The study aims to develop KHRIA: AI Ecommerce Website Builder, a web-based system designed to help individuals, students, and local

businesses easily create and manage websites without requiring technical skills. The platform addresses the challenges of traditional website development by enabling users to generate a fully functional website within 30 seconds, with tools for customization, content management, and AI-powered features. The study involved gathering relevant data, designing the system using standard diagrams and analysis tools, and developing a feature-rich web application that includes AI content generation, e-commerce support, deployment, and integration tools. The system was tested and evaluated using the ISO 25010 software quality standards and was successfully deployed to provide an accessible, efficient, and user-friendly solution for website creation at Mabalacat City College. content management, and AI-powered features. The study involved gathering relevant data, designing the system using standard diagrams and analysis tools, and developing a feature-rich web application that includes AI content generation, e-commerce support, deployment, and integration tools. The system was tested and evaluated using the ISO 25010 software quality standards and was successfully deployed to provide an accessible, efficient, and user-friendly solution for website creation at Mabalacat City College.

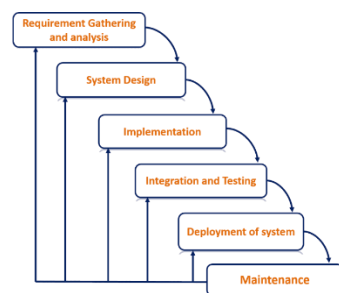
METHODOLOGY

The study followed the Modified Waterfall Model (see Figure 1) of the Software Development Life Cycle (SDLC), ensuring a structured and systematic development process. Each phase contributed to the creation, refinement, and evaluation of the KHRIA: AI Ecommerce Website Builder.

Figure 1
Modified Waterfall Model

Requirements Gathering

During the Requirement Gathering and Analysis phase, the researchers collected accurate and



reliable data through interviews and online research. They conducted library and internet

studies using articles, government websites, and academic journals to generate ideas for the capstone project. The team (see Table 1) maintained regular communication with their technical and capstone advisers to monitor progress, while collaboratively planning activities, creating timelines, and assigning tasks. Interviews were also conducted to identify the challenges small businesses face in establishing an online presence, including their digital marketing strategies, e-commerce needs, mobile compatibility, user interface preferences, and technological and financial constraints.

Table 1
Project Team Role

Team Member	Designation
Mc Khyle Dean Y. Mendoza	Project Leader, Backend & Frontend Developer
Angela Kyla A. Quiambao	Document Analyst; Systems Analyst
Arianne C. Lopez	Quality Assurance Engineer; Graphics Designer
Dennis L. Tacadena	Technical Advisor, Document Analyst

The system development was carried out on a laptop with Microsoft OS, an Intel i5 processor, 8 GB RAM, a 500 GB SSD, and 2 GB video memory. The development utilized both front-end and back-end tools. Visual Studio Code was employed for programming the administrator panel and web system due to its versatile features and user-friendly interface for coding, debugging, and version control. Figma was used for prototyping and interface design, enabling collaborative creation of wireframes and interactive layouts. Canva assisted in designing visual assets and mockups, providing consistent and efficient creation of marketing and UI materials.

System Design

In the System Design phase, the researchers used a variety of analytical and visual modeling tools to ensure clarity and efficiency in developing KHRIA. The storyboard outlined the website's flow, illustrating the user experience and system operations. A Use Case Diagram (see Figure 2) identified the system's actors, administrators, and users, detailing their interactions with the platform. Flowcharts depicted the logical sequence of processes, while the Visual Table of Contents (see Figure 3) organized website components and navigation paths for improved usability. The Entity Relationship Diagram (see Figure 4) defined the database structure and relationships among entities, and the Data Flow Diagram mapped the movement of information from user input to AI processing, database storage, and website

deployment. Collectively, these tools provided a comprehensive understanding of the system's functionality, data flow, and design, promoting collaboration and transparency among team members.

Figure 2
Use Case Diagram

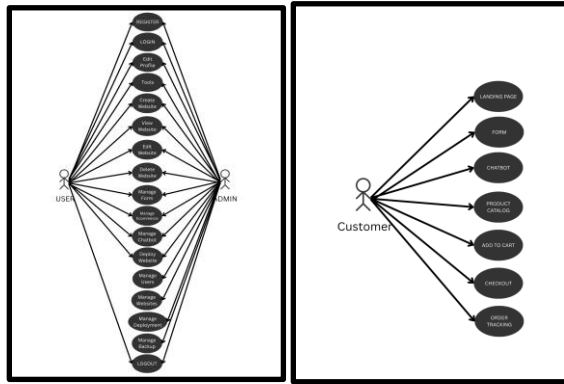
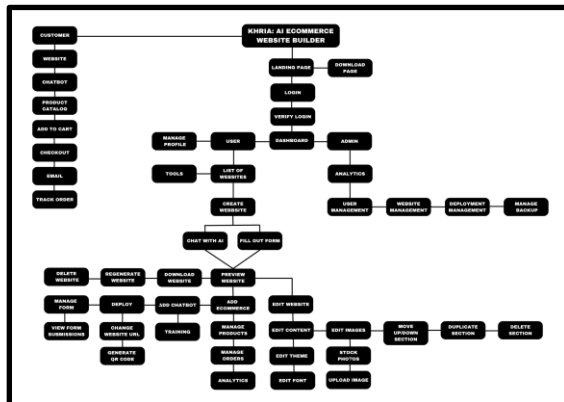


Figure 3
Visual Table of Contents

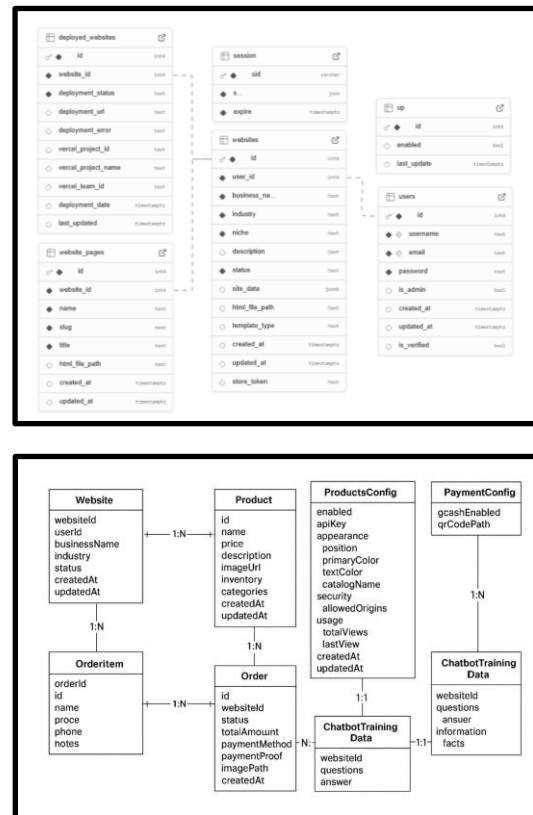


Implementation

The implementation phase of KHRIA involved a structured approach, beginning with requirement gathering and validation to ensure the system met researcher and user needs, including AI-generated design templates and e-commerce integration. During the conceptualization period, the UI/UX team developed wireframes and prototypes, with the modified waterfall model allowing overlap between design and coding to gather early feedback on usability and performance. In the coding phase, developers implemented AI algorithms for automated layout creation, content generation, and integration of third-party APIs, while continuous validation ensured all features met requirements. Rigorous testing

followed, using AI-based QA tools to detect bugs, optimize performance across devices, and confirm system responsiveness. The system was deployed using the Vercel API for efficient cloud deployment, continuous integration, and automated updates. Additionally, the Google Maps API enhanced the platform's functionality by enabling location-based features, improving navigation, and creating a more intuitive user experience.

Figure 4
Entity Relationship Diagram



Integration and Testing

The integration phase of KHRIA involved combining all modules from the coding phase into a unified system, including AI-driven content generation, user interfaces, databases, and external APIs such as domain registration tools. Verification ensured smooth

The interaction between components, while validation confirmed that the system met user requirements.

Testing covered both functional and non-functional aspects, including e-commerce features, system responsiveness, and security. AI-based tools facilitated automated regression testing across multiple devices and browsers.

The testing process included six stages: unit, integration, system, developer, alpha, and beta testing, progressively ensuring that individual components, the complete system, and real-world deployment met quality standards.

Feedback from panels, clients, and advisers was incorporated to improve the system. Alpha and beta testing employed a survey instrument based on the ISO 25010 Software Product Quality Model, assessing functional suitability, interaction capability, security, and flexibility. The questionnaire was pre-tested and validated with IT experts to ensure unbiased and reliable results, using statistical methods such as frequency distribution, mean scores, and Likert scale analysis.

Deployment of System

The deployment phase of KHRIA involves placing the system in a live environment and ensuring it functions as intended. Pre-deployment preparations include finalizing configurations, setting up hosting environments, and verifying hardware and software compatibility. Users are trained on AI-powered features, such as automated content generation, and provided with documentation for operational guidance. Final acceptance tests are conducted to confirm system stability and performance under real-world conditions. Post-deployment, monitoring and feedback mechanisms are implemented to track system performance, user interactions, and engagement using analytics tools. Feedback loops allow the researchers to identify and address any issues, while the modified waterfall approach facilitates incremental adjustments, ensuring smooth integration without disrupting operations.

Maintenance

After deployment, KHRIA undergoes maintenance to ensure functionality, security, and performance. AI-driven tools monitor and predict issues, while automated debugging and updates address code problems and system improvements. Periodic enhancements, user feedback integration, and security patches maintain optimal system performance, with AI enabling autonomous updates for continuous improvement.

RESULTS

The study successfully developed the KHRIA AI E-Commerce Website Builder using the Modified Waterfall Model, employing React.js and Google Gemini AI to enable automated content generation and e-commerce integration. Structured design tools, including flowcharts and storyboards, guided the development process to ensure a logical user journey from

template selection to deployment. The system underwent rigorous evaluation based on ISO 25010 standards, achieving an "Excellent" rating in both testing phases. Alpha testing by IT experts yielded a mean score of 4.88, while Beta testing with students and business owners resulted in an improved score of 4.99, confirming the platform's high stability, security, and usability for non-technical users.

Requirements Gathering and Analysis

The researchers conducted a thorough analysis of user and technical requirements to guide the development of KHRIA: AI E-Commerce Website Builder. Feedback from MCC Entrepreneurship students and local business owners was gathered through surveys and interviews to identify challenges in online presence and needed features such as AI templates, e-commerce integration, mobile responsiveness, and security. Additionally, hardware and software requirements were assessed to ensure system reliability, scalability, data security, and ease of maintenance, providing a solid foundation for efficient development and long-term operation of the platform.

During the design phase of KHRIA, the researchers used structured system analysis and design tools such as flowcharts, storyboards, use case diagrams, VTOC, ERD, and DFD to clearly map workflows, user interactions, and data processes. These methods helped define the complete user journey—from account creation and website generation to customization and deployment—ensuring that all functional requirements were clearly identified and refined before development.

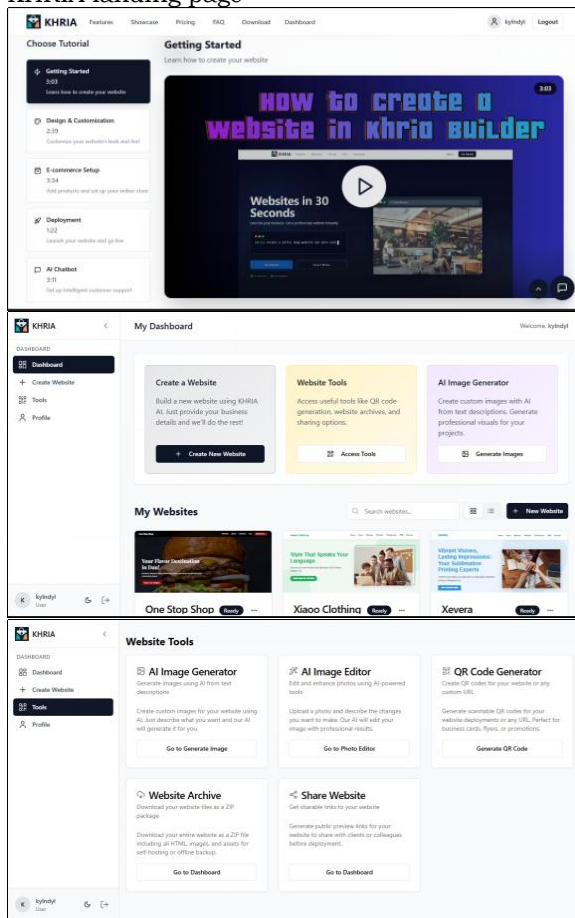
For development, KHRIA utilized a modern technology stack to ensure performance, security, and usability. The frontend was built with React.js and TypeScript, supported by tools for responsive design, form validation, animations, and data visualization. The backend used Node.js and Express.js with real-time communication features, while Supabase, PostgreSQL, and AWS S3 handled data storage and backups. Security was strengthened through encryption, session management, and two-factor authentication. AI features were powered by Google Gemini AI, while deployment and hosting were handled through Render.com and Vercel. Additional integrations such as Google Maps, QR code generation, stock image APIs, and SEO tools further enhanced system functionality, resulting in a scalable and user-friendly platform for entrepreneurs and small businesses.

System Implementation

The implementation of KHRIA (see Figure 5) followed a structured development process that transformed its conceptual designs into a fully functional, AI-powered website builder. This phase ensured that key features—such as automated template generation, AI-assisted content creation, e-commerce integration, and user-friendly customization—were aligned with system requirements and user expectations. The approach aimed to simplify website creation, support digital business growth, and provide a smooth and responsive user experience.

To ensure accuracy and consistency, the researchers applied system analysis and design methodologies, particularly flowcharts, to visualize core processes such as user interaction, login verification, template selection, and AI-driven website generation. These tools clarified system logic and guided development decisions throughout the implementation phase.

Figure 5
KHRIA landing page



Testing

The researchers conducted both alpha and beta testing to evaluate the system. In the alpha testing phase, three respondents Aljon Quiambao, Mervin Tabios, and Robbert Bamba, MEECE were asked to assess the system. All alpha testers are professionals working in the IT industry and teaching IT-related subjects, selected based on their expertise and experience in the field of information technology. For beta testing, thirty respondents participated in the evaluation, consisting of ten students from Mabalacat City College pursuing a Bachelor of Science in Entrepreneurship (BSE) and twenty potential business owners. The system was assessed using the ISO 25010 criteria, which include functionality suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. The proponents applied the ISO evaluation criteria and interpreted the results using a Likert scale.

Table 2
Summary of Alpha Test Result

ISO 25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.98	Excellent
Performance Efficiency	4.78	Excellent
Compatibility	5.0	Excellent
Interaction Capability	4.99	Excellent
Security	4.75	Excellent
Flexibility	4.89	Excellent
Maintainability	4.79	Excellent
Overall Mean Score	4.88	Excellent

The alpha testing of KHRIA (see Table 2), based on ISO 25010 standards, showed excellent performance across all criteria. Functional suitability, performance efficiency, compatibility, interaction capability, security, flexibility, and maintainability all received high scores, with an overall mean of 4.88, verbally interpreted as “Excellent,” demonstrating the system’s stability, usability, and strong alignment with quality standards.

Beta Test Results

The beta testing of KHRIA involved thirty respondents: ten BSE students from Mabalacat City College and twenty prospective business owners. Researchers conducted live demonstrations of the platform before administering questionnaires to collect feedback and suggestions (see Table 3). The evaluation followed ISO 25010 standards, focusing on

functional suitability, compatibility, interaction capability, security, and flexibility. This phase provided a comprehensive assessment of the system's usability, performance, and overall effectiveness from real users' perspectives.

The beta testing of KHRIA showed excellent performance across all evaluated ISO 25010 criteria. Functional suitability, performance efficiency, compatibility, interaction capability, security, and flexibility all received high scores, resulting in an overall mean of 4.99, verbally interpreted as "Excellent." This demonstrates the system's improved performance, usability, and strong alignment with quality standards compared to the alpha test.

Table 3
Summary of Beta Test Result

ISO 25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.98	Excellent
Performance Efficiency	5.0	Excellent
Compatibility	5.0	Excellent
Interaction Capability	5.0	Excellent
Security	5.0	Excellent
Flexibility	4.99	Excellent
Overall Mean Score	4.99	Excellent

The evaluation of KHRIA through both alpha and beta testing (see Table 4), based on ISO 25010 standards, showed consistently excellent performance across all criteria. Functional suitability scored 4.98 in both tests, while performance efficiency remained high (4.78 in alpha, 5.0 in beta). Compatibility achieved a perfect 5.0, and interaction capability improved from 4.99 in alpha to 5.0 in beta. Security increased from 4.75 to 5.0, and flexibility rose from 4.89 to 4.99. Maintainability, assessed in the alpha test, scored 4.79. The overall mean improved from 4.88 in alpha testing to 4.99 in beta testing, both interpreted as "Excellent," demonstrating continuous system improvement, reliability, and adherence to quality standards.

The KHRIA: AI E-Commerce Website Builder offers a user-friendly interface designed to help entrepreneurs and business owners create and manage online stores efficiently. Key features include AI-powered website generation, theme customization, content editing, image management, and e-commerce integration.

Users can upload their own images or access stock photos via the Pexels API, while the Google Maps API allows businesses to display their physical locations. The platform also supports chatbot integration for customer interaction and automatic deployment to Vercel for seamless hosting and updates.

DISCUSSION

The researchers developed KHRIA: AI E-Commerce Website Builder to help entrepreneurs and business owners create professional websites easily using AI. The study aimed to identify current digital promotion methods, challenges in establishing an online presence, and the key features needed to streamline website creation, improve accessibility, and support business growth in the digital market. Conducted at Mabalacat City College (MCC) with entrepreneurship students and local business owners, participants' insights guided the design and development of KHRIA, ensuring the platform effectively meets users' needs for online business promotion.

Table 4
Summary of Alpha and Beta Test Results

ISO 25010 Criteria	Mean Score (Alpha Test)	Verbal Interpretation (Alpha Test)	Mean Score (Beta Test)	Verbal Interpretation (Beta Test)
Functional Suitability	4.98	Excellent	4.98	Excellent
Performance Efficiency	4.78	Excellent	5.0	Excellent
Compatibility	5.0	Excellent	5.0	Excellent
Interaction Capability	4.99	Excellent	5.0	Excellent
Security	4.75	Excellent	5.0	Excellent
Flexibility	4.89	Excellent	4.99	Excellent
Maintainability	4.79	Excellent		
Overall Mean Score	4.88	Excellent	4.99	Excellent

Conclusion

Based on the findings, the researchers concluded that KHRIA: AI E-Commerce Website Builder successfully achieves its objectives as a smart, user-friendly platform for entrepreneurs and business owners.

Comprehensive AI-Driven Platform: KHRIA simplifies website creation by combining conversational AI, structured forms, and

automatic template selection, enabling even non-tech-savvy users to build professional websites quickly and efficiently.

Enhanced Productivity Through AI Tools: Integrated tools such as AI Image Generator, AI Image Editor, QR Code Generator, and Website Archiver improve creativity, efficiency, and digital management, making the platform multifunctional and practical for real-world use.

Secure and Reliable Verification: Time-sensitive email authentication ensures secure access to sensitive site management features, protecting user data and reinforcing system credibility.

User-Centered and Inclusive Design: Offering both chat-based and form-based website creation, along with voice interaction support, KHRIA accommodates diverse user needs and promotes accessibility.

Contribution to Digital Empowerment: KHRIA fosters digital literacy, entrepreneurship, and innovation, helping small businesses and students establish an online presence, enhance visibility, and support long-term community and technological growth.

Recommendations

Based on the study's findings and conclusions, the researchers recommend the following improvements for KHRIA:

Strengthen System Performance for High-Volume Transactions: Enhance system infrastructure by optimizing database management, server responsiveness, and load balancing to ensure smooth operation during periods of heavy concurrent use.

Improve Network Capability: Upgrade network capacity and optimize real-time communication between client and server to maintain accessibility and stability, allowing users to create, edit, and deploy websites efficiently regardless of internet speed.

Increase Authentication Options: Introduce additional login and authentication methods, such as biometric verification or OAuth integration, to improve accessibility, security, and convenience for users while protecting their accounts.

ACKNOWLEDGEMENT

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entrepreneurs and who participated as Alpha and Beta testers, providing essential feedback to improve the system. Finally, the team recognizes the dedication and collaboration of all research members, whose contributions were essential in bringing KHRIA to completion.

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MaCisanmetungCa: A Centralized Student Election Management System for Mabalacat City College - COMSELECA

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ABSTRACT

MaCisanmetungCa is a web-based candidate management system developed to address the inefficiencies and limitations of the traditional student council candidacy and election process at Mabalacat City College. The former process relied heavily on manual submissions, paper-based documents, and in-person verification, which often led to delays, inconsistent candidate screening, human errors, and limited accessibility for both students and election officers. These challenges highlighted the need for a more efficient, transparent, and technology-driven solution. The primary objective of the study was to design and implement a centralized digital platform that streamlines the entire candidacy and election workflow. Through MaCisanmetungCa, student candidates can conveniently submit their applications online, upload required documents, schedule screening appointments, and receive real-time updates regarding their application status. Election administrators are provided with tools to review and verify candidate requirements, manage election activities, and oversee the voting process, ensuring accuracy and consistency in election management. The system was developed using modern web technologies and cloud-based services, including Firebase Authentication and Firebase Realtime Database, to ensure secure user authentication, data protection, and role-based access for administrators, candidates, and voters. The development process followed the Software Development Life Cycle (SDLC), specifically the Modified Waterfall Model, which enabled a structured and systematic approach while allowing necessary revisions and improvements throughout development. To assess the quality and effectiveness of the system, MaCisanmetungCa was evaluated using the ISO 25010 software quality standards, focusing on functional suitability, performance efficiency, interaction capability, reliability, and security. Results from user testing demonstrated that the system significantly reduced manual workload, minimized errors in document verification, and enhanced accessibility and transparency across the candidacy and election processes. Overall, MaCisanmetungCa shows strong potential to modernize student elections at Mabalacat City College by providing an organized, secure, and user-friendly digital solution. The system supports fair, efficient, and accountable student governance and contributes to a more transparent and technology-driven academic environment that benefits student leaders, election officers, and the broader academic community.

Keywords: Information System, Candidate Management System, Student Election System, Election Management, Web-Based Application.

INTRODUCTION

Elections are essential to democratic governance as they enable citizens to choose leaders while ensuring fairness, accountability, and legitimacy. Worldwide, elections take various forms and are guided by international standards that emphasize transparency, secure candidate and voter processes, and accurate result reporting. Organizations such as the International Institute for Democracy and Electoral Assistance (International IDEA)

support democratic institutions by promoting best practices in election management and encouraging the adoption of digital tools to improve efficiency and credibility.

In the Philippines, elections play a vital role in sustaining democracy, with the Commission on Elections (COMELEC) overseeing voter registration, candidate verification, election supervision, and the proclamation of winners. These responsibilities help ensure transparent and lawful electoral processes. Similarly, student council elections mirror democratic systems by allowing students to elect representatives who advocate for their interests,

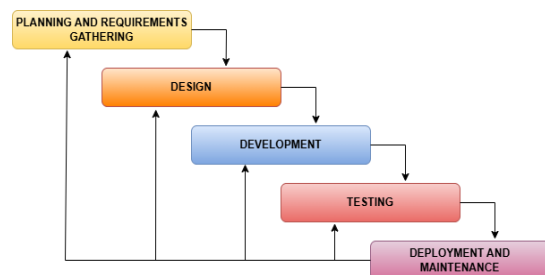
promote leadership, and strengthen institutional governance within academic communities. However, many educational institutions in the Philippines continue to rely on manual student election processes, which are often time-consuming, prone to errors, and lacking real-time updates. These limitations reduce student participation and engagement. Although semi-digital approaches such as the use of Microsoft Forms were implemented during the 2025 student government election at Mabalacat City College under COMSELECA, challenges such as slow processing, limited transparency, and manual data handling persisted.

To address these issues, the study introduces MaCisanmetungCa, a centralized web-based student election management system for Mabalacat City College. The system aims to automate the entire election process, including candidate filing, campaign dissemination, secure online voting, and real-time result generation. By utilizing centralized data management, role-based access control, and real-time reporting, the proposed system enhances transparency, accuracy, efficiency, and accessibility. Overall, MaCisanmetungCa supports modern digital governance in education and seeks to empower students to participate in a secure, reliable, and technology-driven democratic process.

METHODOLOGY

This chapter outlines the methodology and design used in developing MaCisanmetungCa. It presents the systematic steps followed throughout the project using the Modified Waterfall Model of the Software Development Life Cycle (SDLC). Each phase of the SDLC from planning and requirements gathering to system deployment is described in detail to illustrate how the system was conceptualized, developed, tested, and implemented. (See Figure 1).

Figure 1
The Modified Waterfall Model



Planning and Requirements Gathering

The Planning and Requirements Gathering phase is the initial and critical step in developing MaCisanmetungCa: A Centralized Student Election Management System, aimed at modernizing and streamlining student government elections at Mabalacat City College. During this phase, the researchers identified the limitations of the existing election processes, which relied on manual candidacy applications, semi-digital tools such as Microsoft Forms, and other paper-based procedures. These methods often led to delayed results, limited transparency, and susceptibility to human error. Consultations with COMSELECA officials and student representatives were conducted to gain a clear understanding of the workflows, recurring challenges, and expectations for an improved system.

In parallel, the researchers reviewed existing technologies, including web-based election management systems, online voting platforms, and electronic authentication mechanisms. Web-based election systems were analyzed for their ability to provide centralized dashboards, real-time monitoring, automated vote tallying, and reporting functionalities. Online voting platforms were evaluated for accessibility, speed, and security, allowing students to vote remotely while maintaining data integrity and anonymity. Authentication mechanisms were studied to ensure that only authorized users including COMSELECA administrators, candidates, and voters could access the system securely, incorporating measures such as email verification, role-based access, and strong password enforcement. These insights directly informed the design and functionality of MaCisanmetungCa, addressing inefficiencies in traditional and semi-digital election processes, such as errors in vote counting, lack of verification mechanisms, and limited real-time monitoring.

Based on the functional and non-functional requirements identified during consultations and research, the hardware and software specifications necessary to support the system were determined. Hardware requirements focused on development using laptops, ensuring sufficient processing speed, memory, and storage to support real-time data synchronization and responsive interfaces. Software requirements included React 19 for

dynamic and interactive user interfaces, Vite for optimized performance, Tailwind CSS for responsive design, Firebase Authentication for secure login and access control, Firebase Realtime Database for cloud-hosted data storage and synchronization, and React Router DOM for seamless navigation. Development and debugging were performed using Visual Studio Code, while GitHub was used for version control and collaboration. These specifications ensure that the system is reliable, secure, and capable of supporting all planned functionalities.

DESIGN

In this phase, the researchers employed several analysis and design tools to effectively conceptualize and structure MaCisanmetungCa: A Centralized Student Election Management System for Mabalacat City College – COMSELECA. The tools included the Use Case Diagram, Visual Table of Contents (VTOC), Gantt Chart, Storyboard, and Entity Relationship Diagram (ERD). Each tool played a key role in defining system functionality, user interactions, data flow, and database structure. The Use Case Diagram provides a visual representation of how the MaCisanmetungCa system interacts with its primary users Super Admin, Admin, Candidates, and Voter (see Appendix F). The diagram maps the specific actions each user is authorized to perform, emphasizing the flow of operations within the election process. These diagrams define the full scope of the system by mapping out every action each user can perform. For student voters, the use cases include account authentication, viewing election details, reviewing the candidate list, casting votes, and viewing real-time election results. Voters can also apply for candidacy, which extends their access to additional functions once approved.

The VTOC outlines how major components such as user authentication, candidacy management, screening workflows, election configuration, campaign material monitoring, voting processes, and results generation are interconnected to support the entire election lifecycle. By visualizing these modules in a logical sequence, the VTOC helps clarify system navigation paths, showing how users move from one function to another based on their assigned roles. This structure ensures that both students and COMSELECA officers can easily locate system features without confusion, regardless of their

technical expertise. The Gantt Chart outlines the entire development timeline for the MaCisanmetungCa system. It visually presents the sequence and duration of each project phase, including system analysis, design, module development, integration, testing, deployment, and evaluation. By clearly showing the start and end dates of all tasks within this nine-month period, the Gantt Chart helps the team track progress, identify potential delays, and make timely adjustments when needed. It also supports effective resource allocation by highlighting overlapping activities and task dependencies. The Entity Relationship Diagram (ERD) provides a basic yet clear representation of the MaCisanmetungCa system's database structure. It identifies the main entities User, Candidate, Position, Election, Document, Screening Appointment, Campaign Material, Vote, Result, and Audit Log along with their primary keys, attributes, and foreign key relationships. Storyboards were utilized to visually depict key user interactions and system workflows. They demonstrate step by step sequences for processes such as user login, candidate COC submission, appointment scheduling, campaign material upload, electronic voting, and administrative monitoring. Storyboards help the team anticipate user behavior, ensure usability, and align the system's visual and functional design with user expectations. Canva was used to create clear and engaging mockups of the interface, reflecting the platform's responsive and intuitive design.

Development

The development phase marks the transformation of system designs into a fully operational application. For MaCisanmetungCa: A Centralized Student Election Management System for Mabalacat City College – COMSELECA (see Figure 2-3), this stage involved implementing a web-based platform specifically designed to manage student elections efficiently, securely, and transparently. The system includes several key modules, such as Certificate of Candidacy (COC) submission and screening, campaign management, and online voting. Candidates can submit their COCs and support documents digitally, schedule screening appointments based on administrator-assigned time slots, and track their application

status in real-time, reducing manual errors, and improving document management. In the campaign management module, candidates can upload media and platforms, which are reviewed and approved by COMSELECA officers before being made visible to voters, promoting transparency and accessibility.

Figure 2
System Homepage, Super Admin (Manage User), Super Admin (Activity Log), Admin Dashboard, & Candidate Dashboard

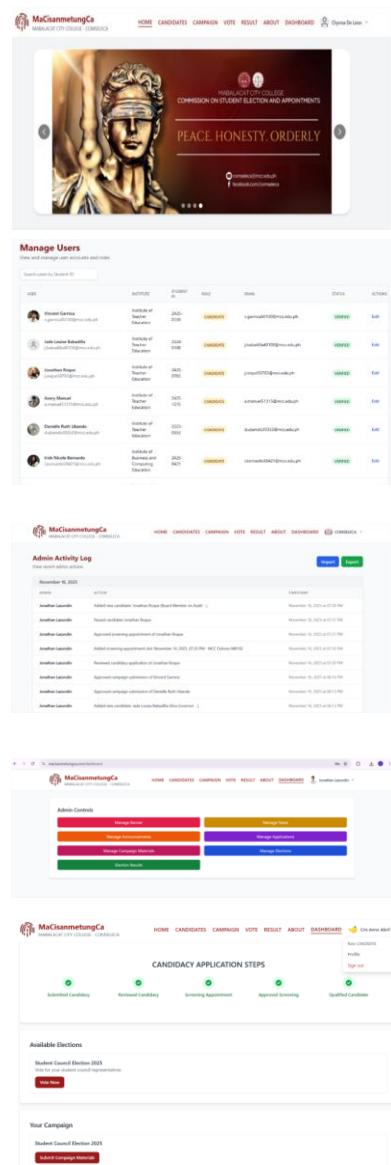
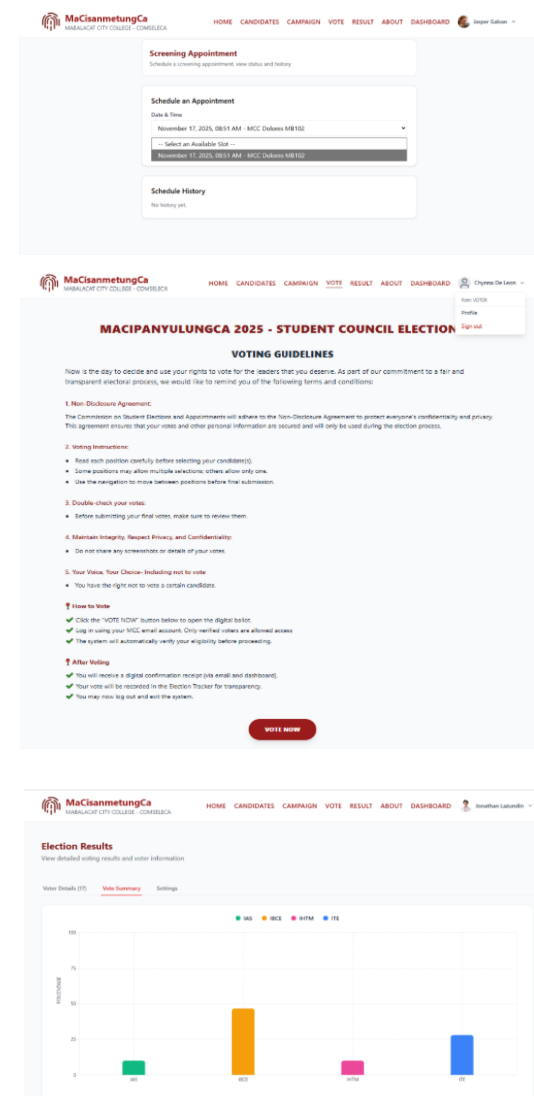


Figure 3
Systems' Candidate Screening Appointment Page, Voting Guidelines, & Real-time Election Results



The voting module enables verified MCC students to cast their votes securely online. This module includes real-time vote tallying, role-based access control, email notifications confirming successful voting, and administrative oversight of live election progress. Administrators can generate official election reports and maintain detailed audit logs for accountability.

Testing

The testing phase of MaCisanmetungCa: A Centralized Student Election Management

System for Mabalacat City College – COMSELECA involved a comprehensive process to ensure accuracy, usability, performance, and reliability prior to deployment. Unit testing was performed to evaluate the functionality of individual modules within the MaCisanmetungCa system.

Core components such as Certificate of Candidacy (COC) submission, document uploads, screening appointment scheduling, campaign material verification, and administrative approval workflows were tested independently to confirm that each operated according to the system's design specifications. Any detected errors or inconsistencies were addressed during this phase to ensure module-level reliability. Afterward, integration testing was conducted to verify the seamless interaction of modules when combined. Data flow and process coordination between candidates, administrators, and voters were thoroughly examined. This stage ensured proper synchronization of records, accurate processing of submissions, and smooth execution of critical election functions such as voting, validation, and result computation. Together, these testing activities confirmed that the system performed coherently as a unified platform. During system testing, the fully integrated application was evaluated by the Quality Assurance (QA) team under realistic conditions. The system was tested on multiple devices, including desktops, laptops, and mobile phones, to ensure responsiveness, compatibility, and consistent performance across platforms. A checklist based on the system's use case diagram was used to systematically assess the functionality, accuracy, and reliability of each feature, including real-time vote tallying, administrative monitoring, and notification systems.

Deployment and Maintenance

The Deployment and Maintenance phase marks the transition of MaCisanmetungCa: A Centralized Student Election Management System from development to real-world use by COMSELECA, candidates, and student voters. After achieving a stable and fully functional build, the system was deployed on a secure online hosting platform to ensure accessibility, reliability, and smooth performance throughout the election period. During deployment, administrator and COMSELECA accounts were

set up, election schedules were configured, and key modules including Certificate of Candidacy (COC) filing, candidate screening, campaign material management, and online voting were activated for official use. All major system features were also prepared and validated, such as secure user authentication with role-based access control, digital COC submission, automated screening and approval processes, managed campaign content uploading, voter eligibility verification, an intuitive online voting interface, automated vote tallying, real-time results generation, and activity logs for transparency and accountability. Once the system was fully deployed, maintenance activities were performed to ensure consistent reliability, security, and long-term sustainability. These activities included continuous monitoring of system performance, resolving technical issues reported by users, fixing bugs, optimizing system components, and updating features whenever needed. User feedback from COMSELECA officers, candidates, and student voters played a crucial role in enhancing system usability, improving navigation, strengthening security measures, and refining election workflows. Through integrated deployment and maintenance, the researchers ensured not only the successful launch of MaCisanmetungCa but also its ongoing efficiency, stability, and adaptability for future student elections at Mabalacat City College.

ure 7: Candidate Screening Appointment Page

RESULTS

This section presents the results of the study and discusses how the objectives of MaCisanmetungCa: A Centralized Student Election Management System for Mabalacat City College – COMSELECA were achieved. It outlines the system's requirements for analysis, design, implementation, and evaluation, as well as the results of alpha and beta testing based on the ISO 25010 software quality model.

Testing Results

The testing of the MaCisanmetungCa system was conducted in two phases: Alpha (see Table 1) and Beta testing (see Table 2). The Alpha phase focused on evaluating the technical functionality of the system, ensuring that all modules, features, and workflows operate as intended. The Beta phase, on the other hand, assessed user satisfaction, usability, and overall

experience with the platform. Both phases of testing were guided by the ISO/IEC 25010 Software Quality Model, which examines critical aspects of software quality including Functional Suitability, Performance Efficiency, Interaction Capability, Reliability, Security, and Maintainability. The results from these evaluations provided insight into system strengths and areas for improvement, ensuring that the final deployment meets both technical standards and user expectations.

Table 1
Summary Result of Alpha Test

Criteria	Weighted Mean	Interpretation
Functional Suitability	4.3	Good
Interaction Capability	4.36	Good
Reliability	4.15	Good
Performance Efficiency	3.9	Good
Security	4.21	Good
Maintainability	4.0	Good
Overall Mean	4.15	Good

The evaluation of MaCisanmetungCa across the Alpha and Beta testing phases demonstrates significant improvement and refinement of the system from internal development to real-user deployment. During Alpha testing, conducted by IT experts, the system achieved an overall weighted mean of 4.15, interpreted as Good, with notable strengths in Interaction Capability (4.36) and functional suitability (4.3), while performance efficiency (3.9) indicated areas for optimization. Following adjustments and improvements based on feedback, Beta testing involved actual users, including COMSELECA administrators, candidates, and student voters, yielding an overall weighted mean of 4.86, interpreted as Excellent. All individual criteria; functional suitability (4.93), Interaction Capability (4.91), reliability (4.92), performance efficiency (4.87), security (4.90), and maintainability (4.6) showed significant enhancement, confirming that the system performs reliably, efficiently, and securely in a real-world environment. This progression from Alpha to Beta testing highlights the effectiveness of iterative development, the responsiveness to

user feedback, and the system's readiness for full deployment in managing student government elections at Mabalacat City College.

Table 2

Criteria	Weighted Mean	Interpretation
Functional Suitability	4.93	Excellent
Interaction Capability	4.91	Excellent
Reliability	4.92	Excellent
Performance Efficiency	4.87	Excellent
Security	4.90	Excellent
Maintainability	4.6	Excellent

Summary Result of Beta Test

DISCUSSION

This section presents the results of the study and discusses how the objectives of MaCisanmetungCa: A Centralized Student Election Management System for Mabalacat City College – COMSELECA were achieved. It outlines the system's requirements for analysis, design, implementation, and evaluation, as well as the results of alpha and beta testing based on the ISO 25010 software quality model.

MaCisanmetungCa has several limitations. It is designed exclusively for Mabalacat City College and cannot be directly used by other institutions or for government-level elections without modification. Only currently enrolled MCC students are allowed to participate as voters or candidates. Although the system supports digital submission of documents, physical submission is still required for official validation. Screening and verification processes are also limited to fixed schedules set by COMSELECA administrators. In addition, the system heavily depends on stable internet connectivity and has limited offline functionality, which may affect access during network interruptions. Its authentication system relies only on email and password login and does not include advanced security measures such as two-factor authentication or biometric verification. Campaign violations are not automatically detected and still require manual review by administrators. Lastly, while vote tallying and result generation are automated, the system does not integrate with external devices such as biometric scanners or voting kiosks.

Conclusions

The development and deployment of the MaCisanmetungCa: A Centralized Student Election Management System successfully addressed the long-standing challenges in the traditional student election process of Mabalacat City College. Through the Modified Waterfall SDLC, each phase from data gathering to deployment was systematically completed, allowing the researchers to refine the system based on user needs and technical requirements. Early investigations into existing web-based election platforms, online voting technologies, and authentication mechanisms revealed key gaps in accuracy, timeliness, transparency, and security in the previous manual system. These insights guided the design of a centralized, role-based platform that streamlined the election workflow.

The system's features including candidate registration, appointment scheduling, campaign material submission, election configuration, secure online voting, and automated results proved effective in improving operational efficiency and reducing human error. The integration of Firebase Authentication and Realtime Database ensured secure, real-time processing of all election data, while the user interface built with React 19 and Tailwind CSS delivered a responsive and accessible experience for students and administrators.

Testing outcomes further validated the system's success. Internal developer testing confirmed the stability of core functions. Alpha Testing by IT experts rated the system "Good" across all ISO 25010 software quality criteria, while Beta Testing by student users produced "Excellent" ratings in functional suitability, interaction capability, reliability, performance efficiency, security, and maintainability. These results indicate that the system meets both professional technical standards and user expectations.

The live deployment of the system via Hostinger and the dedicated domain www.macisanmetungca.com demonstrated that the platform performs reliably in real-world conditions. Role-based access control functioned effectively, audit logs ensured transparency, and online voting operated securely and accurately. The system ultimately proved its capability to support a fair, transparent, and efficient student election process.

In conclusion, MaCisanmetungCa successfully transformed the traditional student election process at Mabalacat City College into a modern, digital, and transparent system. It enhances participation, strengthens institutional integrity, and aligns with global goals on digital empowerment and accountable governance. The system is ready for continued use in future academic years and serves as a strong foundation for further improvements and scalability.

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MCCARE: A WEB-BASED GUIDANCE COUNSELING SYSTEM FOR MABALACAT CITY COLLEGE

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ABSTRACT

Many students are struggling mentally due to pressure or stress in family, life, career, and mostly academics. Being mentally healthy is a crucial part of our daily life; it may affect the way you talk, act, and think, and it can also affect our efficiency. Neglecting mental health may lead to future consequences and unnecessary life events. This study developed a system, named MCCARE, for Students and MCC Guidance Service Unit, which operates to help our locals to encourage the students in the community to seek counsel from our lifeguides of MCC Guidance Service Unit and to have a safe place where they can freely express themselves, allowing them to be heard and helped to improve their mental health. Also, the system helped our lifeguides to have an efficient and reliable web base system for their records and database, a crucial role to see the student status and needed information. The researchers used a modified waterfall approach for systematic progress throughout the project stages. The system is precisely evaluated through a survey, which achieves an overall score of 4.59 rating result in alpha test and a refined score of 4.76 rating result in beta test. The higher beta test rating result showed that improvements were made to happen to address any weaknesses identified during the alpha testing phase. The website system was accomplished by meeting the criteria for functional stability, compatibility, interaction capability, reliability, security, maintainability, flexibility, and safety. These criteria usefully performed all the needed functions, the simplicity of its use, and the security protocols needed and illustrated high reliability. The developed website was designed to line up with and support the attainment of certain Sustainable Development Goals (SDGs).

Keywords: Web System, Appointment System

INTRODUCTION

High cortisol levels can have a profound impact on the overall well-being and performance of every student, and understanding their generality and quantifying it is crucial for achieving effectiveness (Tina Murtagh, 2023). The Web-based Guidance Counseling System plays a big part in determining one's learning progress academically and mentally; every student should exceed the performance in every class while maintaining mental health awareness. It helps students to be aware, informed, and reminded (Independent School Management, 2023). The rising stress and burnout levels among college students in the Philippines, coupled with the increased rates, call for immediate action (Jeff Clyde Guillermo Corpuz, 2023).

According to the National Library of Medicine, attending college can be a stressful time for many students. This may cause coping with academic pressure, dealing with stressful tasks, and even separation from their family origin, and some of the students are pressured to attend to several work and family responsibilities (

Abelson, S., Lipson, S. K., & Eisenberg, D. 2021). Due to this, most students experience the first onset of mental health issues or, worse, an exacerbation of their symptoms.

While here in our country, the Philippines. College students have gained alarming attention for committing suicide. NCMH received 21,568 calls in its mental health hotline, with some 7600 related to suicide. Most of the students were 18 to 30 years old, while around 4800 were below 17 years old. Most of these students are facing the pressure associated with academic performance, financial burdens, social expectations, rising stress, and burnout levels (Jeff Clyde Guillermo Corpuz, 2023).

According to the National Alliance of Mental Illness (NAMI), understanding mental health is essential because it has a massive impact on our daily lives. The World Health Organization (WHO) states that mental health is a condition of well-being in which an individual can cope with the stresses of life and work productively. Good mental health allows people to manage their lives with resilience and adapt to changes in any situation (Solv Health, 2024).

The system is a web-based platform that is being suggested and is intended to improve and

expedite the students of Mabalacat City College (MCC), ensuring the enhancement of the mental health of the students. The system is specifically designed to assist students in achieving their academic goals. It offers an extensive set of features, including daily reminders, quotes of encouragement, and an appointment system. These tools are specifically designed to help reinforce the key understandings and skills necessary to engage students in mental health awareness. Helping students maintain their academic performance while effectively regulating their mental well-being.

Objective of the study

The general objective of the study is to support students' mental health to maintain their academic performance. The system served as the primary information database for the Guidance Council office at Mabalacat City College. It served as an appointment system and a record-keeping tool for students' cases. It is also a gateway for student engagement.

- To gather needed information through surveys, interviews, and internet research.
- To identify hardware and software requirements for the development of the system.
- To design a web-based system using the following diagrams
- To build the system with the following features: Appointment System, Database Management System, Announcements, Motivational Message of the Day, and Freedom Wall
- To integrate the following user-level: Administrators, and Students
- To test the system through alpha and beta testing.
- To assess the simulation software in terms of functional suitability, compatibility, interaction capability, reliability, security, maintainability, flexibility, safety, and ease of use of the ISO 25010 Software Product Quality Standards.
- To implement the system in the Guidance Council at Mabalacat City College

Scope and limitations

A storyboard visually provides the step-by-step process of how the students interact with the system, which is helpful for user interface planning. The Visual Table of Contents (VTOC) outlines the overall structure of the system's features in a graphical format, helping researchers to identify what is included in the system. A menu tree breaks down the navigation and menu hierarchy, which helped the researchers visualize how students have access to the different menus and submenus of the

system. The use case diagram shows what actions each type of user can perform, helping the researchers to define system requirements. The Entity Relationship Diagram (ERD) maps out how entities and their attributes relate to each other within the system, which is essential for database designing.

The researchers developed a student counseling appointment system in which students can book appointments at any time and from anywhere, allowing guidance associates to address their issues or concerns swiftly. Students can choose their preferred setting for the appointment; it can be face-to-face or through chat. The chat system helped monitor students to see if they're interested in making an appointment. The Database Management System enhanced the management of student records. It solves the problem of the guidance counselor about their issues with their records, such as sorting the cases of students. Additionally, it has data analysis so that they can distinguish the results more clearly. The motivational message of the day helps the students to keep going with their studies, and only admins can edit this feature. The Online Freedom Wall provides a space for students to express their opinions, ideas, and emotions, and it can be considered a "confession wall," allowing students to convey their feelings. The system manages the feature and can remove unnecessary or vulgar comments.

To integrate user-level access into the system, administrators and students are the two primary roles, each with distinct access to the system. Administrators have complete control over the system, which includes updating, managing, and monitoring the system contents (such as student records, reminders, messages of the day, and the online freedom wall). Students can interact with the system features, where they can access services such as scheduling appointments, viewing the message of the day and the contents of the online freedom wall, and expressing their thoughts on the online freedom wall. The user-level integration ensures that access to the system components is role-based, maintaining usability and data integrity.

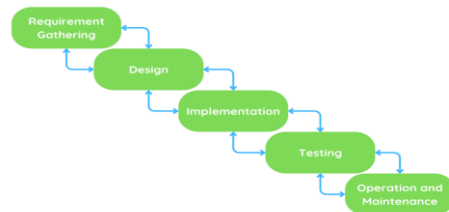
The study targets three (3) professionals as alpha testers. Twenty-five (25) students, one (1) professor, and four (4) guidance associates from Mabalacat City College are the beta testers to gather relevant feedback and insights to improve the system. Additionally, the system is evaluated based on software product quality standards of ISO 25010, with particular emphasis on functional suitability, compatibility, interaction capability, reliability, security, maintainability, flexibility, and safety.

To implement the system in the Guidance Council of Mabalacat City College, the researchers ensure a user-friendly, optimized, and interactive system for both students and admins. It also has secure hosting to make sure that the information is not compromised

METHODOLOGY

This section explained the methodology and design used in the system development process. In this section, the Software Development Cycle (SDLC) was presented, along with the diagrams and data collection tools used by the researchers during the system development. The Software Development Cycle (SDLC) method that the researchers implemented in this study was the Modified Waterfall Model (see Figure 1). It provided a systematic flow of the development process with iterative phases to ensure the system's consistency and quality.

Figure 1
The Modified Waterfall Model.



Requirement gathering

Important hardware and software tools are required to build the MCCARE website systems. For the hardware, a desktop computer was used. For the software, Penpot and Visual Studio were the primary tools. Penpot was used to create the prototype, which allowed the team to visualize and map out the website's features and functionalities in a well-structured manner. This helped ensure that the design flow was clear, refined, and optimized before development began. Visual Studio Code, on the other hand, was used for coding, editing, and basic debugging. Its features supported efficient and well-organized website development, enabling the team to implement the planned structure.

Design

In this phase of the study, the researchers employed the following analysis tools and diagrams, including the Storyboard, Visual Table of Contents (VTOC), Menu Tree, Use Case Diagram, and Entity Relationship Diagram (ERD), to design and develop the web-based system and database management system.

The researchers employed the storyboard diagram (see Appendix A), which facilitates user interface planning, providing a visualization of the step-by-step process of how students interact with the system. In providing the overall structure of the system, the use of a Visual Table of Contents (VTOC) is relevant. Furthermore, a menu tree is used in breaking down the navigation and menu hierarchy for each menu and submenu of the system. The Use Case illustrates what actions each user can execute. The Entity Relationship Diagram (ERD) maps out how entities and their attributes relate to each other within the system. In managing the researcher's time and resources.

Figure 2
The home screen of the website.

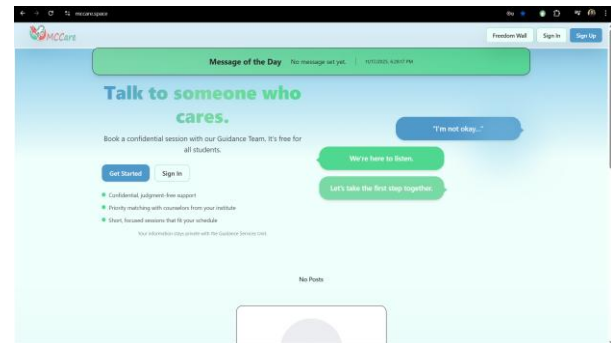
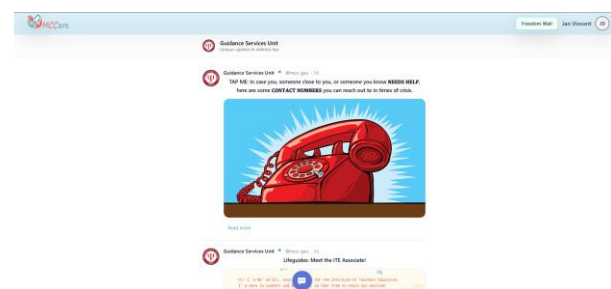


Figure 3
The home screen of the mobile application.



Implementation

The administrator panel and website's features and functionalities are discussed in this section. With a wide variation of user-friendly features and interfaces, the website serves as a primary platform for the students. The administrator panel offers intuitive management, efficient tools, and a purpose-built content management system for the website (see Figure 2-11).

Figure 4
Screenshot of LifeGuides Page

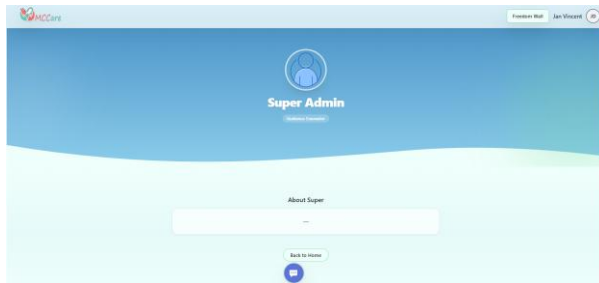


Figure 5
Screenshot of Sign-up Page

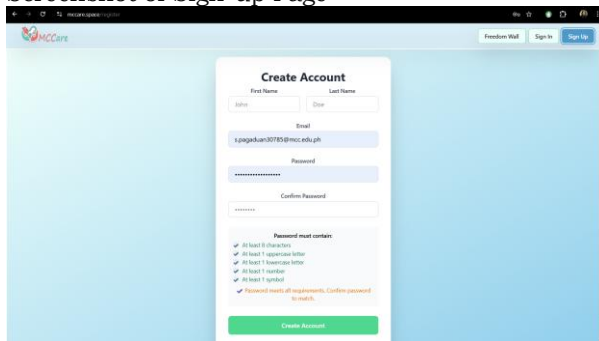
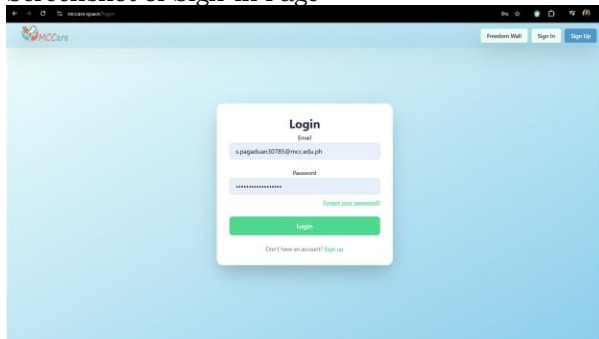


Figure 6
Screenshot of Sign-in Page



Testing

The system underwent two essential testing stages: Alpha and Beta testing. During the alpha phase, the researchers extensively assessed the web system ISO 25010 standards, which include Functional Suitability, Compatibility, Interaction Capability, Reliability, Security, Maintainability, Flexibility, and Safety. The beta phase involved a group of students and professionals concentrated on evaluating functional suitability, compatibility, reliability, security, maintainability, flexibility and safety. Together, these assessments provide a thorough understanding of the system's performance and user experience, serving as the basis for the detailed discussions in the next sections.

Figure 7
Screenshot of Forgot Password Page

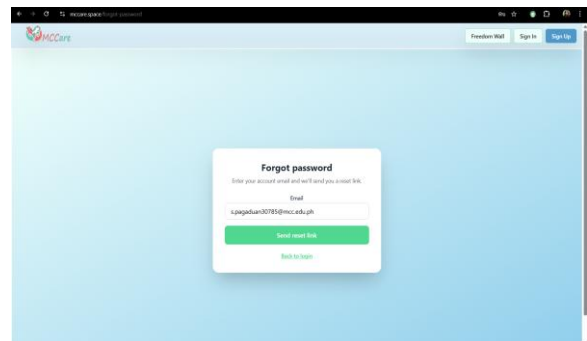


Figure 8
Screenshot of User Interface

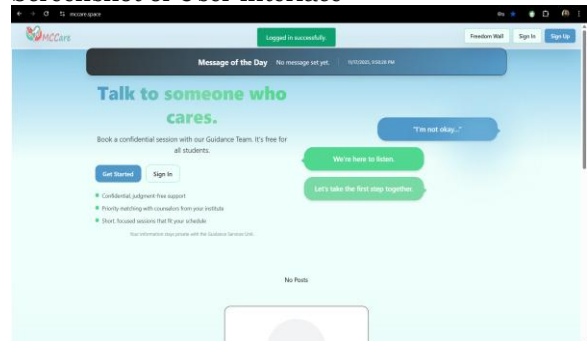


Figure 9
Screenshot of My Appointment Page

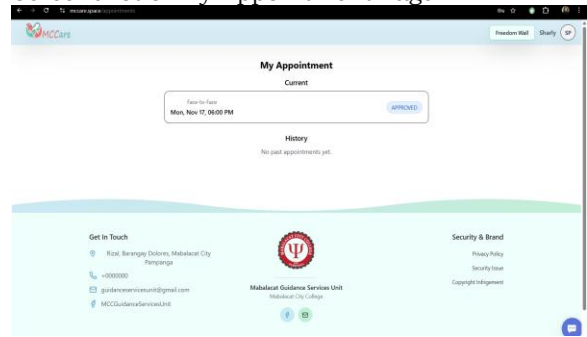


Figure 9: Screenshot of My Appointment Page

Questionnaire validity

Academic and industrial specialists in mental health, education, and information technology assist the researchers in validating the survey questionnaire employed for system assessment. To guarantee that every item based on ISO 25010 criteria effectively measures particular facets of system quality, the questionnaire undergoes content validation. The final form of the instrument includes suggestions from the validators.

Sampling method

The study uses purposive sampling, selecting persons directly engaged in the application or assessment of the guidance counseling system. For Alpha Testing, the sample comprises three (3) expert evaluators; for Beta Testing, twenty-five (25) students and an instructor and the guidance associates. These candidates are picked in accordance with their relevance for the intended consumers and the application of the system.

Figure 10
Screenshot of Booking Page

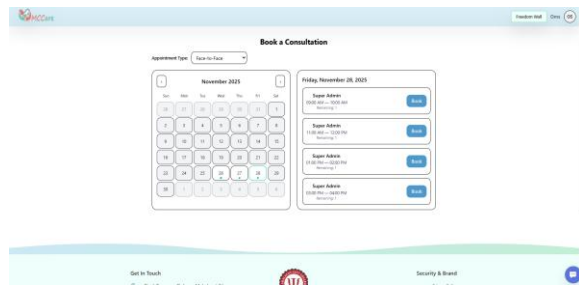
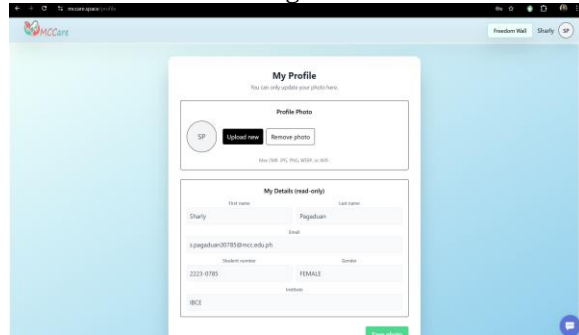


Figure 11
Screenshot of Profile Page



Instrumentation

Response Categories	Numerical Value	Range / Interval	Verbal Interpretation
Strongly Agree	5	4.21 - 5.00	Excellent
Agree	4	3.41 - 4.20	Good
Neutral	3	2.61 - 3.40	Acceptable
Disagree	2	1.81 - 2.60	Marginal
Strongly Disagree	1	1.00 - 1.80	Poor

The main research instrument for the testing phase of the study is a Likert-scale survey questionnaire designed to measure students' evaluation of the system based on the ISO 25010 criteria. The questionnaire consists of several items under each quality attribute, including functionality, usability, reliability,

security, maintainability, compatibility, portability, and safety.

Questionnaire administrators

Following the beta testing phase, the survey questionnaire is distributed. Before completing the evaluation form, participants receive a short introduction to system usage. To guarantee that directions are followed and data is captured consistently, the researchers oversee the administration.

Data analysis

The collected data is analyzed using descriptive statistical tools. It describes the summarization of the data, determining the points where the data were placed, as well as the spread and dispersion of the data. The following statistical techniques were employed for data reduction: Frequency distribution was used in the study to illustrate the number of cases at each score. The scores of the demographic profile of respondents were grouped in categories defined by step intervals, each of which composed a collection of adjacent possible values. The values of a variable, describing the order of the cases, are divided into a number of categories. Frequency is the number of cases for each category.

The mean is the average score of the respondent's set of data compared to the total of all values in the data set. The mean formula in statistics for a set is defined as the sum of the observations divided by the total number of observations. Mean = (Sum of Observations) / (Total Number of Observations)

$$\bar{x} = \frac{\sum fx}{\sum f}$$

Notation 1: The Mean Computation Formula where,

$\bar{x}$ = the mean value of the set of given data

f = corresponding frequency

x = data value

The Likert scale (see Table 1) is employed in questionnaires as a rating system designed to measure respondents' attitudes, opinions, or perceptions. The researchers used the Likert scale to translate the results into the appropriate verbal interpretations following the calculation of each mean score for each survey tool sub-criterion and criterion.

Table 1

Likert Scale - Level of Agreement

Operation and maintenance

The operation and maintenance phase ensures the continuous functionality, reliability, and effectiveness of the system after it has been implemented. It includes the actual use of the system in the Guidance Council of Mabalacat

City College and ongoing support for updates, issue resolution, and improvements.

RESULTS

The system underwent two essential testing stages: Alpha and Beta testing. During the alpha phase, the researchers extensively assessed the web system against ISO 25010 standards, which include Functional Suitability, Compatibility, Interaction Capability, Reliability, Security, Maintainability, Flexibility, and Safety. The beta phase involved a group of students and professionals concentrated on evaluating functional suitability, compatibility, reliability, security, maintainability, flexibility, and safety. Together, these assessments provide a thorough understanding of the system's performance and user experience, serving as the basis for the detailed discussions in the next sections.

Table 2
Alpha Testing Result

ISO 25010 Criteria	Results
Functional Suitability	4.75 – Excellent
Compatibility	4.72 – Excellent
Reliability	4.77 – Excellent
Security	4.80 – Excellent
Maintainability	4.81 – Excellent
Flexibility	4.78 – Excellent
Safety	4.79 – Excellent
Overall Mean Score	4.76 – Excellent

This section presents and summarizes the overall results of the alpha and beta test findings, revealing a comprehensive evaluation web system. Table 2-3 presents a summary of the overall evaluation results for the MCCARE web application from the Alpha (see Table 2) and Beta tests (see Table 3), using the ISO 25010 criteria. There was strong overall evidence of functional suitability, moving from 4.59 in alpha to 4.75 in beta, that indicates an improved fit with the needs of users and the guidance office. There was also strong evidence of compatibility based on the increase in rating from 4.50 in alpha to 4.72 in beta, which indicates better functionality across devices and platforms. Interaction Capability was only evaluated in the alpha phase and had already achieved a rating of 4.61, which provides evidence of good designs, usability, and functionality for the user interface. Both Reliability and Maintainability phases already showed strong alpha results of 4.71 and 4.61 and further improved to 4.77 and 4.81 in the beta phase, which demonstrates both consistent and stable operations and ability to update the system. Security shifted value

from 4.61 to 4.80, suggesting this was one of the higher-rated standards, to show that the system has a stronger level of protection of sensitive student information. Flexibility and Safety, which scored 4.50 and 4.58 in alpha, improved to scores of 4.78 and 4.79 in beta, which again supports an improved level of capacity to meet future needs while also maintaining the security of data and protecting users. Overall, the mean score increased from 4.59 in the alpha test to 4.76 in the beta test, both verbally interpreted as “Excellent,” indicating continuous improvement and strong compliance with ISO 25010 quality standards.

Table 3
Beta Testing Result

ISO 25010 Criteria	Results
Functional Suitability	4.59 – Excellent
Compatibility	4.50 – Excellent
Interaction Capability	4.61 – Excellent
Reliability	4.71 – Excellent
Security	4.61 – Excellent
Maintainability	4.61 – Excellent
Flexibility	4.50 – Excellent
Safety	4.58 – Excellent
Overall Mean Score	4.59 – Excellent

DISCUSSION

In this chapter, the study's research results are presented. The study's objectives and careful analysis produced the results shown here. This chapter provides a summary of the findings and considerations of their implications and overall importance. The researchers carefully calculated the results to guarantee a well-structured and consistent presentation. This chapter provides an in-depth, objective analysis of the research findings.

Limitations

The limitations of the study primarily concern both the functionality of the appointment system and the freedom wall feature. For the appointment system, the system does not include real-time appointment booking or automated notifications. This approach is based on the insights gathered from the guidance associates, who emphasized the need for flexibility in managing their availability due to their dynamic schedules. The absence of a real-time chat feature is one of the limitations of the system. Students need to wait for the guidance associate's replies rather than receiving immediate replies. Online sessions can still take place through the system's built-in chat, but students also have the option to proceed with messaging Guidance Associates through Facebook Messenger. For the freedom wall, the filtering of profanities is limited to Filipino and

English only. The filtering also only identifies profanity that meets national standards for word spellings and conventions. Because of this, profanity that is spelled incorrectly (misspelled) or uses slang or alternative forms of spelling that are intentionally changed will not always be detected. The current system has only basic content filtering. It cannot understand context or automatically moderate posts, so its ability to filter inappropriate content is limited. The study aims to develop a web-based system designed to enhance the well-being of the mental health and academic performance of the students at Mabalacat City College (MCC). The platform offers a user-friendly interface to manage their mental health and well-being, track their progress, and access various resources from the guidance council. The system's features were designed to improve retention and willingness to attend classes and aim to improve the academic performance of every student. The study targeted each student at Mabalacat City College, providing them with efficient guidance in their mental health journey.

Conclusions

The MCCARE: Web-based Guidance Counseling System underwent a comprehensive development journey, encompassing stages such as brainstorming, investigation, research, data gathering, surveying, development, testing, and deployment. The researchers employed the Modified Waterfall Model within the Software Development Life Cycle, ensuring the web system's quality, consistency, and maintainability. Through collaborative efforts, the specific objective of the study MCCare: A Web-based Guidance Counseling System for Mabalacat City College was successfully achieved by incorporating the five diagrams used for systematic progress tracking, which served as guiding tools for the researchers. The researchers faced several challenges during the course of the project, such as difficulties in communication, managing time effectively, and handling financial constraints. These obstacles caused some delays in the project's progress. Nevertheless, these experiences provided valuable lessons for future endeavors, prompting the researchers to improve their communication methods, strengthen time management strategies, and recognize the importance of a well-organized financial plan. In the MCCARE: A Web-based Guidance Counseling System, design assets were created using Visual Studio Code as for the primary code editor and debugging environment. React JS is used as the implementation for front-end development, Laravel for the back-end operations, and MySQL

for database design and management. Additionally, Adobe Illustrator, Adobe Photoshop, Canva, and Penpot are used in making well-designed visual assets and prototypes. The integration of these tools and resources supports the creation of a system that is both technically strong and visually engaging, with an intuitive, user-friendly interface. Aligned with the system's focus on promoting mental health to sustain academic performance, key components are carefully developed to enhance the overall functionality and effectiveness of the platform. After development, the researcher carried out a quality assurance test to detect and resolve any bugs or errors. The evaluation was guided by ISO 25010 standards, assessing the application's functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and flexibility. The researcher sought input from alpha testers, including three IT professionals, and collected their feedback and suggestions. Following this, a beta test was conducted with twenty-five IBCE Students, four Guidance Associates and a professor to further improve and refine the developed project. The survey results from both the alpha and beta tests indicated the web-based system performed exceptionally well, successfully meeting the evaluation criteria in both phases. The alpha test received an overall mean score of 4.59, while the beta test increased to 4.76. All overall scores in both phases can be verbally interpreted as "Excellent," signifying that the developed system met the ISO 25010 standards. The MCCARE: A Web-based Guidance Counseling System for Mabalacat City College successfully achieved its technical objectives and demonstrated significant potential for positive impacts on the academic community. The system shows promising contributions toward achieving SDG Goal 3: Good Health and Well-being by supporting students' mental health, SDG Goal 4: Quality Education by enhancing access to guidance and learning resources, and SDG Goal 8: Decent Work and Economic Growth by preparing students for future employment and career development. By integrating innovative technology with student-centered services, MCCARE provides a reliable platform for promoting well-being, improving educational outcomes, and supporting the professional readiness of students within the institution.

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MediCall: An IoT-Based Enhancing Emergency Response System for Mabalacat City College – Dapdap Campus

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ABSTRACT

MediCall: An IoT-Based Enhancing Emergency Response System was developed to address delays in medical response, communication gaps, and heat-related health risks at Mabalacat City College (MCC) Dapdap Campus. The system integrates Internet of Things (IoT) technology with real-time two-way communication, a tiered alert mechanism, environmental monitoring, and automated heat-mitigation features such as exhaust ventilation and retractable roofing. The study aimed to design, develop, and evaluate a prototype system capable of improving emergency reporting, response coordination, and environmental safety within the campus. The Software Development Life Cycle (SDLC) using a modified waterfall model guided the system development. Alpha and beta testing were conducted, and system performance was evaluated using ISO 25010 quality standards. Results showed high levels of functionality, usability, interaction capability, security, and flexibility. MediCall significantly reduced response delays, improved emergency location accuracy, and minimized heat exposure risks, contributing to a safer and more responsive campus environment while supporting Sustainable Development Goals related to health, education, innovation, and resilient infrastructure.

Keywords: IoT Emergency System, Campus Safety, Real-Time Communication, Heat Index Monitoring, Smart School Infrastructure

INTRODUCTION

Educational institutions require efficient emergency response systems to ensure the safety and well-being of students and staff. Advances in technology, particularly Internet of Things (IoT)-based systems, have enabled faster communication, automated alerts, and real-time monitoring, reducing response delays during emergencies. In the Philippines, schools are increasingly affected by medical emergencies and heat-related illnesses caused by high temperature and humidity levels, especially in crowded or poorly ventilated areas. At Mabalacat City College (MCC) Dapdap Campus, emergency response relies primarily on manual reporting through phone calls or physical notification, resulting in delayed medical assistance. According to campus clinic records, there is a recurring increase in heat-related symptoms such as headaches, dizziness, fatigue, and allergic reactions, particularly during warmer months. These conditions highlight the need for a more responsive and integrated emergency communication and environmental monitoring

system. This study introduces MediCall, an IoT-based emergency response system designed to provide real-time two-way communication between classrooms and the clinic, automated alert prioritization, room location mapping, and heat mitigation through environmental controls. By integrating emergency communication with preventive environmental features, MediCall aims to enhance campus safety, reduce medical response time, and improve overall preparedness at MCC Dapdap Campus.

General Objective

To develop MediCall: An IoT-Based Emergency Response System for MCC Dapdap Campus to enhance real-time emergency communication, monitoring, and prevention.

Specific Objectives:

- Gather information and best practices from clinic staff, web references, academic journals, and related systems.
- Identify hardware (e.g., ESP32, Arduino boards, sensors, motors, speakers, TFT screens) and software (Arduino IDE, MIT App, Google Sheets) requirements.
- Design the system using storyboards, flowcharts, block diagrams, circuit diagrams, and wire diagrams.
- Develop features including:

- **Emergency Communication:** Two-way intercom between classrooms and clinic.
- **Alerts & Notifications:** Tiered alert system with warning indicators for fast location identification.
- **Monitoring & Mapping:** Visual panel mapping emergency locations.
- **Prevention:** Automated exhaust fans and retractable roof system to mitigate heat-related risks.
- **Conduct Alpha and Beta testing** for reliability.
- **Evaluate performance** based on ISO 25010 standards (Functionality, Compatibility, Interaction Capability, Security, Flexibility).
- **Deploy the final system** campus-wide, integrating it into MCC Dapdap's emergency communication infrastructure.

Significance of the Study

Global Context: MediCall supports the adoption of secure, flexible, and scalable emergency systems in educational institutions, improving real-time crisis management and readiness.

Economic Context: By automating alerts and prioritizing emergencies, the system reduces reliance on staff, saves time and labor, and lowers costs associated with delayed responses.

Environmental Context: The digital system streamlines emergency responses, reduces disturbances in classrooms, and fosters a safer, more organized campus environment.

Societal Context: MediCall enhances communication among students, instructors, and clinic staff, enabling quicker, more effective responses and promoting a culture of preparedness and shared responsibility.

METHODOLOGY

The development of MediCall followed the Software Development Life Cycle (SDLC) using a modified waterfall model to ensure structured planning, implementation, and evaluation.

Requirements Gathering

Data were collected through interviews with MCC clinic personnel and faculty members, as well as analysis of campus health statistics and existing emergency response procedures. Key issues identified included delayed emergency reporting, lack of direct communication between classrooms and the clinic, and increased heat-related medical cases.

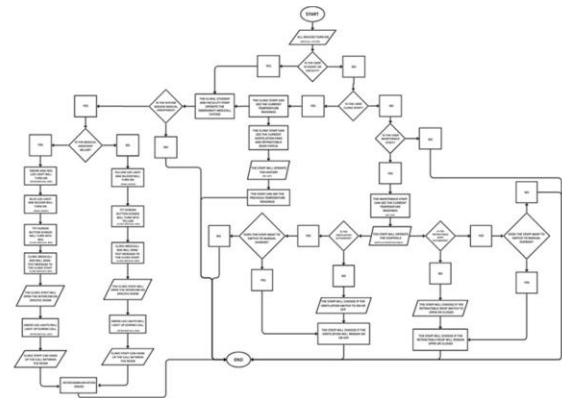
Figure 1
Modified Waterfall Model



System Design

The system architecture was designed using flowcharts (see Figure 2), block diagrams (see Figure 3), circuit diagrams, and wire diagrams. MediCall consists of classroom-based emergency buttons, environmental sensors, a clinic monitoring dashboard, and automated response indicators such as sirens and warning lights.

Figure 2
Flowchart



Implementation

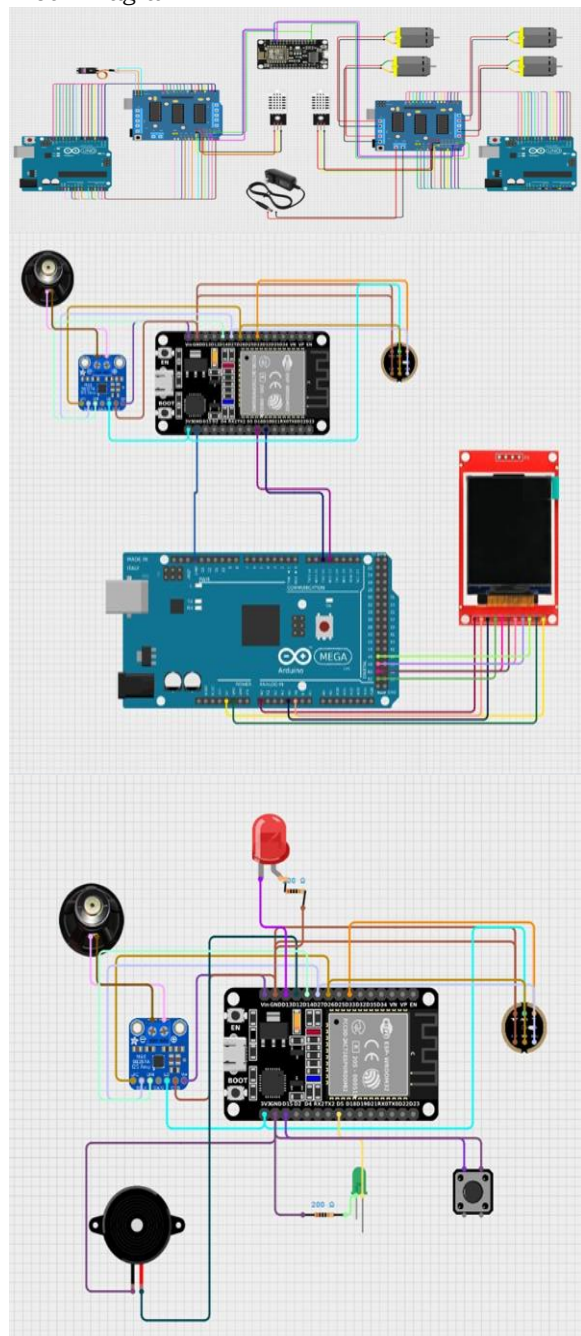
The system was implemented using Arduino-based microcontrollers (ESP32, Arduino Mega, Arduino Uno), sensors for temperature and humidity monitoring, TFT touchscreen displays, speakers, LEDs, and motorized retractable roofing mechanisms. Software development utilized Arduino IDE, MIT App Inventor, and Google Sheets as a cloud-based database.

Testing and Evaluation

Alpha testing was conducted by technical evaluators to assess system functionality and

security, while beta testing involved selected faculty and students. System performance was evaluated using ISO 25010 standards, focusing on functionality, compatibility, interaction capability, security, and flexibility.

Figure 3
Block Diagram



RESULTS

Testing results demonstrated that MediCall effectively enhanced emergency communication and response efficiency. Emergency alerts were transmitted instantly to the clinic, eliminating delays caused by manual reporting. The tiered alert system successfully differentiated between minor and major medical emergencies, allowing responders to prioritize cases appropriately.

The MediCall System's alpha testing phase (see Table 1) provided a thorough evaluation of its interface and functionalities, grounded in ISO 25010 standards, focusing on functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility. The feedback session allowed their observations, leading to valuable suggestions for refinement. Results from the questionnaires, with an overall mean score of 4.83, classified the system as "Excellent" confirming its effectiveness.

Table 1
Alpha Test Result

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functionality	4.94	Excellent
Compatibility	4.67	Excellent
Interaction Capability	4.78	Excellent
Security	4.96	Excellent
Flexibility	4.83	Excellent
Overall Mean Score	4.83	Excellent

The MediCall System's beta testing revealed superb performance according to ISO 25010 standards, with an overall average score of 4.65, which is deemed "Excellent." (see Table 2)

DISCUSSION

The findings indicate that integrating IoT-based communication and environmental monitoring systems can substantially improve emergency preparedness in educational institutions. MediCall addressed key issues at MCC Dapdap Campus by providing real-time alerts, precise location identification, and preventive measures against heat-related health risks. Unlike traditional emergency response methods, the system reduced dependence on manual

reporting and improved coordination among responders. The inclusion of automated environmental controls further enhanced safety by minimizing exposure to high heat index conditions. MediCall supports Sustainable Development Goals, particularly SDG 3 (Good Health and Well-Being), SDG 4 (Quality Education), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 11 (Sustainable Cities and Communities).

Table 2
Beta Test Result

Overall Evaluation Results - Beta Test

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functionality	4.66	Excellent
Compatibility	4.50	Excellent
Interaction Capability	4.83	Excellent
Security	4.20	Very Good
Flexibility	4.70	Excellent
Overall Mean Score	4.65	Excellent

Limitations of the Study

The MediCall system is limited to MCC Dapdap Campus and cannot replace existing medical procedures. It does not provide live video or telemedicine, and its effectiveness depends on available medical staff. Technical issues like weak signals may affect performance, and delays can occur if responders are busy. Despite these limitations, it enhances emergency reporting, communication, and coordination on campus.

CONCLUSIONS

The study successfully developed and evaluated MediCall: An IoT-Based Enhancing Emergency Response System for MCC Dapdap Campus. The system improved emergency response efficiency, enhanced communication between classrooms and clinic staff, and reduced heat-related health risks through automated monitoring and mitigation features. MediCall demonstrates the effective application of IoT technology in campus safety and emergency management. Future enhancements may include mobile application integration, expanded sensor coverage, and scalability for deployment across other educational institutions.

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MEDITRACK+: A SMART SOLUTION FOR MEDICAL SERVICES AND RECORDS

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ABSTRACT

This study presents MediTrack+, a web-based healthcare management system developed to improve medical record handling, workflow efficiency, and patient care. The system addresses common issues such as fragmented records, manual documentation, and challenges in monitoring patient information by integrating secure patient data management, inventory monitoring, sales reporting, progress tracking, and laboratory result management. MediTrack+ was developed using the Modified Waterfall Model of the Software Development Life Cycle (SDLC). Its quality was evaluated based on ISO 25010 standards through alpha and beta testing conducted by IT experts and medical professionals. Results showed high levels of acceptance, with an overall mean score of 4.92 (Strongly Agree) in the alpha test and 4.47 (Agree) in the beta test, indicating strong performance in functionality, efficiency, reliability, usability, security, maintainability, and portability. Security obtained the highest rating in both evaluations, highlighting confidence in data protection. Overall, MediTrack+ is a reliable and user-centered digital solution that supports the modernization and effective management of healthcare services.

Keywords: Healthcare Information System, Web-Based Application, Medical Records Management, Patient Information Management, Clinical Workflow Management

INTRODUCTION

Healthcare plays a vital role in promoting population well-being and supporting national development. Despite continuous advancements in digital health technologies, many healthcare facilities still encounter challenges such as fragmented medical records, inefficient workflows, long waiting times, and delays in accessing patient information. These issues hinder timely decision-making and reduce the overall quality of healthcare services.

In the Philippines, small- to mid-sized clinics and diagnostic centers continue to rely on manual and paper-based systems for managing patient records, laboratory results, vaccinations, and clinic operations. Although the Department of Health (DOH) emphasizes the adoption of digital health solutions through the Philippine eHealth Strategic Framework and Plan 2023–2028, the implementation of integrated healthcare information systems at the clinic level remains limited.

At the local level, Medlife Diagnostic Center in Balibago, Angeles City experiences similar operational challenges, including manual record-keeping, delayed laboratory result dissemination, limited vaccination monitoring, and inefficient sales and inventory management. These conditions contribute to fragmented

workflows, increased waiting times, and reduced patient satisfaction, highlighting the need for a centralized and efficient digital system.

In response to these challenges, this study proposes MediTrack+: A Smart Solution for Medical Services and Records, a web-based healthcare management system designed to centralize patient information, efficient clinic and laboratory operations, and enhance service efficiency. MediTrack+ aims to improve the accuracy, accessibility, and security of medical records while supporting patient-centered care. Through the integration of clinical and administrative processes, the system contributes to the modernization of healthcare services and supports the ongoing digital transformation of healthcare delivery in the Philippines.

Objectives of the Study

The primary objective of this study is to design and develop MediTrack+, an integrated digital platform for small- to medium-sized private health facilities such as the Medlife Diagnostic Center, which aims to improve operational efficiency, digitize medical workflows, and provide timely access to clinical information.

Specifically, this study aims to gather relevant data for system development from the Medlife Diagnostic Center, Google Scholar, books, journals, articles, and related studies and literature. It also aims to identify the necessary hardware and software requirements, design the web-based system using storyboards, use case diagrams, data flow diagrams (DFD), visual tables of contents (VTOC), entity relationship

diagrams (ERD), and Gantt charts, and develop system features for patient management, clinic and inventory management, security, user access levels, and platform functionality. Patient management includes centralized medical history and records, online access and download of laboratory results, and vaccination monitoring. Clinic and inventory management cover sales tracking and real-time stock monitoring. Security features include email login for secure account creation, mandatory password change on first login, and password change options in the user profile. User access levels are defined for Administrators, Front Desk staff, Medical Representatives, and Patients, while platform features include secure web-based access, centralized information management, integrated medical service processing, digital results management, comprehensive records system, user-friendly interface, and protected data transmission.

The system is tested through alpha and beta testing to validate performance and identify errors prior to deployment, evaluated using ISO/IEC 25010 standards—covering functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability—and deployed using a reliable web hosting service with Hostinger to ensure accessibility, reliability, and sustainability.

The scope of the study focuses on the design, development, testing, and evaluation of MediTrack+ to provide healthcare staff and patients of Medlife Diagnostic Center with an efficient platform to manage medical services, records, and administrative workflows. The system is aligned with relevant Sustainable Development Goals (SDGs) and incorporates real operational workflows, templates, and insights from Medlife staff, ensuring that it reflects practical healthcare needs. MediTrack+ is designed for four primary user roles—Administrator, Front Desk staff, Medical Representatives, and Patients—allowing secure access, centralized data management, and efficient handling of patient records, laboratory results, vaccination monitoring, sales, and inventory.

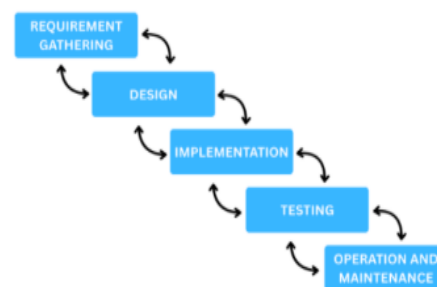
The study has limitations, including its focus on a single diagnostic center, which may limit generalizability to other healthcare facilities. System testing was performed with a limited number of users, and integration with external databases, government health portals, and insurance systems was not implemented. The researchers' IT background limited their medical expertise, and certain advanced clinical features could not be fully developed. Resource and

technical constraints necessitated prioritizing core functionalities, while sensitive processes such as medical consultations and certifications remain manual. The pharmacy component was not included due to the absence of pharmacy operations at the partner facility, and the system does not enforce user accountability, leaving responsibility for correct actions to the licensed medical staff. Despite these limitations, MediTrack+ provides a reliable, accessible, and efficient platform for managing medical services and records and lays a foundation for future system enhancements.

METHODOLOGY

This study employs a descriptive-developmental research design to develop and evaluate MediTrack+, a web-based healthcare management system. The descriptive component was used to gather baseline information from Medlife Diagnostic Center staff and patients, including their needs, pain points, and current workflows, while the developmental component guided the design, building, and evaluation of the system. The software development followed the Modified Waterfall Model, progressing through requirements analysis, design, implementation, testing, and deployment, with iterative feedback loops incorporated at major milestones such as design review, alpha testing, and beta testing. Analysis diagrams and data-gathering tools were used to visualize system processes and ensure a systematic and structured approach throughout the development process (see Figure 1).

Figure 1
The Modified Waterfall Model



Requirement Gathering

The requirement-gathering process for MediTrack+: A Smart Solution for Medical Services and Records was conducted through a systematic and collaborative approach. The researchers began with brainstorming sessions to identify potential system features and

functionalities that could address operational challenges at Medlife Diagnostic Center. Interviews and informal discussions with clinic staff—including the owner, medical representatives, and administrative personnel—were conducted to gather insights on existing workflows for patient record management, laboratory result dissemination, and inventory tracking. Feedback from patients was also considered to understand common pain points such as long waiting times, delays in receiving laboratory results, and difficulties in accessing medical history.

In addition, relevant literature, academic journals, and industry publications were reviewed to study best practices in health information management and digital health solutions. Consultations with IT practitioners and healthcare professionals were conducted to validate the feasibility and usability of the proposed system features. Hardware and software requirements were identified to support system development, including a desktop computer with Intel i5 11400 processor, 32 GB memory, 8 GB video RAM, and 2 TB SSD, and software tools such as Visual Studio Code, Canva, Adobe Photoshop, XAMPP, JavaScript, HTML5, CSS3, MySQL 9.3, Ajax, and PHP 8.4. These efforts ensured that the gathered requirements were comprehensive, practical, and aligned with the needs of the Medlife Diagnostic Center while incorporating current digital health trends.

Design

In the design phase, the researchers utilized various tools and diagrams to guide the overall structure and layout of MediTrack+. A Storyboard was created to visually represent the user interface and simulate user interactions, serving as a visual guide for easier navigation. A Use Case Diagram defined system boundaries by outlining user roles and specific actions for each, clarifying feature allocation. The Visual Table of Contents (VTOC) mapped the overall navigation structure, illustrating connections between pages and modules, while the Entity Relationship Diagram (ERD) depicted relationships between database elements to efficiently manage, link, and store information. A Gantt Chart was also prepared to schedule project activities, outline task durations and deadlines, and track development milestones. Collectively, these design tools ensured a systematic, well-structured, and user-centered development process aligned with the needs of Medlife Diagnostic Center.

Implementation

In the implementation stage, the researchers utilized a combination of software tools to develop MediTrack+: A Smart Solution for Medical Services and Records. The primary development environment was Visual Studio Code, where system design, features, and functionalities were built and integrated to create a user-friendly platform for both patients and clinic staff. The system features two user access levels: Admin for clinic staff or front desk personnel to manage patient records, laboratory results, inventory, and overall content, and Patient accounts for viewing laboratory results and tracking medical records online. The back-end was developed using PHP to connect the front-end with the database, while MySQL served as the database management system for storing and organizing patient profiles, laboratory results, and inventory data. CSS was applied to enhance front-end styling and layout design. Continuous testing and debugging were conducted to ensure reliability, functionality, and usability, providing a seamless and efficient user experience prior to deployment.

Testing

The developed system was evaluated after a

Response Categories	Numerical Value	Range Interval	Verbal Interpretation
Strongly Agree	5	4.21 - 5.00	Excellent
Agree	4	3.41 - 4.20	Good
Neutral	3	2.61 - 3.40	Acceptable
Disagree	2	1.81 - 2.60	Marginal
Strongly Disagree	1	1.00 - 1.80	Poor

preliminary assessment in the testing phase. The researchers conducted system testing and alpha and beta testing to ensure the functionality and reliability of the system. Before preparing the system for administration, the validity of the questionnaire was also assessed during the testing phase. The procedures for acquiring, analyzing, and processing the data, as well as the sampling methods, were also executed accordingly.

Sampling Method

The researchers employed a purposive sampling technique, selecting participants directly involved in the daily operations of Medlife Diagnostic Center and potential users of the MediTrack+ system to ensure relevant feedback. For alpha testing, four (4) Information Technology (IT) experts evaluated the system's technical performance, functionality, and security, providing recommendations implemented prior to deployment. For **beta testing**, thirty (30) participants, composed of seven (7) clinic staff and twenty-three (23) patients, assessed usability, reliability, and effectiveness in streamlining clinic operations

and providing timely laboratory results. Feedback was collected through survey forms and direct observation, enabling the researchers to refine the system and ensure it met both operational and patient needs, resulting in a user-centered and functional platform.

Instrumentation

The researchers utilized the ISO 25010 Software Quality Product Model to evaluate the quality, performance, and effectiveness of MediTrack+ in clinic and laboratory processes. A survey questionnaire based on ISO 25010 criteria—including Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability—was developed to assess the system's features and usability. To ensure validity, the questionnaire underwent pre-testing and validation with IT professionals, healthcare experts, and faculty members, who provided feedback for refinement. Alpha testing involved four (4) IT experts evaluating system functionality, identifying bugs, and detecting security vulnerabilities, with insights applied to improve the platform. Beta testing included thirty (30) end-users, composed of patients, administrative staff, and the clinic owner, who assessed usability, efficiency, and reliability in real-world settings. Feedback from both testing phases was incorporated into the final version of MediTrack+, ensuring a validated, reliable, and user-centered system.

Questionnaire Administration

The questionnaire for MediTrack+: A Smart Solution for Medical Services and Records was administered to healthcare professionals, clinic staff, and patients at Medlife Diagnostic Center. Prior to distribution, participants attended an orientation where the purpose of the study and instructions for completing the questionnaire were clearly explained in a language familiar to them. Alpha testing involved healthcare professionals and IT experts who assessed the system's functionality, data accuracy, and usability based on their knowledge of clinic and laboratory workflows. Beta testing was conducted with selected clinic staff and patients, allowing participants to evaluate the system in real-world conditions. Feedback from both phases was collected to refine the system, ensuring that MediTrack+ met the operational needs of its intended users and improved clinic workflow efficiency.

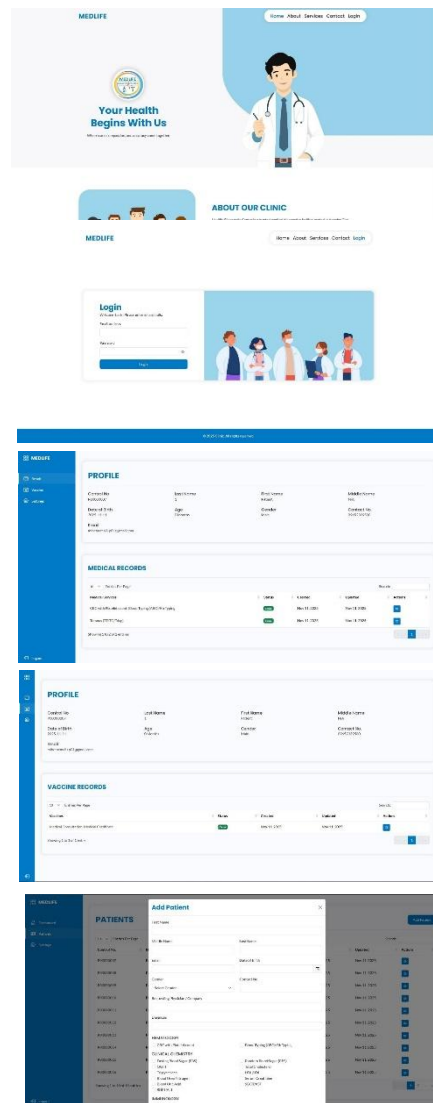
Data Analysis

Descriptive statistics were employed to analyze the data collected from the survey, focusing on frequency distribution, measures of central tendency (mean, median, mode), and variability (range, variance, standard deviation). Frequency

distribution was used to classify responses into categories, allowing the researchers to identify patterns in participant feedback. The mean was calculated to determine the central tendency, reflecting the average score of the responses. A Likert scale was applied to interpret the mean scores, providing verbal descriptions that assessed user satisfaction and the overall effectiveness of the MediTrack+ system.

Figure 2

Systems' landing page, login page, result section, vaccine section & Patient section.



Development

The development of MediTrack+: A Smart Solution for Medical Services and Records was guided by detailed requirements gathering, design, and implementation processes to ensure

alignment with the operational needs of MedLife Diagnostic Center. Requirements gathering involved consultations with clinic staff, laboratory personnel, and patients to identify key features that address patient registration, record management, and laboratory result processing. The study also established the necessary hardware and software components, including Windows-based desktops or laptops, internet-enabled devices, a MySQL database, and a secure web-based interface. The design phase employed Storyboards, Use Case Diagrams, Visual Table of Contents (VTOC), and Entity Relationship Diagrams (ERD) to map user interactions, system structure, and data relationships. These tools provided a clear visualization of system workflows, feature allocation, and database organization, ensuring user-centered and efficient system architecture. During implementation, modern web technologies were used to develop a responsive and secure system. The front-end utilized HTML5, CSS3, JavaScript (ES2023), and Bootstrap 5, while Laravel 12.33.0 and PHP 8.3 handled back-end operations and data processing. MySQL 9 served as the relational database for storing patient records, laboratory results, and clinic transactions. Vite.js optimized front-end performance, and Canva and Adobe Photoshop were applied for interface prototyping and design consistency.

The system features include secure patient login, result viewing and downloading, vaccination tracking, account management, and administrative functions such as patient, inventory, and sales management. Separate dashboards were developed for patients, front desk staff, medical representatives, and admin users, allowing tailored access and operations according to user roles (see Figure 2).

Testing and evaluation followed the ISO/IEC 25010 Software Quality Model. Alpha testing with IT experts focused on functional accuracy, stability, and system performance, leading to the resolution of technical issues. Beta testing involved actual end-users, including patients and clinic staff, to assess usability, data accuracy, and security. The results confirmed that MediTrack+ is functional, reliable, user-friendly, and suitable for real-world clinical and laboratory operations, meeting both system requirements and user expectations.

Maintenance

The Maintenance phase of MediTrack+ provides guidelines to ensure the system's continued functionality and reliability after the capstone project is completed. Following the formal turnover to MedLife Diagnostic Center,

responsibility for system management, updates, and troubleshooting will rest solely with the designated clinic personnel or future IT staff, as the research team will no longer perform technical interventions.

The Memorandum of Agreement (MOA) specifies that the collaboration remains valid until project completion unless terminated earlier with a written notice of at least fifteen (15) days. To maintain system stability and protect sensitive medical data, the clinic is advised to perform routine database checks, validate patient and laboratory records, and apply necessary software and security updates.

By following these maintenance procedures, MedLife Diagnostic Center can ensure that MediTrack+ continues to operate efficiently, supports reliable management of clinical and laboratory processes, and remains a beneficial tool for healthcare service delivery beyond the research team's involvement.

Results

The results and outcomes of the system called "MediTrack+: A Smart Solution for Medical Services and Records." This section presents the findings from the system evaluation using ISO 25010 standards, including Alpha and Beta Testing, as well as feedback from actual users. The study assessed the system's ability to streamline clinic operations, manage patient records, provide secure access to laboratory results, and monitor vaccination history at MedLife Diagnostic Center. The evaluation confirmed that MediTrack+ delivers a reliable, user-friendly, and secure platform for both clinic staff and patients, enhancing efficiency in healthcare service delivery.

Alpha Test Results

The MediTrack+ platform underwent Alpha Testing to evaluate its overall functionality, stability, and user experience before deployment in a real healthcare setting (see Table 1). This phase aimed to identify potential system issues, collect expert feedback, and verify that the platform met its intended objectives.

The alpha test was conducted on October 20, 2025, across two sessions at Paya Street Coffee, SM Clark, and Marquee Mall, Angeles City. Four (4) IT professionals participated, providing expert insights on both technical performance and user interface usability. Participants were given access to the MediTrack+ platform for live testing, which included navigation of clinic and laboratory modules, data entry, and feature validation.

Following the hands-on testing, participants shared observations and recommendations

regarding functionality, responsiveness, and data handling efficiency. They also completed a validated survey questionnaire based on the ISO/IEC 25010 Software Quality Model, assessing Functional Suitability, Performance Efficiency, Compatibility, Reliability, Usability, Security, Maintainability, and Portability. The results of the alpha testing indicated that MediTrack+ performed at a high level across all evaluated criteria. Feedback from the experts was used to refine system functions, ensuring the platform's readiness for Beta Testing in a live clinical environment.

Table 1
Alpha Test Result

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.20	Agree
Performance Efficiency	4.92	Strongly Agree
Compatibility	4.50	Strongly Agree
Reliability	4.75	Strongly Agree
Usability	4.55	Strongly Agree
Security	4.50	Strongly Agree
Maintainability	4.70	Strongly Agree
Portability	4.71	Strongly Agree
Overall Mean Score	4.68	Strongly Agree

Beta Test Results

The Beta Testing phase assessed the usability, reliability, and overall effectiveness of MediTrack+: A Smart Solution for Medical Services and Records among 30 participants, including patients, clinic personnel, and laboratory staff from MedLife Diagnostic Center. Conducted from October 29 to November 5, 2025, participants were oriented and given a live demonstration of key system functionalities, such as patient record management, appointment scheduling, and laboratory result access, to ensure a clear understanding of the platform (see Table 2). Following the demonstration, participants completed a validated survey questionnaire based on ISO 25010 software quality standards, focusing on Functional Suitability, Performance Efficiency, Compatibility, Reliability, Usability, and Security.

The evaluation results revealed high mean scores across all criteria: Functional Suitability (4.39), Performance Efficiency (4.41), Compatibility (4.39), Reliability (4.47), Usability (4.43), and Security (4.52), with an overall mean score of 4.47, interpreted as "Agree/High." These

findings indicate that MediTrack+ is user-friendly, responsive, and reliable in managing patient records, laboratory results, and clinic operations. Users agreed that the platform ensures data integrity, confidentiality, and efficient workflow, confirming its suitability for real-world healthcare implementation.

Table 2
Beta Test Result

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.39	Agree
Performance Efficiency	4.41	Agree
Compatibility	4.39	Agree
Reliability	4.47	Agree
Usability	4.43	Agree
Security	4.52	Strongly Agree
Overall Mean Score	4.47	Agree

DISCUSSION OF RESULTS

MediTrack+: A Smart Solution for Medical Services and Records was evaluated through alpha and beta testing to assess its functionality, usability, reliability, and security based on ISO 25010 standards. Alpha testing, conducted with IT professionals, focused on system functionality, responsiveness, and data handling, resulting in an overall mean score of 4.68 ("Strongly Agree"). Beta testing involved 30 participants, including patients and clinic staff, who used the system in real-world conditions. This phase yielded an overall mean score of 4.47 ("Agree"), reflecting high user satisfaction and confirming the system's effectiveness in managing patient records, appointments, and laboratory results.

Across both testing phases, MediTrack+ demonstrated strong performance in Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, and Security, with Security consistently receiving the highest ratings. These results indicate that MediTrack+ is a user-centered, reliable, and efficient digital healthcare platform suitable for clinical and laboratory operations.

CONCLUSION

Based on the findings of the study, it can be concluded that MediTrack+ successfully provides a secure, reliable, and comprehensive digital platform for healthcare facilities, effectively managing patient records, laboratory results, inventory, sales, and vaccination tracking. The system enhances operational

efficiency and accuracy through real-time data processing and an intuitive, user-centered interface, allowing healthcare staff to perform tasks seamlessly across multiple devices. Furthermore, MediTrack+ promotes productivity and engagement by reducing reliance on paper-based processes and integrating digital tools that simplify workflow and improve patient service. The platform also offers healthcare administrators high-level control and flexibility, enabling them to monitor system usage, maintain data integrity, and adapt operations to meet evolving clinic and laboratory needs. The implementation and testing at MedLife Diagnostic Center in Mabalacat City, Pampanga, demonstrated that the system is highly effective and responsive to the needs of local healthcare providers. To further improve its functionality, the system could integrate advanced features such as automated vaccination reminders, AI-assisted report summaries, telehealth consultations, enhanced security options like biometric or two-factor authentication, advanced analytics for administrative monitoring, and collaborative communication tools for staff coordination. Overall, MediTrack+ demonstrates its capability to support healthcare facilities in delivering organized, efficient, and secure services while providing a foundation for future enhancements and wider adoption in digital healthcare management.

ACKNOWLEDGEMENT

The completion of this capstone project, *MediTrack+: A Smart Solution for Medical Services and Records*, would not have been possible without the guidance, support, and encouragement of numerous individuals. First and foremost, the researchers express their deepest gratitude to Almighty God for His wisdom, strength, and provision, which enabled them to persevere and accomplish the project despite challenges encountered. The researchers sincerely acknowledge the invaluable guidance and constructive feedback of Mrs. Dessa Lyn J. De Castro, Technical Adviser, and Mrs. Ritchell Z. Escoto, Capstone Adviser, whose patience, insights, and encouragement significantly contributed to the refinement and successful completion of the system. Special thanks are extended to Dr. Myrna C. Calma, former Dean of the Institute of Business and Computing Education (IBCE), and Engr. Dennis L. Tacadena, DIT, for their support, leadership, and recognition throughout the study. The researchers also appreciate the contributions of the Alpha testers, Information Technology

experts who evaluated the system in its early stages, and the Beta testers, comprising patients and staff of MedLife Diagnostic Center, whose active participation and feedback provided essential validation in a real-world healthcare setting. Finally, the dedication, collaboration, and perseverance of the research group members were fundamental in bringing this project to fruition. The successful completion of this study reflects the collective support, guidance, and belief of all those involved.

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Moral Matrix: A Role-Based System for Violation and Sanction Tracking for the Center for Character Development Unit of Mabalacat City College

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ABSTRACT

Moral Matrix addresses the limitations of paper-based student violation documentation in the Center for Character Development Unit (CCDU) of Mabalacat City College, which is prone to errors, falsification, and slow record retrieval. The project developed a QR code-enabled, web-based, role-based platform for students, faculty, security personnel, CCDU staff, administrators, and validators, with permissions for recording, validating, monitoring, and reporting disciplinary cases. The system was built using a modified Waterfall model with PHP, HTML, CSS, JavaScript, and MySQL, and includes QR-based identity verification, community service tracking, GMRC request processing, automated notifications, and summary reporting compliant with the Data Privacy Act of 2012. System quality was evaluated through alpha testing with three IT experts and beta testing with purposively selected end-users from all roles using an ISO/IEC 25010-based questionnaire. Alpha testing produced an overall mean score of 4.97, while beta testing yielded 4.59, both interpreted as Excellent in functional suitability, performance efficiency, interaction capability, and security. These findings indicate that Moral Matrix is an effective and acceptable solution for automating violation and sanction tracking, improving transparency and accountability, and supporting institutional initiatives aligned with quality education, innovation, strong institutions, and partnerships.

Keywords: Moral Matrix, Role-Based System, Student Violation Tracking, QR Code Technology, ISO/IEC 25010, Web-Based Application, Transparency and Accountability

INTRODUCTION

School rules and regulations are techniques instilled in an educational institution to control, regulate, and manage student behavior in schools to create a friendly environment. (Amelia, N., et al, 2023). These rules assist school members and staff in being aware of their duties, rights, and obligations in an academic institution. At the same time, school regulations are matters regarding school admissions, uniform regulations, student obligations, prohibitions, rights, and penalties for violating these regulations (Atenya, H., M., & Dr. Wekesa, W., R, 2020). Students violating school rules and regulations will get disciplinary action for the violations committed. According to Nehru, N. et al., (2022), students are expected to behave according to the school rules and regulations to avoid receiving any violations and penalties. Academic honesty is a core value in academic institutions to ensure students maintain honesty and responsibility in their academic life. Yet student infractions, such as cheating and misrepresentation, continue to be a repeated

problem in the Philippines. The Department of Education reported that academic dishonesty cases have been on the rise, and students have been able to circumvent traditional manual disciplinary actions (DepEd, 2021). This issue extends beyond academic cheating, affecting how student violations are recorded and managed, leading to incorrect data and fraudulent entries in school disciplinary systems. Additionally, academic honesty is a fundamental concern in the Philippine higher education, the Commission of Higher Education (CHED) emphasizes that program quality and integrity, especially in the assessment of student learning, are central to its regulatory mandate (CHED, 2021) However, despite the existing policies and standards, academic dishonesty remains a persistent issue in CHED-supervised institutions (Beruin, 2022). For example, Alvarez et al. (2022) reported that most students in a state university admitted to cheating in assignments, quizzes, and examinations conducted synchronously and asynchronously, even though proctored examinations helped reduce such practices. Within this landscape, CHED's policies on the flexible implementation of Student Affairs and Services (CMO No. 8, s. 2021) and its enhanced monitoring mechanisms require higher education institutions to submit

verified data on student services and disciplinary actions. Nonetheless, many institutions continue to rely on manual forms, fragmented spreadsheets, and locally maintained paper-based records, making violation data prone to inaccuracy, incompleteness, and even tampering (CHED, 2024). These conditions highlight a critical gap in how student violations are documented, monitored, and analyzed, and they underscore the need for a more reliable, systematic, and technology-driven approach to managing student discipline in the tertiary level. Manual documentation methods for student offenses in educational settings create both inaccuracies and inefficiencies, which reduce the effectiveness of the disciplinary system. Traditional documentation methods, including logbooks and paper reports at Mabalacat City College, create vulnerabilities for tampering and mistakes in student infraction records. Students who want to dodge disciplinary actions may submit false information about their names or student IDs which can lead to innocent students getting wrongly accused. The school's disciplinary system loses its fairness because of incorrect data entry and tracking challenges for repeat offenses become more complex. For these issues to be addressed, "Moral Matrix: A Role-Based System for Violation and Sanction Tracking for the CCDU of Mabalacat City College" revolutionizes student infractions by enabling QR code automation integration into students' profiles. Security guards scan QR codes to view students' records in real time to enable infractions to be recorded under the proper student identity. By applying the system to Mabalacat City College will make tracking of violations more credible, avoiding false allegations and unbiased disciplinary sanctions. The system further has an added feature to track community service penalties, making students serve their imposed disciplinary tasks. This innovation aligns with Mabalacat City College's aspiration to enhance accountability, responsibility, and honesty and to maximize the efficiency and security of records of student violations.

Objective of the Study

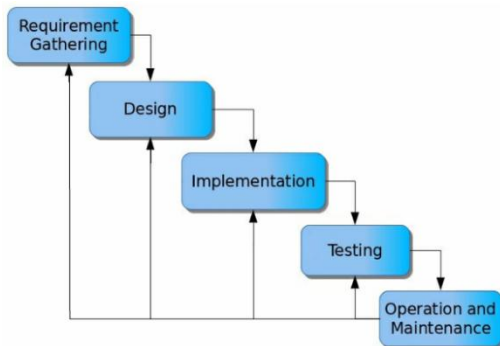
The general objectives of this project was to establish a sense of responsibility, accountability, and integrity among the student of Mabalacat City College when it comes to student violations. The researches aim to improve student violation recording through "Moral Matrix: A Role-Based System for Violation and Sanction Tracking for the CCDU of Mabalacat City College" for better accuracy and prevent falsification of student violations.

In line with the general objective, the researchers aimed to achieve the following:

- To gather information on the current manual process of student violation tracking and student experiences on student violation falsification through interviews, surveys, published studies, articles, and books.
- To identify the required specification for hardware and software developmental tools needed to create the web application named Moral Matrix on Windows 10 and 11 such Desktop/Laptop and QR scanner (OTG conversion connection Wired Scanner QR Code 1D & 2D Code Reader). While software requirements consist of Canva, Adobe Photoshop, Visual Studio Code, XAMPP and Twilio.
- To design the web application utilizing the following diagrams and tools such as Storyboard, Data Flow Diagram, Use case Diagram, Wireframe, Gantt Chart and VTOC.
- To develop a web application consisting of a Home Page that presents the Center for Character Development Unit staff, security personnel, and contact and location information; an About Page that provides the history of the Center for Character Development Unit and the services it offers; a Login Page with a forgot password feature; and an Email module that sends notification emails to students.
- To integrate multiple user levels within the system, including Guest Users who can view the landing page; Students who can view their personal violation records and receive SMS notifications for parental summons; Security Personnel and Faculty who can verify and view student information and input and edit student violations; CCDU Staff who can manage student violation records, community service, validators, good moral verification, incident reports, approval of violation reports, and generate PDF reports; Administrators who can manage the dashboard, users, data analytics, generate PDF reports, and set user access levels; Super Admins who can create and manage administrator accounts; and Validators who can manage assigned student community service, view service records and history, and log community service activities.

- To test the performance limits of the system in terms of accuracy and reliability through Alpha and Beta testing.
- To evaluate the acceptability of the system using the ISO 25010 Software Quality Standards in terms of functionality suitability, performance efficiency, interaction capability, and security.
- To deploy and implement the web application in Mabalacat City College's Center for Character Development Unit.
- These objectives collectively support the successful development, evaluation, and implementation of Moral Matrix, ensuring that the system effectively strengthens the monitoring and management of student violations, enhances transparency and accountability in disciplinary processes, and supports the Center for Character Development Unit in promoting integrity, responsibility, and good moral conduct among students of Mabalacat City College.

Figure 1
SDLC Modified Waterfall Model



METHODOLOGY

The Software Development Life Cycle (SDLC) provided a structured approach in building high-quality, cost-efficient software within a limited timeframe. Its main objective is to create software that fully satisfies user needs and expectations. The SDLC model outlines a series of phases, each with specific tasks and deliverables, to guide the development process. Following the SDLC helps speed up the development process while minimizing risks and expenses related to various production technologies. For this research, the researchers chose the modified waterfall model (see Figure 1) as the SDLC approach. This model features a

structured sequence of development stages with the flexibility to revisit earlier phases when needed, allowing for better adaptation and refinement throughout the development process.

Requirements Gathering

The researchers conducted an initial needs assessment of the community to formulate and refine project titles for the title defense, collaborating closely with the technical adviser and the Center for Character Development Unit (CCDU) staff of Mabalacat City College through literature review, online research, interviews, and structured brainstorming sessions, which led to the finalization of the project entitled “Moral Matrix: A Role-Based QR-Based Violation and Sanction Tracking System for the CCDU of Mabalacat City College”; throughout the development phase, weekly consultations and meetings via Messenger, MS Teams, and face-to-face discussions were held to validate system requirements, clarify functional specifications, and address existing issues in the paper-based violation recording process, such as data loss, inefficient retrieval, inconsistent tracking, and record falsification, while appropriate hardware and software specifications including desktop or laptop systems, QR scanning devices, and development tools such as Visual Studio Code, Canva or Adobe Photoshop, and XAMPP were identified to support system implementation, with the primary goal of digitizing student violation records through a secure, user-friendly web-based platform that enables real-time logging, QR code-based identification, role-based access for students, CCDU staff, security personnel, and administrators, and improved accuracy, transparency, and accountability in student behavior management.

Design

During the designing phase, the researchers focused on translating the user requirements into a comprehensive blueprint that will guide the development process. In this stage, the researchers created data flow diagrams (DFD), use case diagrams, and wireframes to visualize the interactions between system components and users. The user interface (UI) will be minimalistic and accessible, prioritizing ease of use for the Center for Character Development Unit staff and school counselor, security personnel and administrators. Each module was structured to provide straightforward navigation with limited training needed. The researchers created a Use Case Diagram (See Appendix F) which illustrates the interaction between user roles and Moral Matrix’s system core functionalities. This diagram is crucial in visualizing how different actors utilize the

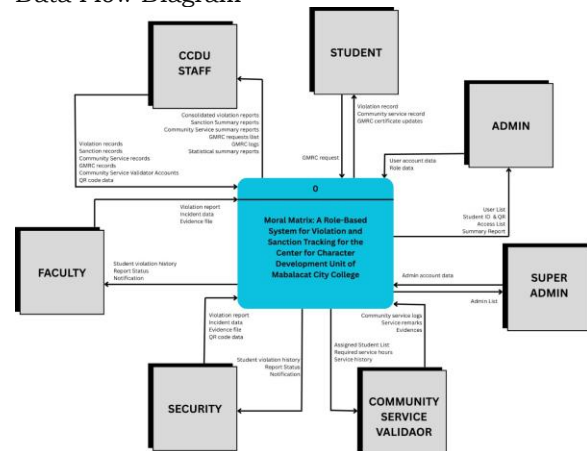
system to carry out specific tasks related to student discipline monitoring. The roles are Administrator, Security Personnel, Faculty, Center for Character Development Staff, and Student and each role is assigned specific functions based on responsibilities in maintaining school discipline. The Administrator has access to user management, adding and editing user roles and delete user accounts. The administrators also have access to view recorded student violations only. Security Personnel are responsible for upon-entry violation reporting, use the QR scanner for quick data entry, and add student violation records, particularly dress code and student ID infractions only as their access is limited to their scope of responsibility. While the Center for Character Development Unit Staff have full access to the student violation record, they are allowed to input, edit, delete, and manage student violation records and types of offenses. Their role supports student counseling and behavioral intervention, making accurate and timely access to disciplinary records essential. On the other hand, the students can only view their personal student violation record, which promotes transparency and accountability while preserving data security and privacy. The researchers will also create a Data Flow Diagram (DFD) that served as visual representation for how the data moves within the web-application, detailing the interactions between users, processes, and data storage components. It played a key role during the system analysis and design phase by providing a clear overview of the logical flow of information related to student violation monitoring. The DFD (see Figure 2) shows how data was collected through QR code scanning, processed by system modules such as violation recording and user management, and stored in a centralized database. It also demonstrates how outputs, such as SMS or email notifications was generated and sent to concerned stakeholders like parents and guardians. By defining the external entities, including students, administrators, security personnel, and CCDU staff, and mapping interactions with the system, the DFD helped ensure that all intended functionalities are properly addressed. Hence, the diagram will guide the researchers with the development process, improve system clarity, and support the design of a secure, efficient, and organized digital platform for managing school discipline.

Implementation

The implementation phase of Moral Matrix involved the actual development and coding of the web-based application that was based on the

finalized system design. The researchers used standard web technologies for the development of Moral Matrix such as HTML, CSS, PHP, JavaScript and MySQL for building the front-end, back-end, and the database components of the system. The system was hosted on a local database for the coding process and deployed using Hostinger.com for online web hosting. A critical feature to be implemented is the integration of a USB-compatible QR code scanner, which allowed the staff to scan student QR codes from student IDs and automatically retrieve student profiles from the system's database. This significantly reduced the manual entry errors and speed up the violation logging process. The system also included user login, role-based access control, violation management, automated report generation, and additional functionalities such as the capability to generate Certificates for Good Moral & Right Conduct (GMRC) upon administrative approval.

Figure 2
Data Flow Diagram



Testing

The researchers assessed the web-application's functionality, reliability, and user-friendliness during the testing phase prior to its deployment. This stage included the unit testing, integration testing, and user acceptance testing (UAT) to verify that all system features meet intended functionalities. Unit testing was conducted first, focusing on individual components such as user login, QR code scanning, violation recording, and report generation to ensure each feature functions correctly on its own. Followed by integration testing to assess how these features work together, validating seamless dataflow and system interaction. Alpha testing was conducted with the help of three (3) selected IT experts. This testing focused on detecting bugs, performance issues, and design flaws in a

controlled environment. This step is crucial in refining the system features. After addressing the issues found in alpha testing, beta testing involved selected end-users to test the web-application. This phase evaluated how the system performed under actual usage conditions. Feedback was collected to identify usability, concerns and make final improvements. Any detected errors, performance issues, or inconsistencies during testing was carefully recorded and resolved through refinement. The primary objective of this phase was to confirm that the Moral Matrix is stable, efficient, and intuitive for end-users, making it ready for deployment in the academic environment.

Sampling Method

This study used purposive sampling, a non-probability sampling method in which respondents are chosen based on their accessibility and willingness to participate. This approach involved selecting available participants such as students, faculty members, CCDU staff, admins, and security personnel who are directly involved in or affected by the system's functions. By gathering responses from individuals who can be easily reached and are familiar with the system, the researchers efficiently collected useful data within a limited timeframe. This method ensured that the findings were directly applicable to improving the system's functionality and user experience.

Instrumentation

The researchers used the ISO25020 model software quality requirements to evaluate Moral Matrix: MCC QR-based Violation Record Tracking System. The researchers based on selected software product quality characteristics to create a survey questionnaire and extensive validity testing was conducted to prevent biased results.

Ethical Consideration

The respondents were informed of the study's objectives, procedures, and any potentially sensitive aspects, including possible risks, and were assured that their participation was entirely voluntary, without any obligation to provide information or complete the survey, and intended solely for research purposes; furthermore, in compliance with the Data Privacy Act of 2012 (Republic Act No. 10173), all personal information and data collected were treated with strict confidentiality through the implementation of appropriate security measures and proper citation practices, while the study was carefully designed to ensure no harm by avoiding sensitive or intrusive questions, assuring participants that their

responses would not affect their academic performance or personal relationships, and maintaining respect and dignity throughout the entire research process.

Table 1
Likert Scale

Response Categories	Numerical Value	Range / Interval	Verbal Interpretation
Strongly Agree	5	4.21 – 5.00	Excellent
Agree	4	3.41 – 4.20	Very Good
Neutral	3	2.61 – 3.40	Acceptable
Disagree	2	1.81 – 2.60	Marginal
Strongly Disagree	1	1.00 – 1.80	Poor

Questionnaire Administration

After the respondents tested the Moral Matrix web application, the questionnaire was administered either in printed or digital form using a 5-point Likert scale with clear instructions, and its validity was ensured through a structured process that included preparation of objectives, scheduling, and participant selection; expert review by three (3) experienced IT professionals; careful design of questions assessing user satisfaction, ease of use, QR scanning accuracy, and overall system performance; purposive recruitment of Center for Character Development Unit staff, administrative staff, security personnel, faculty members, and students of Mabalacat City College; conduct of the survey based on actual user experience; systematic analysis of both quantitative and qualitative feedback; and final reporting of results highlighting strengths, issues, and recommendations to ensure the questionnaire effectively measured user feedback for Moral Matrix.

Data Gathering

The researchers collected data by distributing questionnaires to selected respondents. Before answering, the respondents were given time to explore and use the web-application to ensure understanding of its features. The questionnaire gathered qualitative data through Likert scale items and qualitative feedback through open ended questions. All responses were compiled and analyzed to assess user satisfaction and overall performance of the web-application.

Data Analysis

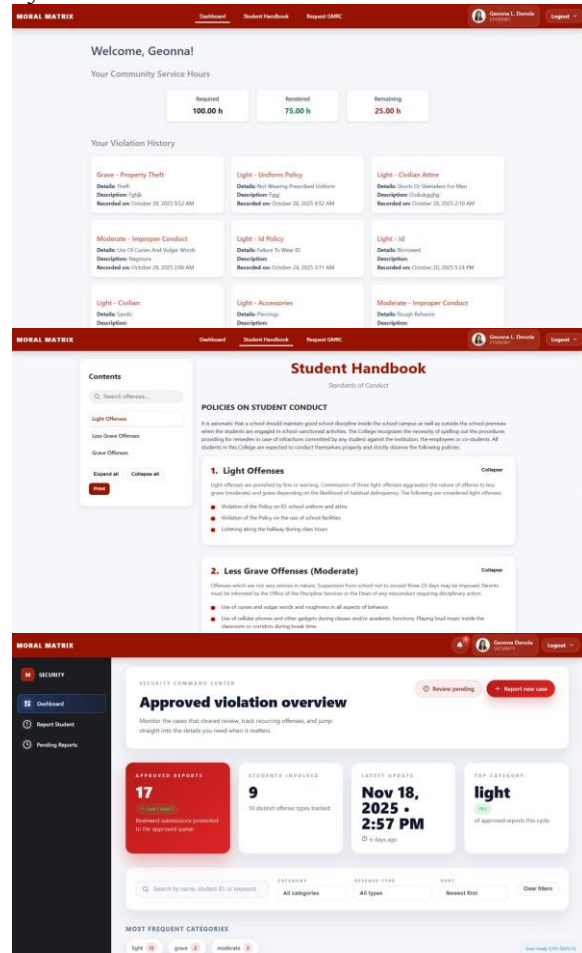
Descriptive statistics was used to analyze the data once its collection is complete. This involved summarizing the main findings and examining the distribution and consistency of the responses gathered from respondents.

Table 1. The 5-point Likert Scale – level of agreement.

Data Processing

Once the survey responses were completed, the researchers reviewed the responses for tallying and organization. Each response was labeled based on user type and satisfaction levels. Numerical values will be assigned to Likert scale answers to prepare the data for analysis. Finally, the data was organized into tables and graphs to visually present the respondents' feedback.

Figure 3
Systems Dashboard



Deployment

The Moral Matrix: A Role-Based System for Violation and Sanction Tracking for the CCDU of Mabalacat City College will be installed and tested in a real school setting after it has been fully developed and tested (see Figure 3). Although the web-application is not yet developed, the plan is to launch it at Mabalacat City College, Center of Character Development

Unit. The goal of this phase is to examine if the system functions, the ease of use, and meets the quality standards of ISO 25010. During deployment, selected staff from the Center for Character Development Unit will use the system and provide feedback. Feedback from the staff will help determine areas for improvement before the web-application is used in the school. This step is part of the future for this study.

RESULTS

The website platform interface underwent a comprehensive alpha evaluation by three (3) IT experts. The session featured live demonstrations and guided hands-on testing, followed by a structured discussion to elicit criticisms, feedback, and suggestions. Each expert then validated and completed survey questionnaires aligned to ISO/IEC 25010 quality characteristics: Functional Suitability, Performance Efficiency, Interaction Capability, and Security.

Table 2
Overall Evaluation Results - Alpha Test

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.95	Excellent
Performance Efficiency	5.00	Excellent
Interaction Capability	4.97	Excellent
Security	5.00	Excellent
Overall Mean Score	4.97	Excellent

Based on the ISO 25010 software quality model, the platform exhibited outstanding performance across all evaluated dimensions during the Alpha Testing phase (see Table 2). It effectively addressed user requirements, providing a consistent and seamless experience across diverse user roles and operational contexts. The platform demonstrated strength in Performance Efficiency (M = 5.00) and Security (M = 5.00), indicating that system operations are executed with optimal speed, responsiveness, and strong protection of data and access control. Interaction Capability (M = 4.97) and Functional Suitability (M = 4.95) likewise attained "Excellent" ratings, reflecting that users can interact with the system smoothly while core functionalities are implemented accurately and aligned with user needs. With an overall mean score of 4.97, the platform achieved an "Excellent" rating at the alpha stage, confirming its high functional stability, data integrity, and user-centered design. These findings suggest that the platform is technically sound and well-

received, positioning it strongly for subsequent beta testing and deployment phases.

Table 3
Overall Evaluation Results - Beta Test

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.61	Excellent
Performance Efficiency	4.57	Excellent
Interaction Capability	4.61	Excellent
Security	4.60	Excellent
Overall Mean Score	4.59	Excellent

The Beta Test (see Table 3) presents the consolidated beta test evaluation of the Moral Matrix system based on the ISO 25010 quality criteria. The mean score shown in the table are pooled results from all the participant user roles – students, faculty, security personnel, CCDU staff administrators, and community service validators – so the ratings reflect the perspective of every major stakeholder who uses the system. As shown, the system obtained an overall mean score of 4.59, interpreted as Excellent on the e5-point Likert scale. Among the criteria, functional suitability and interaction capability both achieved the highest mean of 4.61, indicating that users across roles strongly agrees that the system’s functions match their tasks and that the interface is easy to use and understand. Performance efficiency registered the lowest Excellent range, suggesting that users generally experienced fast response times and were confident that the access control and data protection mechanisms are properly implemented. Taken together, the beta-test results from all roles confirm that the Moral Matrix system satisfies the ISO 25010 quality characteristics at an excellent level.

DISCUSSION

The study entitled Moral Matrix: A Role-Based System for Violation and Sanction Tracking for the Center for Character Development Unit of Mabalacat City College aimed to design, develop, and evaluate a web-based system that improves the accuracy, transparency, and efficiency of student violation and sanction management. The development of the system began with a comprehensive review of related literature, existing disciplinary tracking systems, and institutional policies to identify common issues such as manual record errors, falsification, and delayed processing. Through this process, the researchers determined the necessary hardware and software requirements and applied system analysis and design methodologies, including

storyboards, data flow diagrams, use case diagrams, wireframes, a visual table of contents, and a Gantt chart, which guided the system’s structure and workflow. The Moral Matrix system integrated QR code-based student identification, real-time violation logging, role-based access control, community service monitoring, and automated generation of Good Moral Certificates to ensure secure and organized disciplinary management. The interface was designed to be user-friendly and intuitive for students, faculty, security personnel, CCDU staff, administrators, and validators, promoting efficiency and accountability across all user roles. The system underwent Alpha testing conducted by IT experts and Beta testing involving actual end-users, evaluated using ISO 25010 quality standards. The Alpha test achieved an overall mean score of 4.97, while the Beta test obtained 4.59, both interpreted as Excellent. These results confirm that the system met ISO 25010 criteria in terms of functional suitability, performance efficiency, interaction capability, and security, with slight variations reflecting real-world usage conditions. Overall, the findings demonstrate that Moral Matrix successfully met its objectives by providing a reliable, secure, and effective platform that enhances the management of student conduct at Mabalacat City College.

Table 4
Overall Evaluation Results – Alpha and Beta Test

ISO 25010 Criteria	Mean Score (Alpha Test)	Verbal Interpretation (Alpha Test)	Mean Score (Beta Test)	Verbal Interpretation (Beta Test)
Functional Suitability	4.95	Excellent	4.61	Excellent
Performance Efficiency	5.00	Excellent	4.57	Excellent
Interaction Capability	4.97	Excellent	4.61	Excellent
Security	5.00	Excellent	4.60	Excellent
Overall Mean Score	4.97	Excellent	4.59	Excellent

The table above (Table 4.) summarizes the evaluation of the Moral Matrix system for both alpha and beta tests results. The mean scores were computed based on the responses of all participants including the three (3) IT experts who tested the system. For the alpha test, mean scores ranging from 4.95 to 5.00, results in an overall mean of 4.97, which is verbally interpreted as Excellent. This indicates that the initial version of the system was already perceived by evaluators as highly functional,

efficient, user-friendly, and secure. In the beta test, which involved a larger and more diverse group of end users, the mean scores remained consistently high, from 4.57 to 4.61, with an overall mean of 4.59, also interpreted as Excellent. Comparing the two phases, there is a slight decrease in numerical values from alpha to beta, which is expected when moving from controlled testing to broader real-world use. However, the standards included – Functional Suitability, Performance Efficiency, Interaction Capability, and Security – remain within the Excellent range in both tests. This confirms that the Moral Matrix satisfies the ISO 25010 quality characteristics at an excellent level across iterative evaluations and across different user roles.

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The successful completion of this research project was made possible through the guidance, support, and generosity of many individuals who willingly shared their time and expertise. Above all, we offer our heartfelt gratitude to Almighty God, whose wisdom, grace, and guidance have been our constant source of strength and inspiration throughout this journey. We extend our sincere gratitude to our technical adviser, Mr. Khyle L. Alegre and Mrs. Ritchel Escoto for their steady guidance, constructive critique, and patience that shaped this study, for the continued support, timely approvals, and encouragement that made this research project possible. Our deepest appreciation goes to the staff of Center for Character Development Unit of Mabalcat City College, Mr. Ryzen Coboy Estardo and Ms. Katherine Angelie Acero for their invaluable cooperation, assistance, and support throughout the conduct of this study. Their endorsement has been invaluable to the success of our research. We are especially grateful to our Alpha testers, who offered candid, detailed and essential feedback on the system's functionality. Additionally, to the Beta Testers—faculty, security, and students of Mabalacat City College—for their active participation and honest responses that significantly contributed to the validation process of the study. Lastly, we extend our heartfelt thanks to every member of the research team for their dedication and collaboration. Each one's unique contributions were vital to this project's success, and we are sincerely grateful to all who offered support, guidance, and encouragement throughout this journey.

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PetalPicks: An Interactive Web-Based Application for Personalized Bouquet Arrangement

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ABSTRACT

PetalPicks: The study developed PetalPicks, an interactive web-based application designed to address the operational challenges of Blooms and Petals, a flower shop in Mabalacat City, Pampanga. Traditional ordering methods—such as calls, messages, and manual price quotations—often resulted in delays, miscommunication, and limited customization options. To resolve these issues, the system integrated bouquet customization with real-time pricing, secure payment simulation, and an appointment booking module with calendar-based slot availability and automated email confirmations. Using the Software Development Life Cycle (SDLC) Prototyping Model, the system was designed, developed, and refined through continuous user feedback. Alpha testing was conducted by IT experts to validate functionality and identify initial system improvements. Beta testing followed, involving users familiar with e-commerce platforms to evaluate the system based on ISO 25010 quality characteristics, including functional suitability, performance efficiency, reliability, usability, security, maintainability, and portability. Results showed an overall Excellent rating in both Alpha (4.55) and Beta (4.67) testing, confirming that the system performed effectively across all intended features. PetalPicks demonstrated strong usability, stable operation, accurate booking processes, and consistent cross-device performance. Although payment integration used simulated e-wallet processes due to shop limitations, the system successfully fulfilled its goal of providing a modern, convenient, and user-friendly platform for bouquet arrangement and appointment scheduling. Overall, the study concludes that PetalPicks significantly improves customer experience and operational efficiency for Blooms and Petals, while offering a scalable model for future enhancements and broader adoption within the floral industry.

Keywords: Bouquet Customization System, Web-Based Application, Appointment Booking System

INTRODUCTION

Flowers have been used internationally for so long as a symbol of emotions and to express feelings whether it is love, sympathy, gratitude, or celebration. Every culture used flowers as potent symbols to express emotions that words might not have been able to convey. Globally, e-commerce had opened up new markets for flower businesses; however, many platforms in use were unable to provide interactive bouquet-arranging capabilities.

With the advent of digital technologies, e-commerce transformed the operations of flower shops. Most flower businesses had already adapted to online systems to increase their market coverage, simplify ordering, and offer consumers more convenience. Despite this, many e-commerce systems for flowers still did not have the appointment booking capability

that would let customers set up the delivery or consultation and, at the same time, reserve the time slots that were available based on the shop's availability. Online appointment systems have been indicated as a factor that contributes to the improvement of user satisfaction and the smoothing of business processes (Atherton et al., 2024). Although online platforms increased accessibility, most existing systems still failed to incorporate functionalities such as real-time bouquet arrangement customization and transparent price mechanisms—both of which played a key role in the buying process. Research into personalization in online shopping indicates that when consumers are given the option to adjust product characteristics (such as color, parts, or configuration), it not only leads to higher user interaction but also makes users feel that the product is more valuable (Kaluza et al., 2023).

In the Philippines, an increasing number of florists had begun taking advantage of growing seasonal markets and culturally significant

occasions such as Valentine's Day, graduation, and All Saints' Day. However, many local florists continued to rely on traditional ordering by phone, text messaging, or social media pages—methods that were prone to errors and offered limited avenues for bouquet customization and pricing transparency. The absence of proper appointment scheduling features in these methods complicated the management of multiple bookings for events—weddings, birthdays, funerals, anniversaries. Despite the country's rapidly increasing smartphone and internet usage, most local florist shops did not have a suitable digital platform that allowed customers to easily buy bouquets, view them in real time, book appointments, and make secure payments.

In Mabalacat City, Pampanga, local flower shops continued to play a vital role in personal and community celebrations, providing arrangements for events such as birthdays, weddings, graduations, and funerals. However, most of these businesses still relied on traditional, in-person transactions or basic social media messaging for orders. There were not many fully developed e-commerce platforms in the area that were made specifically for flower shops.

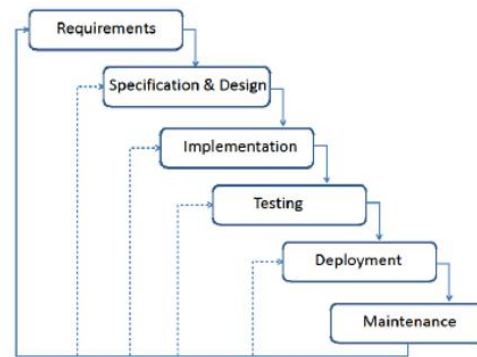
To address these issues, this study introduced *"PetalPicks: An Interactive Web-Based Application for Personalized Bouquet Arrangement"* specifically designed for Blooms and Petals, located at McArthur Highway, Mabalacat City, Pampanga. The system has a module for appointment booking that requires customers to enter their complete name, email address, phone number, and event type (wedding, birthday, funeral, or anniversary) and pick the date and time they want to consult from a calendar indicating fully booked and available slots. Afterwards, customers get a confirmation email informing them about the acceptance or decline of their booking. The system also provides users with an interactive and user-friendly platform where they can customize bouquets, obtain real-time pricing, and complete payments through e-wallets. PetalPicks aimed to increase customer satisfaction, improve florists' operational efficiency, and promote digitalization in the floral industry by bridging the gap between traditional floral shopping and modern digital solutions.

METHODOLOGY

The development of the "PetalPicks: An Interactive Web-Based Application for Personalized Bouquet Arrangement" followed the Waterfall Model of the Software Development Life Cycle (SDLC). This model provided a well-defined

structure, sequential process, and allowed for detailed documentation and evaluation at each stage. The figure 1 illustrates the Waterfall Model phases that will be applied in this study.

Figure 1
The Modified Waterfall Model



Requirements Gathering

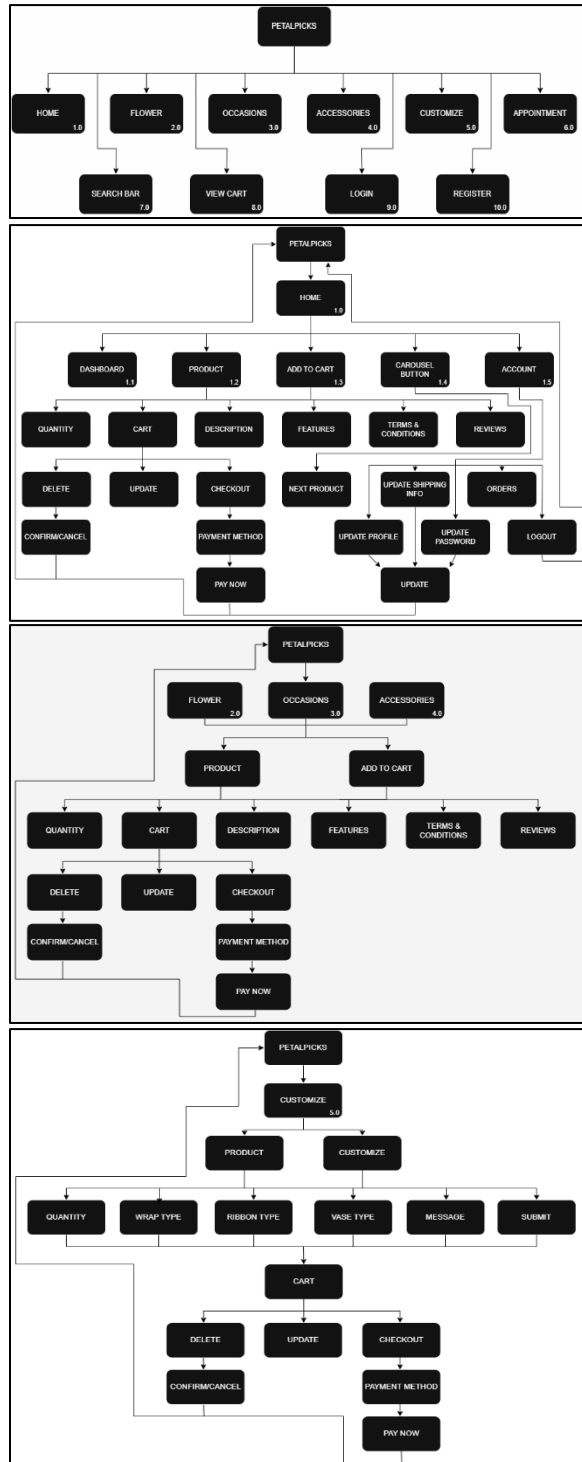
The researchers reviewed literature, conducted interviews, and researched technology to identify system needs. They explored scholarly articles and online resources on e-commerce, flower arrangement systems for customization, and payment security. Additionally, they carried out more studies on online appointment booking systems. The goal was to integrate a scheduling module that allows customers to book consultations or orders for events through the system. They also interviewed the staff and customers of Blooms and Petals to find common issues in manual ordering, scheduling, and payment processing. The information gathered helped outline the overall scope, workflow, and features of the system.

Design

In this phase, the team carefully examined the system's requirements and turned them into technical solutions that guided development. The wireframes that depicted the layout and design of every interface component were made by the researchers in order to depict the system's structure and user interactions in a clear manner. They also prepared a Visual Table of Contents (VTOC) to map the navigation flow and organization of content within the application. This helped both developers and stakeholders understand the system's setup. Additionally, use case diagrams were created to show the functional interactions between users and the system, highlighting how different modules respond to user actions. These planning tools helped create a structured

development process, reducing potential errors and improving usability.

Figure 2
Visual Table of Contents



Implementation

The implementation phase involves integrating all planned features to create the functional web application. The system includes bouquet designing, interactive buttons, real-time pricing updates, secure e-wallet integration for payments such as QR codes, and delivery/pick-up scheduling. An exclusive appointment scheduling function was introduced allowing users to select event appointment days and hours, check availability using a live calendar, and get automatic email replies about booking status updates if accepted or declined.

An admin dashboard is implemented for inventory, price, and order management. The system is also designed for both mobile and desktop optimization to enhance accessibility. Moreover, it gives administrators the capability to handle and verify appointment reservations and examine client data connected to every planned event.

During the development phase, the web application was built based on the design specifications. Developers implemented the planned features, including a user-friendly interface for customizing premade bouquets by selecting flowers, colors, and accessories; real-time pricing updates; and integration of e-wallets as the primary payment method. The module for appointments was established to comply with these principal objectives and make sure that customer bookings are synchronized with shop availability.

The development phase followed industry best practices to ensure maintainability, scalability, and optimized performance. Development tools such as XAMPP, which offers a local server setup for PHP and MySQL; Notepad++, which served as the main code editor for creating scripts and interfaces; and Hostinger, which served as the web hosting platform for deployment and testing, were in use.

Testing

During this phase, the researchers test and refine the system on the basis of comments from the capstone panel, technical advisers, alpha testers, and beta testers. The objective of this phase is to ensure that the system works as per the defined specifications and to deploy improvements based on the proposed recommendations. Improvements are made to enhance the general user experience, functionality, and stability of the system.

To ensure a thorough evaluation, the researchers conducted both alpha and beta testing using a survey questionnaire specifically designed to align with the ISO 25010 Software Product Quality Standard. The appointment

booking feature was subjected to testing that validated the calendar's accuracy, eliminated double booking, and confirmed that email notifications were sent out properly to both the customers and the administrators.

This framework includes the following key quality characteristics: functional suitability, performance efficiency, compatibility, maintainability, security, usability, reliability, and portability. The ISO-based tool serves as a standardized measure to detect defects, gauge performance, and validate user satisfaction.

Sampling Method

The researchers administer purposive sampling techniques through beta testing tools. Purposive sampling is also employed to identify participants with relevant experience in using online bouquet platforms or e-commerce websites. According to Nyimbili and Nyimbili (2024), purposive sampling, also referred to as judgment sampling, is a non-probability technique in which individuals are deliberately selected based on specific traits or expertise. In this study, the researchers determine the type of knowledge needed and intentionally select participants most likely to provide meaningful feedback due to their relevant experience.

To quickly obtain a specific sample, the study used homogeneous purposive sampling. It prioritized participants with shared characteristics relevant to the system's features instead of ensuring proportional representation. Before beta testing, three IT specialists worked with the researchers during the alpha testing phase. They examined the system's technical performance, interface behavior, and security functions. The recommendations of the experts played a crucial role in polishing the system, removing functional inconsistencies, and enhancing the overall stability before a bigger group of testers was allowed to access it.

For the beta testing phase, the researchers picked a similar group of 30 respondents aged 18 and older who had previous experience using e-commerce platforms, online ordering systems, or appointment-booking applications. This group included young adults and working individuals who were familiar with digital transactions. This ensured that the feedback was informed and relevant to real-world user behavior. Their shared level of digital skills allowed for consistent evaluation of the system's usability, bouquet customization features, pricing automation, and appointment scheduling module. Through this approach, the study gathered reliable insights from users with similar competencies who could provide

meaningful assessments of the PetalPicks system.

The researchers analyzed the collected data using descriptive statistics, which included frequency distribution, mean scores, and interpretation of the Likert scale. This helped evaluate the system's usability and functionality. The study used homogeneous purposive sampling, selecting participants who had similar levels of digital literacy and experience with online platforms. As a result, the data reflected consistent and reliable user insights. This sampling method, along with the structured responses from the Likert scale, allowed the researchers to assess how well the system met user expectations and operational needs.

Instrumentation

The researchers created a validated questionnaire based on the ISO 25010 software quality model to assess the system's usability, efficiency, reliability, and overall user satisfaction. The questionnaire measured important quality attributes, including functional suitability, performance efficiency, usability, reliability, security, and portability. The system, which included bouquet customization, secure payment processing, and appointment booking, was uploaded to a secure web-based testing platform. This allowed respondents to evaluate functions such as booking flow accuracy, confirmation emails, calendar updates, and real-time pricing.

Questionnaire Administration

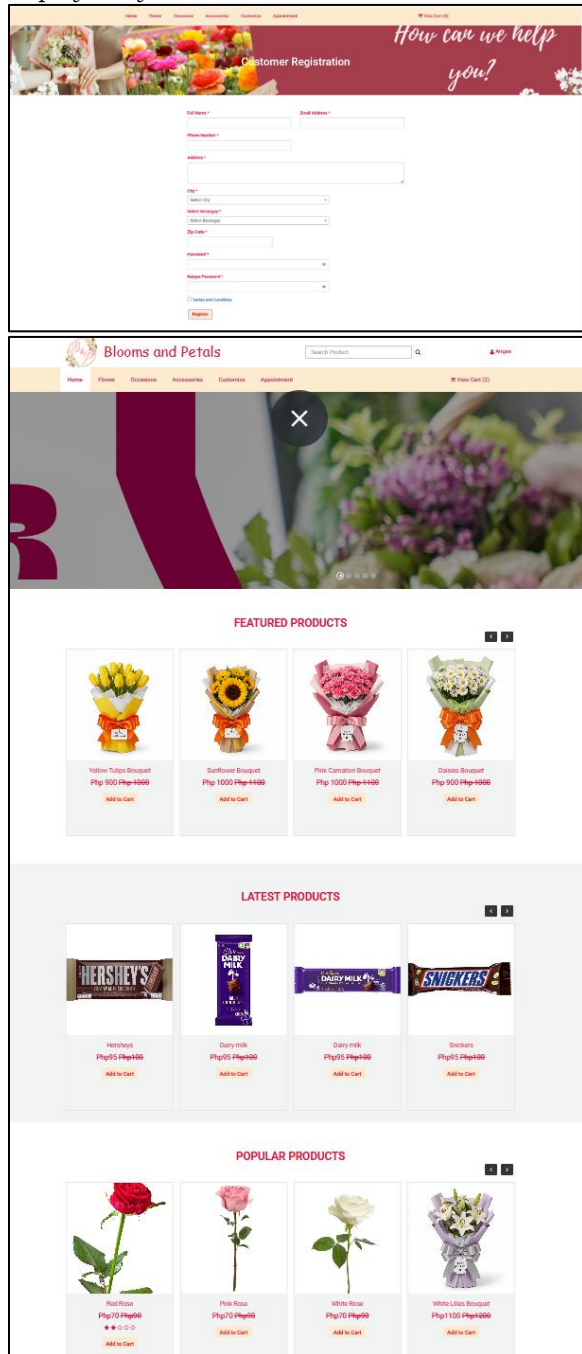
The survey is conducted in Mabalacat City, Pampanga, on October 2025. Respondents were given a quick briefing on how to respond to the checklist prior to filling out the forms. For clarity and comfort, the instruction was given in the language spoken by the participants.

As part of the evaluation process, the survey was first administered to the alpha testers, which composed of three IT experts who were in charge of reviewing the system before the general respondents. These experts evaluated the initial version of the application, giving their technical feedback regarding the performance, functionality, and design of the system. Their evaluation guided the researchers to find and fix bugs and in improving system stability before proceeding to the beta testing phase.

After incorporating the feedback from the alpha testers, the updated version of the system was evaluated through beta testing. Respondents were selected through purposive sampling. This two-step process made sure that the questionnaire was distributed correctly through google form, the ISO 25010-based criteria were

assessed properly, and the system was thoroughly tested before broader use.

Figure 3
Deployed System



Data Analysis

The analysis of the data gathered was carried out through the use of descriptive statistics. This entails summarizing and analyzing the

responses in order to derive meaningful conclusions about system performance.

Deployment

The system was deployed using Hostinger for real-world use at Blooms and Petals. During the deployment phase, training for florists and personnel involved in bouquet management, appointment requests, booking approvals, and event calendar updates was conducted. This way, the users were able to smoothly and effectively use the system.

The researchers' developed system was officially launched and is freely accessed through the domain repository website address of <https://petal Picks.site/index.php>.

Deployment operations included data transfer, security protocols setup, and user feedback gathering during the initial stages to check system stability and responsiveness in the live environment.

Maintenance

Ongoing maintenance was done to keep the system working well. The maintenance phase included regular monitoring, fixing bugs, and updates based on real-world usage and user feedback. Improvements were made to speed up page loading, make the interface easier to use, and enhance the overall user experience.

Additional maintenance tasks included updating the event calendar, improving appointment handling features, boosting system security, and conducting regular backups to protect transactional and customer data. These efforts kept the system reliable, secure, and in line with the needs of Blooms and Petals.

RESULTS

The results and outcomes of the system called "Petal Picks: An Interactive Web-Based Application for Personalized Bouquet Arrangement." It discusses the findings from the system evaluation using ISO 25010 standards, including Alpha and Beta Testing, along with user feedback and performance validation. The study assessed the system's ability to offer personalized bouquet customization, real-time pricing, payment processing, and appointment booking for Blooms and Petals in Mabalacat City, Pampanga.

Alpha Testing

Alpha testing was conducted by the development team to identify system errors, check usability, and verify that each feature functioned as intended (see Table 1). The evaluation followed the ISO 25010 standard, focusing on seven criteria: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. The

team made sure that all modules, including bouquet customization, real-time pricing, appointment booking, and checkout, worked properly.

Table 1
Alpha Test Result

Criteria	Weighted Mean	Verbal Interpretation
Functional Suitability	4.60	Excellent
Performance Efficiency	4.87	Excellent
Compatibility	4.47	Excellent
Usability	4.50	Excellent
Reliability	4.67	Excellent
Security	4.13	Excellent
Maintainability	4.67	Excellent
Portability	4.45	Excellent
Overall Weighted Mean	4.55	Excellent

Beta Testing

Beta testing was conducted by 30 selected respondents who were at least 18 years old and had previous experience with online order systems. Respondents assessed the system's performance through a survey instrument aligned with ISO 25010 software quality characteristics.

Table 2
Beta Test Result

Criteria	Weighted Mean	Verbal Interpretation
Functional Suitability	4.69	Excellent
Performance Efficiency	4.65	Excellent
Compatibility	4.54	Excellent
Usability	4.67	Excellent
Reliability	4.62	Excellent
Security	4.67	Excellent
Maintainability	4.71	Excellent
Portability	4.69	Excellent
Overall Weighted Mean	4.67	Excellent

Discussion of Results

The evaluation results showed that the system achieved the goals outlined in Chapter 1. It provided an interactive and reliable online platform that makes ordering and scheduling bouquets easier. The appointment booking feature specifically addressed previous issues with manual scheduling. These changes improved accuracy and communication between customers and staff.

The standards of software quality based on ISO 25010 were also followed by the system. It demonstrated excellent ratings in functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. These results indicate that the application meets key quality attributes expected of a well-designed system. Such performance is especially valuable for small and medium enterprises, as it ensures dependable operation, secure transactions, and a user-friendly experience.

Limitations

The researchers implemented the system specifically for Blooms and Petals, a local flower shop in Mabalacat City, Pampanga. As such, the study was limited in scope to local flower retail and did not support international deliveries upon launch. Deliveries were available only within Pampanga using either the shop's personal delivery service (L300 driver with location-based shipping fees) or through couriers booked by customers.

The system allowed users to customize bouquets, but customization was limited to the flowers listed in the shop's inventory, such as rados, roses, Anthuriums, sunflowers, tulips, and carnations. Customers can customize the premade bouquet by choosing their preferred flowers, flower types, and accessories. They may also mix different flower types based on their preferences after selecting from predefined arrangement types. However, fully custom designs outside the shop's available stock were not accommodated.

The booking system for appointments was restricted to a single branch of Blooms and Petals and only showed the availability for consultations and arrangements of events done in-store locally. Moreover, it didn't offer any automated synchronization with external calendar tools like Google Calendar or integration with third-party booking systems.

The shop's current average of up to 20 orders per day was considered the expected workload for the system. Instances of errors due to miscommunication—common in the manual ordering process—were addressed by the digital platform, but the system did not account for external issues such as transaction failures, refund delays, or security breaches arising from third-party payment gateways.

Furthermore, the study did not implement advanced features such as AI-driven bouquet recommendations, automated reminder notifications for booked appointments, or international shipping integration. These enhancements were beyond the scope of the

current project but may be explored in future upgrades.

Conclusions

The study's findings confirm that the research objectives were fully met. The PetalPicks system effectively addressed the limitations of the shop's traditional bouquet-ordering process by offering organized digital features like appointment scheduling, order processing, and secure online payment transactions. These improvements greatly reduced communication errors and increased the overall efficiency of service delivery.

Furthermore, the system fully complied with the ISO 25010 software quality model, achieving Excellent ratings in all areas evaluated. These results confirm the system's overall strength, reliability, and ability to meet the expected software quality standards. Customer experience improved significantly with real-time pricing and organized appointment scheduling. This allowed users to manage their budgets and preferred service times effectively. Also, the use of email verification and payment processes ensured that sensitive information was handled securely, which built trust and protected data. The system's deployment through Hostinger added to its reliability by providing a stable hosting environment, ensuring continuous access and consistent performance.

In conclusion, PetalPicks improved the workflow, customer satisfaction, and online presence of Blooms and Petals. It provides a practical and sustainable technology solution that helps local florists meet the rising demands of digital commerce.

Acknowledgement

The completion of this capstone project, PetalPicks: An Interactive Web-Based Application for Personalized Bouquet Arrangement, would not have been possible without the guidance, support, and encouragement of many individuals who shared their time, expertise, and dedication throughout the entire process.

First and foremost, we extend our deepest gratitude to Almighty God for granting us wisdom, strength, and perseverance from the beginning until the successful completion of this study.

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Our heartfelt thanks are also extended to Dr. Myrna E. Cuento-Calma, CPA, FRIAcc, Ph.D., former Dean, and Engr. Dennis L. Tacadena, DIT, current Dean of the Institute of Business and Computing Education (IBCE) of Mabalacat City College, for granting us permission to conduct our research and for their strong support in ensuring its successful implementation.

We would like to acknowledge the invaluable contributions of our Alpha testers, composed of Information Technology professionals, whose technical feedback enabled us to identify system bugs, improve performance, and enhance overall user experience. Likewise, we extend our gratitude to our Beta testers, particularly the residents of Mabalacat City, Pampanga. Their participation and honest evaluation played a vital role in validating the system based on ISO 25010 standards.

To the management and staff of Blooms and Petals, we offer our appreciation for allowing us to develop this system for their flower shop and for providing the necessary information and cooperation throughout the study.

Lastly, we express our heartfelt gratitude to every member of the research team. Each individual's dedication, hard work, and collaboration were essential to the successful completion of this project.

To everyone who contributed in any way—your support, encouragement, and trust are deeply appreciated.

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PETKLINIKA: A Web-Based Appointment System with Pet Diseases Verification and QR-Code Pet Locator

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ABSTRACT

PetKlinika is a web-based veterinary management system developed to modernize clinic operations by automating appointment scheduling, pet disease verification, real-time communication, and QR-code-based pet identification for lost and found reporting. Designed for a veterinary clinic in Pampanga, the system addressed common issues in traditional manual processes such as delayed bookings, mismanaged records, and inefficient information retrieval. Developed using the Prototyping Model, PetKlinika features dedicated panels for administrators, veterinarians, and pet owners, supporting tasks like medical record management and automated QR generation. Evaluation through Alpha and Beta Testing based on ISO 25010 standards showed high user acceptance, confirming the system's effectiveness in improving workflow efficiency, data management, and overall service delivery in veterinary clinics.

Keywords: Veterinary Management System, Web-Based Application, Appointment Automation, QR-Code Pet Locator, ISO 25010 Evaluation

INTRODUCTION

Pet ownership has grown substantially in recent years, with pets increasingly regarded as valued family members who provide emotional and psychological support. As the population of pet owners rises, the demand for reliable, efficient, and accessible veterinary services also increases. However, many veterinary clinics still rely on manual procedures such as walk-in scheduling, handwritten medical records, and basic communication channels like text messaging or phone calls. These traditional systems are prone to errors, scheduling conflicts, misplaced records, and delayed communication.

Globally, web-based information systems have revolutionized healthcare and service industries by automating processes, improving user convenience, and enabling digital record-keeping. In veterinary practice, these advancements not only streamline clinic operations but also enhance animal welfare by ensuring accurate medical tracking and timely interventions. Appointment systems, for instance, have been shown to increase client satisfaction, reduce waiting time, and optimize clinic workflow. Likewise, digital identification tools, such as QR codes, significantly improve the likelihood of reuniting lost pets with their owners.

In the Philippines, although pet ownership is widespread, digital veterinary platforms remain limited. Many clinics continue to manage appointments and medical inquiries manually. Lost pet identification is also a persistent issue due to the absence of standardized tagging systems. This gap highlights the urgent need for technological solutions that support both clinic operations and community pet management.

To address these concerns, the researchers developed "PetKlinika", a web-based system composed of four major modules: Appointment Scheduling, Pet Diseases Verification, Chat-Based Medical Inquiry, QR-Code Pet Locator. The system features distinct user interfaces for administrators, veterinarians, and pet owners, each performing essential roles. PetKlinika also includes automated pet QR code generation, lost-and-found reporting, and organized medical record management. These components are reflected in the system DFDs and interface designs provided in the document, illustrating how data flows through the system's core modules. By modernizing traditional veterinary workflows and providing pet owners with convenient access to clinic services, the PetKlinika project supports Sustainable Development Goal (SDG) 3 (Good Health and Well-Being) and SDG 9 (Industry, Innovation, and Infrastructure). This study presents the development, evaluation, and impact of PetKlinika on improving veterinary service delivery.

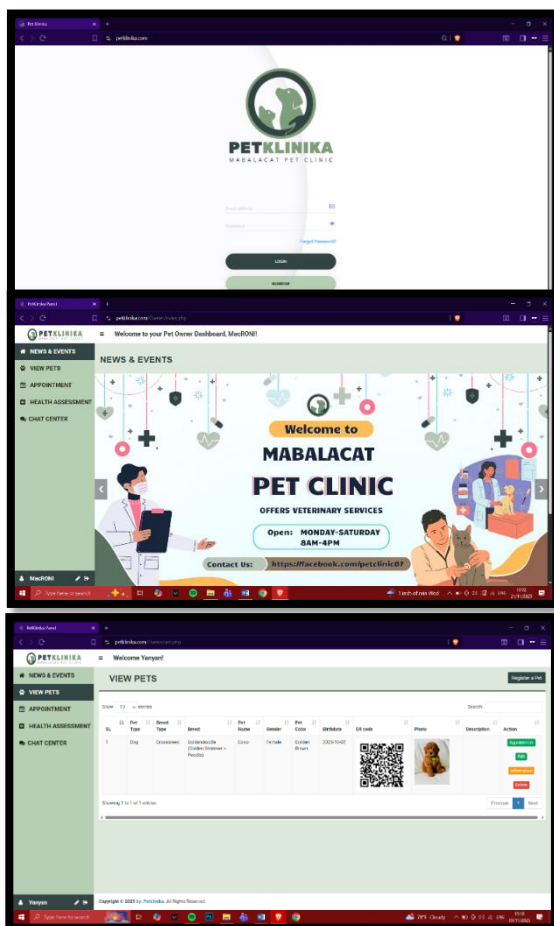
QR-Based pet identification and locator tool Observations and document reviews helped the team define the system's scope, interface requirements, and multi-role user access.

Design

The design phase involved preparing: Use Case Diagrams (see Figure 2) detailing interactions between pet owners, veterinarians, and the admin, Data Flow Diagrams (DFDs) (see Figure 3) showing appointment, inquiry, and pet data processes and User Interface Designs for dashboard, appointments module, and QR code scanning pages (as reflected in the PDF screenshots)

The design ensured simple navigation, clear classification of veterinary records, and responsive layouts suitable for mobile and desktop use.

Figure 4
PetKlinika System



Prototype

In this phase, the system features were defined based on the operational challenges experienced by Mabalacat Pet Clinic, particularly in appointment management, medical record handling, and pet recovery. To address these issues, PetKlinika introduced a calendar-based appointment scheduling module that allows pet owners to book consultations while enabling veterinarians to accept, reject, or reschedule appointments, improving time management and reducing errors. The Pet Disease Verification module provides veterinarians with secure access to pet profiles and medical histories, supporting accurate diagnoses and efficient record updates. The system consists of four user interfaces—Admin, Veterinarian, Pet Owner, and Pet Finder—each with role-specific access and dashboards to ensure secure, organized, and effective system operations, including QR-code scanning for lost pet identification and owner contact.

Customer Evaluation

The ISO 25010 Software Product Quality Model, which evaluates eight quality attributes such as functionality suitability, interaction capability, and security, is used by the advocates. Respondents for the system testing were chosen from among the employees and pet owners of Mabalacat Pet Clinic using the self-selection sampling and purposive sampling technique. After being allowed to test the system, these users were requested to fill out a questionnaire created by the researcher. To ascertain satisfaction levels and evaluate the quality of the system, the feedback is subjected to a weighted mean analysis. The analysis's findings directed the process of improvement and guaranteed that the finished system met user requirements.

Refined Prototype

In this phase, based on the panel's recommendations and advice from the technical and capstone advisors, the developers made a few changes to the system. In the testing phase, every aspect of the research is evaluated to see if the system meets the requirements. To improve the system that had been developed, the panels and clients agreed-upon feedback and proposals were evaluated and included. Using a survey tool developers created and anchored with the ISO25010 Software Product Quality Standard criteria, the developers carried out alpha and beta testing to examine and fix any bugs or issues in the program. For evaluating the quality of the developed system, the developers designed a survey questionnaire based on the ISO25010 model's functionality suitability, interaction capability, and security requirements.

Final Product

In this phase, the system was made accessible on a range of internet-connected devices by means of a scalable and secure web hosting platform. To ensure easy integration into the system, veterinary personnel have training sessions, and pet owners received user manuals and verbal instructions to help them navigate the system's features. Since the QR-Code Pet Locator is presently limited to Mabalacat City, its design would eventually enable regional or national extension (See Figure 4).

RESULTS

The PetKlinika system achieved its primary goals by successfully integrating digital veterinary services into a unified platform. The system interface screenshots—covering the Admin Panel, Pet Owner Panel, and Veterinarian Panel—demonstrate functional implementation across all primary modules.

Alpha Testing Results

Alpha testers confirmed that: All main modules functioned as intended, Appointment scheduling prevented conflicts, QR codes successfully displayed pet information, Disease verification displayed correct analysis parameters, and Security features such as login authentication worked properly (see Table 5).

Table 7: Overall Evaluation Results – Alpha & Beta Test

ISO 25010 Criteria	Mean Score (Alpha Test)	Verbal Interpretation (Alpha Test)	Mean Score (Beta Test)	Verbal Interpretation (Beta Test)
Functional Suitability	4.40	Very Great Extent	4.91	Very Great Extent
Interaction Capability	4.33	Very Great Extent	4.92	Very Great Extent
Security	4.00	Great Extent	4.89	Very Great Extent
Overall Mean Score	4.24	Very Great Extent	4.91	Very Great Extent

Beta Testing Results

Beta testers rated the system highly, citing: Ease of scheduling appointments, Accurate retrieval of pet medical records, User-friendly QR code scanning, Helpful disease verification indicators, and Effective real-time chat with veterinarians (see Table 6).

Overall Evaluation Results

The summary of the Alpha and Beta test results shows that the PetKlinika system consistently achieved high ratings across all evaluation

criteria based on the ISO 25010 standards (see Table 7). During the Alpha Test, the system obtained an overall mean score of 4.24, verbally interpreted as “Very Great Extent,” with notable strengths in Functional Suitability 4.40 and Interaction Capability 4.33, while Security 4.00 was rated to a “Great Extent.” After implementing improvements based on the initial feedback, the Beta Test reflected significant enhancement, resulting in an overall mean score of 4.91, still interpreted as “Very Great Extent.” All criteria in the Beta Test—Functional Suitability 4.91, Interaction Capability 4.92, and Security 4.89—received consistently high ratings, indicating that the system became more refined, user-friendly, and secure. These results confirm that PetKlinika successfully met its objectives, demonstrating reliability, strong system performance, and an excellent user experience after iterative testing and enhancement.

Table 5: Overall Evaluation Results - Alpha Test

Criteria	Weighted Mean	Verbal Interpretation
Functional Suitability	4.40	Very Great Extent
Interaction Capability	4.33	Very Great Extent
Security	4.00	Great Extent
Overall Mean	4.24	Very Great Extent

Table 6: Overall Evaluation Results - Beta Test

Criteria	Weighted Mean	Verbal Interpretation
Functional Suitability	4.91	Very Great Extent
Interaction Capability	4.92	Very Great Extent
Security	4.89	Very Great Extent
Overall Mean	4.91	Very Great Extent

DISCUSSION

PetKlinika addressed the limitations of traditional veterinary workflows by providing a structured, digital, and user-friendly platform for pet owners and clinic staff. The appointment module resolved issues of double-booking and miscommunication, while the QR-based identification significantly improved lost-pet recovery processes. The inclusion of diseases verification and chat support empowered pet owners with early guidance and professional communication before physical consultation.

The results confirmed that PetKlinika met its intended objectives, successfully improving service speed, information accuracy, and

communication between veterinarians and pet owners. The high ratings from both alpha and beta testers affirmed that the system aligned with established software quality standards and responded effectively to real-world clinic needs.

Limitations

The system was limited to a single veterinary clinic and has not yet been expanded to support multi-branch integration. The diseases verification module functions only as an advisory tool and cannot replace an official veterinary diagnosis. The QR-based lost-and-found reporting feature also relies heavily on user participation and stable internet connectivity, which may affect its effectiveness. Moreover, the current version does not include an automated payment gateway, and external calendar synchronization, such as integration with Google Calendar, has not yet been implemented.

Conclusion

The development of PetKlinika successfully digitized essential veterinary operations, providing an efficient platform for appointment handling, medical record management, diseases verification, and QR-based pet tracking. The system met ISO 25010 quality standards and received highly positive evaluation from both experts and users. With its organized modules and user-centered design, PetKlinika enhances clinic workflow, improves client satisfaction, and promotes responsible pet ownership. The system is scalable and ready for further enhancements in future development.

ACKNOWLEDGMENT

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Signify: An Interactive E-Learning Application for Deaf and Educators

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ABSTRACT

Deaf learners continue to face challenges in educational settings that depend heavily on spoken and text-based communication. This study developed Signify, an Android-based interactive e learning application designed to support American Sign Language (ASL) learning for Deaf individuals and educators. The Modified Waterfall Model guided the development process, which included requirements gathering, system design, coding, testing, and deployment. Signify features offline and online ASL video lessons, interactive assessments, real-time search, game-based exercises, progress tracking, and speech-to-text capabilities. The system was evaluated through ISO 25010 quality criteria using alpha testing with IT experts and beta testing with members of the Christian Society for the Deaf in Pampanga North. Results showed strong functional suitability, usability, compatibility, and reliability. Signify provides an accessible and scalable model for improving ASL learning and strengthening communication between Deaf and hearing users.

Keywords: Deaf education, American Sign Language, E-learning application, accessibility, Android-based application, mobile learning, inclusive technology.

INTRODUCTION

Education is crucial for human development, but access to quality education remains uneven, especially for Deaf learners who face challenges in traditional, spoken language-based classrooms. The global prevalence of hearing loss is rising, with over 1.5 billion affected individuals (Guo et al., 2024), and over 430 million needing rehabilitation for disabling hearing loss (WHO, 2025). For Deaf students, education systems must adapt to their needs, and American Sign Language (ASL) offers a valuable framework for this. Recent innovations in digital learning tools, such as ASL-based e-learning platforms, help address these challenges by providing visual and interactive content. For example, research on Inclusive Emotion Technologies explores sign language-friendly video platforms that enhance engagement, while augmented reality (AR) systems are improving real-time captioning for Deaf learners (Chen et al., 2024; Samaradivakara et al., 2025).

In the Philippines, Deaf education still faces structural barriers despite Filipino Sign Language (FSL) being recognized by law. Many schools continue to rely on text-based instruction, which hinders comprehension. ASL-based digital resources, such as video lessons

and mobile apps, are often used to supplement FSL materials. Studies have shown the potential of digital approaches to improve accessibility, but more effort is needed to design systems that meet the specific needs of Deaf learners (Lucero et al., 2022).

In Mabalacat City, local schools face similar challenges with limited access to digital tools for Deaf students. However, there is an opportunity to improve education by introducing an ASL-centered platform with video lessons, visual aids, and interactive quizzes. This system could help students learn independently and allow teachers to create accessible lessons without technical expertise. Platforms designed with ASL and visual engagement could significantly improve educational outcomes in Mabalacat by fostering deeper student engagement, independence, and inclusive teaching practices.

Objectives of the Study

The general objective of the study is to develop an Android application entitled "Signify: An Interactive E-Learning Application for Deaf and Educators".

In line with this, this study aims to achieve the following specific objectives:

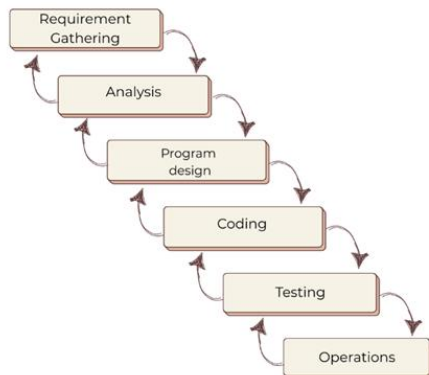
- To gather relevant data from interviews, government and non-government websites, technical sources, and academic journals, focusing on Deaf education programs using ASL, studies on Deaf pedagogy and ASL acquisition, sign language learning materials, and ASL-based e-learning platforms.

- To identify the hardware and software needed for the project, including development devices such as laptops, smartphones, and optional tablets, as well as software like Flutter, Firebase, Dart, Android Studio, Visual Studio Code, GitHub, and Canva.
- To design the Android application using essential diagrams and tools, including a storyboard, visual table of contents, flowchart, and Gantt chart for proper planning and scheduling.
- To develop the Android application with key features such as ASL video lessons, interactive assessments, progress monitoring, educational games, real-time search, speech-to-text functionality, and favorites management.
- To evaluate the system using the ISO 25010 Software Product Quality Model, assess criteria such as functional suitability, performance, compatibility, reliability, flexibility, interaction capability, and maintainability.
- To deploy the Android application.

METHODOLOGY

The Modified Waterfall Model is selected because of its sequential and formalized method, guaranteeing that every phase of development is finished before advancing to the next. This approach offers a well-defined path from planning to deployment, which makes it appropriate for the design and implementation of the SIGNIFY application. The model contains several major stages: requirements gathering, analysis, design, coding, testing, and operations. Every stage will be diligently carried out to accomplish the project objectives effectively and precisely.

Figure 1
Modified Waterfall



Requirements Gathering

The researchers identified and gathered all requirements for developing the Signify Android application. They reviewed references, conducted interviews, and consulted with their technical adviser and local stakeholders to establish the study locale and collect reliable information on Deaf education and ASL pedagogy. They also examined recent academic journals, government and non-government publications, and online sign language learning platforms. This information guided the creation of the system's scope, objectives, and functions.

The development of Signify relied on specific tools, frameworks, and platform requirements to ensure smooth performance and broad compatibility. The app was designed to run on Android 7.0 (Nougat) and later versions. Testing required an Android smartphone, with a tablet as an optional device for wider accessibility. The software stack included Flutter, Dart, Firebase, Android Studio, Visual Studio Code, GitHub, and Canva, chosen for their efficiency, compatibility, and suitability for interactive learning application design.

Analysis

While conducting the analysis phase, the researchers closely looked at the requirements of the target users, so that the system would be a proper tool for learning ASL. Among the data, the researchers considered interviews with the Christian Society for the Deaf and educational resources that were used to figure out the main features of the system, such as video lessons, both offline and online, interactive assessments, and progress tracking. The analysis also involved recognizing the app's limitations, the users' expectations from the app, and even the app's accessibility features so that the app would be inclusive and its design relevant.

Design

The developers figured out and organized the layout of the system and the graphical interface for the user. They came up with several charts, such as a storyboard to get an idea of the user's way through the app, a visual table of contents (see Figure 2) to present the app structure, a flowchart (see Figure 3) to see the logical flow of the application, and a Gantt chart to plan the time of the different stages of the project. The interface was devised to be such that a user would find it easy, attractive, and it would be equally usable by a Deaf person as well as a hearing user. The design featured the combination of different media formats, the simplicity of the app structure, and the clarity of the visual signs so that the users' experience would be of a higher level. The program was also

organized in such a way that it would have lessons, tests, games, and modules for the users to see their progress, thus providing a well-balanced and interesting way of learning.

Figure 2
Visual Table of Contents

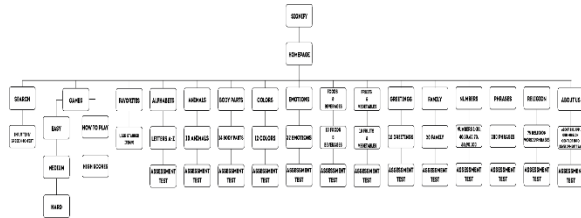
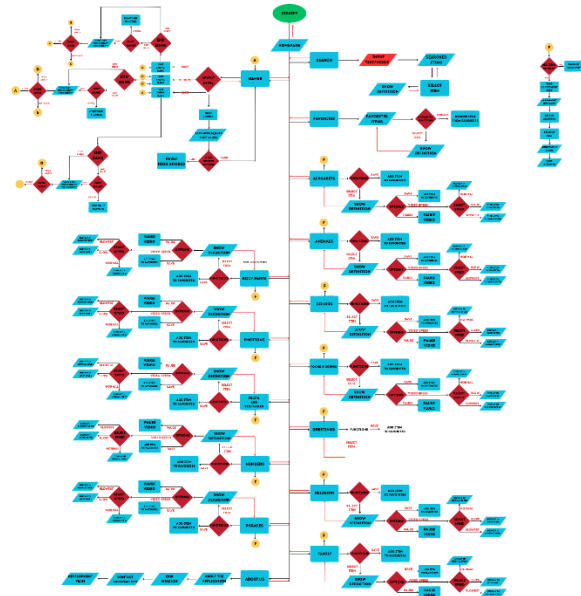


Figure 3
Flowchart



Testing

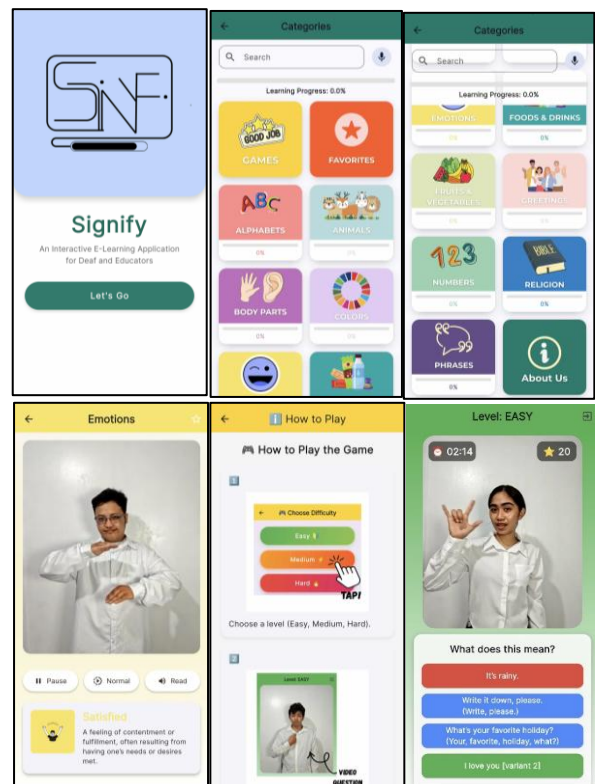
The system underwent a thorough check based on the ISO/IEC 25010 Software Product Quality Model, specifically for functional suitability, interaction capability, flexibility, performance efficiency, compatibility, reliability, and maintainability. The alpha and beta testing will be done by the researchers using the researchers' developed survey instrument anchored on the ISO25010 Software Product Quality Standard criteria to check and correct any application bugs or flaws.

Sampling Methods

The researchers used a combination of simple random sampling and purposive sampling methods. Simple random sampling, used

because the population was relatively homogeneous, ensured that each individual had an equal chance of selection, reducing bias and supporting fair representation. Purposive sampling, a non-probability method, was also applied to intentionally select participants with specific characteristics or relevant expertise. In particular, homogeneous purposive sampling helped the researchers quickly access participants who shared similar traits or experiences needed for in-depth insights. Surveys were distributed through printed forms, and purposive sampling guided the selection of participants closely connected to the study topic, following best practices for accessible research with d/Deaf communities.

Figure 4
Signify App



Instrumentation

The researchers used a validated survey tool to assess whether the Signify app met its objectives. The app was published on APKPure and tested by two groups: IT experts (alpha testers) and deaf individuals (beta testers). For alpha testing, three IT experts evaluated the app's functionality, interactivity, and flexibility. In beta testing, 30 deaf individuals from the

Christian Society for the Deaf tested the app and provided feedback.

The app's performance was evaluated based on its functional suitability, usability, and user experience, which was expected to improve for d/Deaf individuals using interactive online platforms. Both testing phases involved surveys to gather feedback. Testing was done on the same smartphone configurations for consistency.

Alpha testing involved IT professionals assessing aspects like navigation, content structure, speed, and responsiveness, in line with inclusive design principles. Beta testers, including deaf educators and non-deaf individuals, provided additional feedback, and a foreign sign language expert reviewed the app's linguistic accuracy to ensure the material supported effective sign language learning and literacy development.

Questionnaire Administration

The researchers administered the survey questionnaire. During the distribution, the researchers provided a brief introduction to guide respondents on how to accurately complete the checklist based on their experience using the application. To ensure clarity and understanding, the instructions will be delivered using the respondents' native language.

Alpha testing took place on September 26, 2025. A team of three (3) Information Technology experts examined the system in detail to check its operation, to find any technical problems, and to make sure that all the features were working as they were supposed to according to the design specifications. Their comments were used as a basis for the next modifications and upgrades of the system.

After that, beta testing was started from October 6, 2025, to October 10, 2025, at the Local Congregation of Barangay Village, Ecclesiastical District of Pampanga North, where thirty (30) members of the Christian Society for the Deaf were involved in the process to assess the application. With this wider testing stage, the researchers got the possibility to collect more detailed insights coming from different user experiences that led them to be sure that the application was of high quality and in accordance with the users' expectations as per the ISO 25010 criteria.

Data Gathering

The researchers are in charge of administering, distributing, and collecting both alpha and beta survey questionnaires. The respondents are requested to fill out the forms right after engaging with and exploring the developed application, which normally will take under fifteen (15) minutes. The alpha testing and

related data collection are planned from September 26, 2025, to September 28, 2025, and then the beta testing duration will be from October 6, 2025, to October 10, 2025.

Data Analysis

This study used descriptive statistics to summarize the data by identifying its central points, spread, and dispersion. Frequency distribution was applied to categorize respondents' demographic data and count occurrences within defined intervals. The mean was calculated to determine the central tendency of responses using standard statistical formulas. To interpret the results, a Likert scale was employed, converting mean scores into verbal descriptions ranging from "Excellent" to "Poor" based on predefined numerical intervals.

Table 1
Likert Scale

Response Categories	Numerical Value	Range / Interval	Verbal Interpretation
Strongly Agree	5	4.21 – 5.00	Excellent
Agree	4	3.41 – 4.20	Good
Neutral	3	2.41 – 3.20	Acceptable
Disagree	2	1.81 – 2.60	Marginal
Strongly Disagree	1	1.00 – 1.80	Poor

Operations

The last stage was the Operations and use of the Android app. Following the test and the adjustments made, the app was bundled and deployed via APKPure, a non-Google Play Store distribution platform. In this way, users were able to download and install the application. The deployment, therefore, was the end of the development cycle, the app being available for use in education and further evaluation.

RESULTS

Three (3) Information Technology experts performed the system check through a detailed inspection on September 26, 2025, at the Brookside Group of Companies in Bamban, Tarlac, in the course of the alpha testing. They assessed the operational integrity of the application by locating minor bugs and inconsistencies while, at the same time, they confirmed that all functionalities were operating as they were supposed to. Their technical feedback served as the basis for the implementation of necessary adjustments and performance enhancements that took place before the arrival of the next testing phase.

Table 2
Overall Evaluation Results – Alpha Test

Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.85	Excellent
Interaction Capability	4.88	Excellent
Flexibility	4.34	Excellent
Performance Efficiency	4.86	Excellent
Compatibility	4.70	Excellent
Reliability	4.84	Excellent
Maintainability	4.70	Excellent
Total Mean	4.74	Excellent

Alpha Testing of the Signify app (see Table 2), conducted by technically knowledgeable users, resulted in an overall average score of 4.74 (“Excellent”), showing that the system met early expectations. The app showed strong Functional Suitability with a score of 4.85 (“Excellent”), meaning the ASL lessons, sign videos, tests, and game features worked correctly, reliably, and as intended.

Usability received one of the highest ratings, 4.88 (“Excellent”), indicating that users found the interface easy to navigate and beginner-friendly while still accommodating experienced users.

The lowest category was Flexibility at 4.34 (“Excellent”), suggesting that although the initial version was less adaptable, this became a focus for improvement before the Beta release. Performance Efficiency scored 4.86 (“Excellent”), showing quick loading times, smooth transitions, and efficient resource use.

Compatibility earned 4.70 (“Excellent”), meaning the app performed well across various Android devices, though minor layout issues remained. The system also demonstrated strong Reliability at 4.84 (“Excellent”), with users noting very few errors or interruptions. Lastly, Maintainability scored 4.70 (“Excellent”), indicating that the app’s structure supported easy fixes and updates, though backend optimization was still recommended.

Table 3 provides the overall evaluation of beta test results, which reflect improvements after incorporating feedback from the alpha test phase.

Thirty (30) members of the Christian Society for the Deaf were present during this test, which took place between October 6 and October 10, 2025, at the Local Congregation of Barangay Village, Ecclesiastical District of Pampanga North. Such a broader evaluation made it possible for the researchers to collect a great

variety of insights and experiences from the real end-users who, in this case, are the app’s intended audience.

Table 3
Overall Evaluation Results – Beta Test

Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.94	Excellent
Interaction Capability	4.93	Excellent
Flexibility	4.88	Excellent
Performance Efficiency	4.89	Excellent
Compatibility	4.88	Excellent
Reliability	4.94	Excellent
Maintainability	4.89	Excellent
Total Mean	4.91	Excellent

The focus was on real-world usability, accuracy, and stability. The app earned a Total Mean of 4.91 (“Excellent”), indicating an extremely positive reception and confirming that the revisions greatly enhanced the user experience. Functional Suitability received 4.94 (“Excellent”), showing that lessons, assessments, videos, and game features not only worked flawlessly but also strongly met user expectations. No functional issues were reported, demonstrating complete and reliable operation. Usability scored 4.93 (“Excellent”), indicating that users found the interface intuitive, well-organized, and easy to navigate, which especially benefited first-time ASL learners.

A major improvement appeared in Flexibility, which rose to 4.88 (“Excellent”) due to better responsiveness, smoother transitions, and improved layout adaptability across devices. Performance Efficiency, rated 4.89 (“Excellent”), confirmed fast load times, smooth video playback, and efficient performance across different devices and networks.

Compatibility improved to 4.88 (“Excellent”), reflecting successful optimization for various Android versions and screen sizes. Users noted consistently smooth performance across both low-end and high-end devices. Reliability reached 4.94 (“Excellent”), supported by stable operation with no system crashes or unexpected behavior. Lastly, Maintainability scored 4.89 (“Excellent”), indicating that the system’s architecture supports efficient updates, quick bug fixes, and long-term maintainability.

The comparison between the Alpha and Beta Test results for the Signify app reveals significant improvements across nearly all criteria, demonstrating that the changes made

after the first evaluation successfully enhanced the app's performance and user satisfaction. The Total Mean increased from 4.74 to 4.91, indicating that the system has transitioned from being functionally adequate to highly effective and user-centric. Key areas of improvement include Functional Suitability, which rose from 4.85 to 4.94 due to smoother navigation and better lesson integration, and Usability, which increased from 4.88 to 4.93, thanks to a clearer interface and more intuitive user interactions. Flexibility saw the largest improvement, jumping from 4.34 to 4.88, as a result of better responsiveness, content arrangement, and broader device adaptability.

Additionally, several technical categories showed notable development. Performance Efficiency improved from 4.86 to 4.89, while Compatibility rose from 4.70 to 4.88, addressing issues related to screen scaling and device-specific behavior. Reliability also increased significantly, from 4.84 to 4.94, reflecting the successful resolution of problems identified during the Alpha Test and resulting in a more stable system. Maintainability improved from 4.70 to 4.89, indicating better code organization and a system architecture that now facilitates easier updates and maintenance. Overall, the changes implemented between the Alpha and Beta Testing phases led to substantial gains in the app's functionality, usability, and technical performance, suggesting that user feedback was effectively incorporated and that the app is now better equipped to support inclusive and accessible ASL learning.

Table 4
Comparison of Alpha and Beta Results

ISO 25010 Criteria	Mean Score (Alpha Test)	Verbal Interpretation (Alpha Test)	Mean Score (Beta Test)	Verbal Interpretation (Beta Test)
Functional Suitability	4.85	Excellent	4.94	Excellent
Interaction Capability	4.88	Excellent	4.93	Excellent
Flexibility	4.34	Excellent	4.88	Excellent
Performance Efficiency	4.86	Excellent	4.89	Excellent
Compatibility	4.70	Excellent	4.88	Excellent
Reliability	4.84	Excellent	4.94	Excellent
Maintainability	4.70	Excellent	4.89	Excellent
Overall Mean Score	4.74	Excellent	4.91	Excellent

DISCUSSION

The study entitled Signify: An Interactive E-Learning Application for the Deaf and Educators aimed to design, develop, and evaluate an accessible Android-based learning tool that promotes American Sign Language (ASL)

education for both Deaf learners and educators. The development followed a systematic process using a modified waterfall model (Pal, 2025) that included requirements gathering, design, implementation, and testing. The researchers identified that most existing sign language learning tools lacked inclusivity, offline access, and a user-friendly interface suitable for both Deaf (Karger, 2020) and non-Deaf users. Through careful analysis and consultation with experts and the target locale, the researchers established the system's essential features, such as ASL video demonstrations, interactive lessons, quizzes, progress tracking, and text-to-speech functionalities.

The results of the testing phase, which adhered to the ISO/IEC 25010 Software Product Quality Model (ISO25000, 2022), revealed that the application achieved high standards of performance and usability. Alpha testing (GeeksforGeeks, 2024), conducted with IT experts, produced an overall mean of 4.74, verbally interpreted as Excellent, signifying that the system functions accurately and efficiently according to design specifications. Beta testing (GeeksforGeeks, 2023), conducted with members of the Christian Society for the Deaf, resulted in an even higher overall mean of 4.91, also interpreted as Excellent, confirming that the users found the system effective, interactive, and easy to navigate. The integration of a Read-Aloud feature further broadened the app's inclusivity, while feedback from Beta testers, such as enhancing facial expressions and including Broken English translations, guided further refinements. The findings indicate that Signify successfully met its objectives by providing an engaging, functional, and inclusive e-learning platform that supports ASL learning and bridges communication barriers between the Deaf and hearing communities.

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The researchers extend their deepest gratitude to all the individuals and groups who made this capstone project possible. First and foremost, to Almighty God, for granting us wisdom, strength, and guidance throughout every stage of this study. His blessings made every challenge bearable and every success meaningful. Our heartfelt appreciation goes to Engr. Dennis L. Tacadena, DIT, our Technical Adviser, for his expertise, constant support, and invaluable guidance. His insights greatly shaped the direction and quality of this project. We also express our sincere thanks to Ms. Ritchell Z. Escoto, MIT, our Capstone Instructor, whose mentorship, encouragement, and dedication

helped us refine our work and stay aligned with academic standards. To Sister Cristina Datu, the CSD Organization Officer, thank you for your assistance, coordination, and for welcoming this study into the community. We are grateful to Brother Carl Matthew R. Dela Cruz, our mentor for sign language, who generously shared his knowledge, time, and commitment to ensure the accuracy of ASL content used in the application. Our appreciation extends to the IT experts who participated in the alpha testing, and to the Christian Society for the Deaf members who served as our beta testers. Your feedback, suggestions, and support were instrumental in improving and finalizing the system. A very special thank you to our families, whose patience, understanding, and motivation sustained us through long hours of development, research, and revisions. Lastly, we acknowledge the dedication, cooperation, and hard work of every member of Group 1. This project stands as a testament to our unity, teamwork, and shared commitment to producing something meaningful for the community.

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SIGNSAYA: A Mobile Application for Filipino Sign Language Interpretation Using Real-Time Gesture Recognition to Aid in Deaf Communication

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ABSTRACT

This study introduces SignSaya, a mobile-based Filipino Sign Language (FSL) application designed to support Deaf individuals, FSL learners, and teachers by providing accessible communication and learning tools. The system includes real-time FSL-to-Text and Text-to-FSL translation, an FSL dictionary, video demonstrations, a customizable interface, and a game-based quiz for learning enhancement. The system was developed using the Modified Waterfall Model of the Software Development Life Cycle (SDLC), ensuring a structured process of analysis, design, development, testing, and refinement. Evaluation involved alpha testing with IT experts and beta testing with Deaf and hearing participants, including SPED teachers. Using the ISO 25010 Software Quality Model, results showed an alpha mean of 4.33 (Excellent) and a beta mean of 4.31 (Excellent), indicating improved usability and system performance. Overall, SignSaya is an effective tool that enhances FSL learning, communication accessibility, and inclusive education. The study aligns with Sustainable Development Goals (SDGs), primarily targeting Goal 4 (Quality Education), Goal 8 (Decent Work and Economic Growth), Goal 9 (Industry, Innovation, and Infrastructure), and Goal 10 (Reduced Inequalities).

Keywords: Filipino Sign Language (FSL), Mobile Application, Real-Time Interpretation, Computer Vision, Machine Learning, Deaf Communication

INTRODUCTION

Clear communication is fundamental to human interaction, enabling the exchange of information, ideas, and emotions while fostering meaningful social relationships. However, for the deaf and hard-of-hearing community, communication remains a significant challenge. According to the World Health Organization (2025), more than 5% of the global population over 430 million individuals, including approximately 34 million children experience disabling hearing loss requiring rehabilitative support. These hearing impairments often create barriers in education, employment, healthcare, and social participation, ultimately contributing to social exclusion and reduced quality of life. To address these communication barriers, sign language has emerged as a vital mode of interaction. It is a complete visual-gestural language system with its own grammar and structure, incorporating hand movements, facial expressions, and body language to convey meaning. However, there is no universal sign language; more than 160 distinct sign languages

exist worldwide, each shaped by cultural and regional contexts. While this diversity reflects linguistic richness, it also presents challenges in developing standardized and accessible communication within the human solutions. In the Philippines, Filipino Sign Language (FSL) has been officially recognized as the national sign language through Republic Act No. 11106. This law mandates the use of FSL in education, government services, media, and public institutions, affirming the linguistic rights of the deaf community. Despite this legislative advancement, communication gaps persist, particularly due to the limited FSL proficiency among hearing individuals and the shortage of qualified interpreters. Current estimates suggest a ratio of approximately one interpreter for every 1,000 deaf individuals in the country, highlighting the urgent need for accessible and scalable communication tools. Many hearing individuals lack basic knowledge of FSL, restricting effective interaction in everyday settings such as schools, workplaces, healthcare facilities, and public spaces. This gap is further intensified in rural and underserved areas, where access to trained interpreters is even more limited. As a result, deaf individuals continue to face challenges in achieving

inclusive communication and equal participation in society. To address these challenges, this study proposes SignSaya, a mobile application designed to provide real-time Filipino Sign Language interpretation using computer vision and machine learning technologies. By utilizing Using smartphone cameras for hand gesture recognition, the application translates Filipino Sign Language (FSL) into text and vice versa, enabling seamless communication between Deaf and hearing individuals. In addition, the system serves as a learning tool for beginners by incorporating features such as an FSL dictionary, categorized vocabulary, interactive learning modules, and user-friendly interface customization. It also integrates Text-to-Speech (TTS) and Text-to-FSL functionalities to further enhance two-way communication and accessibility.

Furthermore, SignSaya includes feedback and improvement mechanisms that allow users to report mistranslations, technical issues, and suggest additional features, contributing to the continuous development and accuracy of the system. The application is designed with usability and accessibility in mind, ensuring that both Deaf and hearing users can easily navigate and interact with the platform regardless of their level of familiarity with sign language. By combining assistive technology with educational support, the system not only facilitates communication but also promotes the learning and adoption of FSL among a wider audience.

The system also encourages independent learning through interactive quizzes, guided sign demonstrations, and categorized lessons that help users improve their comprehension and retention of FSL concepts. Through these features, learners are provided with a more engaging and practical learning experience that supports both academic and real-world communication needs.

Ultimately, SignSaya aims to bridge the communication gap between the Deaf and hearing communities by providing an accessible, portable, and efficient solution. Beyond facilitating real-time interaction, the system empowers users by reducing dependence on human interpreters and increasing opportunities for independent communication. By enhancing communication accessibility and promoting awareness of FSL, the system contributes to inclusivity, social integration, and the overall well-being of the Filipino Deaf community.

Objective of the study

The primary objective of this study was to develop an efficient and user-friendly Android

application, “SignSaya: A Mobile Application for Filipino Sign Language Interpretation Using Real-Time Gesture Recognition to Aid in Deaf Communication.” The system aims to facilitate communication between deaf and hearing individuals by providing real-time Filipino Sign Language (FSL) interpretation and interactive learning tools.

- To gather relevant data and information from online libraries, articles, journals, surveys, interviews, and related applications to support the development of the system.
- To identify and specify the hardware and software requirements necessary for the development of the application, including devices such as desktop computers, laptops, Android mobile phones, and webcams, and tools such as Visual Studio Code, Android Studio, Kotlin, Canva, Firebase, Python, OpenCV, MediaPipe, TensorFlow, and Natural Language Toolkit (NLTK).
- To design a mobile application using the following analysis, diagrams, and design tools throughout the development process: Storyboard, Visual Table of Contents (VTOC), Flowchart, Data Flow Diagram (DFD), and Gantt Chart to ensure a structured, organized, and efficient system design and implementation process.
- To develop a mobile-based Filipino Sign Language (FSL) application that enhances communication and learning through real-time FSL translation, user authentication, libraries, dictionary modules, and interactive quizzes such as Gesture Recognition, True or False, and Paragraph-based activities to improve users’ understanding, recognition, and retention of FSL communication skills.
- To test the system using developer testing, alpha testing, and beta testing to ensure functionality, usability, and system performance.
- To deploy the functional system through an application repository site for distribution and accessibility testing of the developed mobile application.

METHODOLOGY

The research employed the Modified Waterfall Model, a structured yet flexible approach that allowed iterative refinement at each stage of development. This methodology ensured adaptability to user feedback and enabled the researchers to address challenges effectively throughout the system development process. The process began with requirements gathering, which established the foundation of the system through literature reviews, related studies,

surveys, and interviews. Input from potential users, particularly students and individuals with interest in Filipino Sign Language (FSL), helped ensure that the system design was user-centered and aligned with real-world communication needs.

The system design utilized various tools such as Storyboards, Visual Table of Contents, Flowcharts, Data Flow Diagrams, and Gantt Charts to illustrate the system architecture, user interface, and workflow processes. These tools provided clarity in planning and supported effective project management. For development, the researchers used Visual Studio Code and Android Studio as the primary integrated development environments (IDEs). Technologies such as Kotlin were used for mobile application development, while Python, OpenCV, MediaPipe, and TensorFlow were utilized for implementing computer vision and machine learning functionalities. Firebase served as the backend for database management and real-time data handling. The system was developed incrementally, integrating key features such as real-time FSL translation (FSL-to-Text and Text-to-FSL), an FSL dictionary, interactive learning modules, quiz-based assessments, and Additional functionalities, including text-to-speech (TTS) and user feedback mechanisms for mistranslation reporting and word suggestions, were incorporated to enhance both communication and learning experiences. Continuous refinement was carried out based on testing results and user feedback to ensure system accuracy, usability, and efficiency.

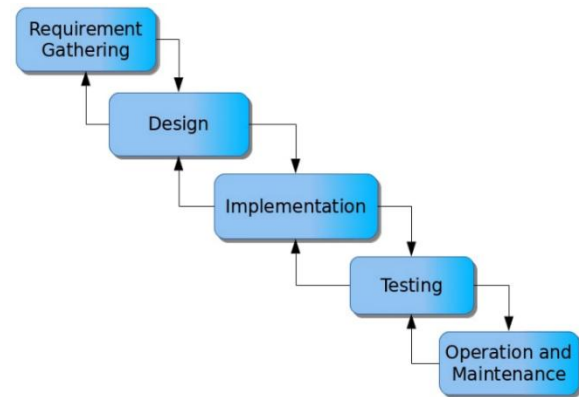
The researchers conducted alpha testing with IT experts to identify system errors, bugs, and performance issues. This was followed by beta testing involving student respondents, allowing the system to be evaluated in a real-world usage environment. Feedback gathered from both testing phases was used to further improve system functionality, usability, and overall performance.

The developed system was evaluated using the ISO 25010 Software Quality Model, focusing on Functional Suitability, Performance Efficiency, Usability, Compatibility, Reliability, and Portability. Descriptive statistical methods, particularly weighted mean, were used to analyze the results and determine the level of user acceptance and system effectiveness.

After deployment, the system was monitored through user feedback, system performance, and usability observations. Necessary updates and improvements were implemented to ensure the reliability, efficiency, and adaptability of the application to user needs. The use of the

Modified Waterfall Model (see Figure 1) provided a systematic yet flexible framework, enabling the successful development of SignSaya as an effective and accessible mobile application for Filipino Sign Language interpretation and learning.

Figure 1
Modified Waterfall Model



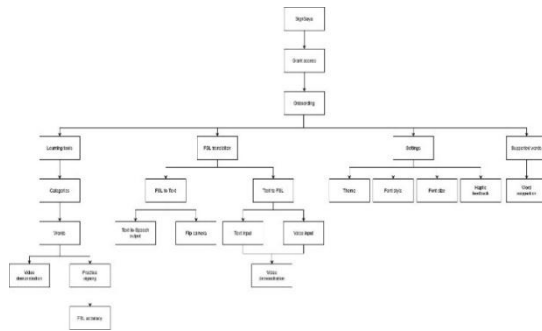
Requirements

The requirements gathering phase for the system involved a collaborative effort among the researchers to collect relevant insights necessary for the development of SignSaya. The process began with brainstorming sessions and group discussions to conceptualize the system and identify its key features. These initial activities helped establish the overall direction and functionality of the application.

To further support the development process, the researchers conducted field visits to gather real-world data. Surveys were distributed at Mababacat Elementary School (MES) and Mauaque Resettlement High School (MRHS) to both deaf and hearing students, as well as teachers, in order to understand their communication challenges and daily experiences. In addition, interviews were conducted with two signing teachers, Ma'am Gina S. Quiambao from MES and Ma'am Almeida M. Miclat from MRHS. These interviews provided in-depth insights into the communication methods, difficulties, and needs of deaf students within an educational setting. To supplement the gathered data, the researchers also reviewed related capstone projects available at the MCC Library and explored various online sources, including academic journals, research studies, and existing applications focused on sign language and assistive technologies. This comprehensive approach ensured that the system design was

grounded in both theoretical knowledge and practical user needs. The hardware requirements for the system included desktop computers, laptops, Android mobile phones, and webcams to support development, testing, and real-time gesture recognition. On the other hand, the software requirements consisted of development tools and technologies such as Visual Studio Code and Android Studio for coding and application development. Kotlin was used as the primary programming language for the Android application, while Python, OpenCV, MediaPipe, and TensorFlow were utilized for implementing computer vision and machine learning functionalities. Firebase was used for database management and real-time data handling, while Canva supported the creation of visual assets.

Figure 2
Modified Visual Table of Contents Diagram



Design

The SignSAYA system integrates inputs, processes, and outputs to create a cohesive and user-centered mobile application. Inputs include user requirements, communication needs of deaf and hearing individuals, and data gathered from surveys, interviews, related studies, and existing assistive technology applications. These inputs focus on understanding real-world communication barriers, Filipino Sign Language (FSL) usage, and learning preferences to ensure that the system is aligned with user needs. The processes include system requirements analysis, interface design, and iterative development phases. These stages involve the integration of core features such as real-time FSL gesture recognition, FSL-to-Text and Text-to-FSL translation, interactive learning modules, and user feedback mechanisms. Additional functionalities such as an FSL dictionary, quiz-based learning activities, and interface customization are also incorporated. These processes ensure that the system is developed in a structured manner while continuously

improving through refinement and testing. This combination of hardware and software, along with user-centered data collection, ensured a comprehensive, efficient, and well-informed development environment for the successful implementation of the SignSAYA system.

Figure 3
Storyboard

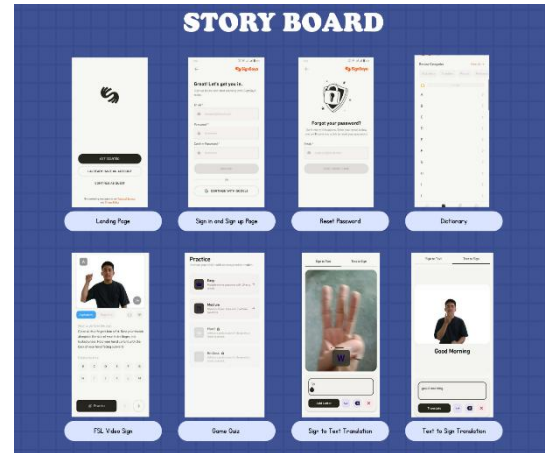
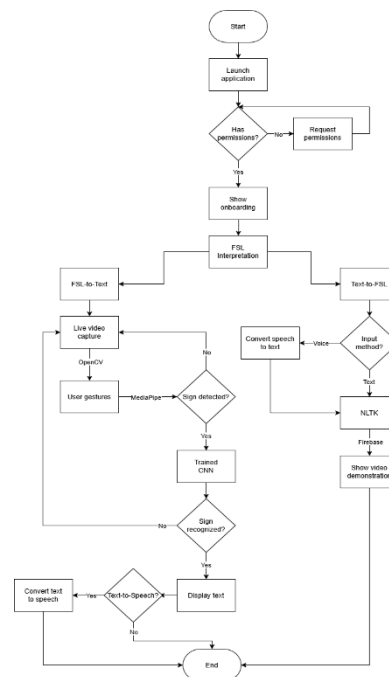


Figure 4
Flowchart



Development

The development phase of the SignSAYA system involved the use of various analysis tools and diagrams to guide system creation. Visual Table

of Contents (see Figure 2), storyboards (see Figure 3), flowcharts (see Figure 4), and data flow diagrams were utilized to define system components, visualize user interaction, organize system structure, and support efficient development and implementation process forming the foundation of the database design. The database, managed through Firebase, securely handles user data, dictionary entries, feedback records, and system-generated outputs, ensuring data integrity and efficient real-time access for both learning and communication functionalities.

Storyboards were created to visually represent the user interface and application flow, helping the development team align the system design with user needs and expectations. These included user-side interactions such as accessing the FSL dictionary, using real-time translation features, navigating learning modules, and engaging with quiz-based activities. The storyboard also illustrated key application flows for both deaf and hearing users, ensuring clarity in user experience and system functionality. These visual guides supported the development of an intuitive and accessible interface.

The home screen design was carefully planned to serve as a centralized hub for all system features. It provides seamless navigation to core functionalities such as FSL translation, learning modules, quizzes, and user settings. The interface ensures that users can easily access communication and educational tools in a structured and efficient manner. Accessibility and simplicity were prioritized to accommodate both deaf and hearing users, ensuring smooth interaction with the application.

Visual Studio Code and Android Studio served as the primary development environments for the system. The user interface was developed using Kotlin, while computer vision and machine learning functionalities were implemented using Python, OpenCV, MediaPipe, and TensorFlow. Firebase was used for backend services, including authentication and real-time database management. Throughout the development process, iterative testing and refinement were conducted to ensure that features function correctly and meet the communication needs of users, particularly deaf and hard-of-hearing individuals.

The final application integrated communication and learning tools into a single mobile platform, providing real-time Filipino Sign Language interpretation and interactive educational features. The system was designed to enhance accessibility, improve communication efficiency

and support the learning of FSL while ensuring a user-friendly and inclusive experience for all users accessibility, improve communication efficiency, and support the learning of FSL while ensuring a user-friendly and inclusive experience for all communication efficiency, and support the learning of FSL while ensuring a user-friendly and inclusive experience for all users.

The testing phase of SignSaya was comprehensive and methodical, employing multiple testing approaches to ensure functionality, usability, and user satisfaction. Alpha and beta testing were conducted as the primary evaluation stages, allowing iterative refinement of the system based on feedback.

The study employed purposive sampling, where participants were intentionally selected based on their relevance to the research objectives. The respondents consisted of thirty (30) Deaf and hearing individuals, who represent the primary users of the SignSaya application. This ensured that the evaluation directly reflected the actual user experience of the system's Filipino Sign Language (FSL) features.

During alpha testing, three Information Technology (IT) experts evaluated the system to identify bugs, errors, and technical issues. Their feedback was used to improve system stability, optimize performance, and refine gesture recognition accuracy prior to user testing.

Beta testing involved the selected deaf and hearing participants, who assessed the system in real usage scenarios. They interacted with key features such as real-time FSL translation, dictionary access, and learning modules. Feedback was collected using structured questionnaires to evaluate usability, functionality, and overall user satisfaction.

To assess system quality, the researchers utilized the ISO 25010 Software Quality Model, focusing on functional suitability, performance efficiency, usability, compatibility, reliability, and portability. The results of the evaluation indicated a high level of user satisfaction, confirming that the system effectively supports communication and learning for both deaf and hearing users.

The testing process ensured that SignSaya is a reliable, accessible, and user-friendly mobile application designed to bridge communication gaps and promote Filipino Sign Language learning. A 5-point Likert scale was used to measure user responses across different evaluation criteria.

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Table 1
Likert Scale used by the Researchers

Response Categories	Numerical Value	Range / Interval	Verbal Interpretation
Strongly Agree	5	4.21 – 5.00	Excellent
Agree	4	3.21 – 4.20	Good
Neutral	3	2.61 – 3.20	Acceptable
Disagree	2	1.81 – 2.60	Marginal
Strongly Disagree	1	1.00 – 1.80	Poor

Deployment

The system, SignSaya, was deployed as an Android mobile application, utilizing integrated development tools and backend services for efficient operation and management. The application was developed using Android Studio, while Firebase was used to handle database management, user authentication, and real-time data processing. This setup ensured reliable system performance and seamless interaction between application components.

Maintenance

Regular maintenance protocols were established to ensure SignSaya's reliability and effectiveness. Key metrics, such as user feedback, system performance, and gesture recognition accuracy, were monitored regularly to promptly identify and address issues. Periodic updates were implemented to enhance application functionality, improve translation accuracy, and resolve system bugs, ensuring continuous system improvement and long-term application stability. Users were encouraged to utilize the feedback feature within the application to report mistranslations, errors, and usability concerns. These reports allowed the researchers to efficiently identify problem areas and implement necessary improvements. and corrective actions.

RESULTS

The alpha test results demonstrated excellent performance across all evaluated criteria, with an overall mean score interpreted as "Excellent." Functional Suitability, Performance Efficiency, Usability, Compatibility, Reliability, and Portability all received high ratings from the IT experts. These results highlight the system's strong functionality, efficiency, and usability, as well as its reliability and adaptability during the initial testing phase.

Table 3 presents the summary of the beta test results, which reflect improvements after incorporating feedback from the alpha testing phase. A comprehensive evaluation of the SignSaya mobile application was conducted during beta testing, focusing on Functional Suitability, Performance Efficiency, Usability, Compatibility, Reliability, and Portability, based on the ISO 25010 standards. The beta test involved thirty (30) purposively selected deaf and hearing participants who interacted with the system in real-world scenarios.

The beta test results showed strong overall performance, achieving a grand mean score of 4.31, interpreted as "Excellent." Usability obtained the highest rating of 4.50, followed by Functional Suitability (4.43) and Performance Efficiency (4.30), indicating that users found the system easy to use, effective, and responsive. Compatibility (4.25), Reliability (4.20), and Portability (4.17) also received positive evaluations, demonstrating that the system performs well across different conditions, although portability was slightly limited due to restricted device testing.

Overall, the beta test results indicate that the SignSaya application is highly acceptable to users, demonstrating strong usability, functionality, and performance. These findings confirm that the system is effective in supporting Filipino Sign Language communication and learning, and is ready for deployment as an assistive mobile application.

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DISCUSSION

The development of SignSaya: A Mobile Application for Filipino Sign Language Interpretation Using Real-Time Gesture Recognition to Aid in Deaf Communication aimed to provide an accessible and efficient

communication tool for both deaf and hearing individuals. This study sought to address the communication barriers experienced by the deaf community by introducing a user-centered mobile application integrated with real-time translation and learning features. Specifically, the study identified the challenges faced by deaf individuals in everyday communication, as well as the limited knowledge of Filipino Sign Language (FSL) among hearing individuals. Based on these findings, the researchers designed a system that incorporates essential features to enhance communication accessibility and learning. Conducted with selected deaf and hearing participants, along with insights from signing teachers, the study ensured that the system was aligned with real-world communication needs.

Table 3. Summary of Beta Test Result

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.43	Excellent
Performance Efficiency	4.30	Excellent
Usability	4.50	Excellent
Compatibility	4.25	Excellent
Reliability	4.20	Excellent
Portability	4.17	Excellent
Overall Mean Score	4.31	Excellent

The study concluded that SignSaya successfully provides an accessible and interactive communication and learning environment. Features such as real-time FSL translation, dictionary access, and learning modules enable users to communicate more effectively and improve their understanding of sign language. The integration of computer vision and machine learning technologies enhances the system's ability to recognize gestures accurately, making it a practical assistive tool. The application's user-friendly interface further supports ease of use, allowing both deaf and hearing users to navigate the system efficiently.

The system emphasizes usability, accessibility, and adaptability, benefiting both primary user groups. Deaf users are provided with a tool that supports independent communication, while hearing users gain access to learning resources that help them understand and use FSL. Features such as quiz-based learning, user feedback mechanisms, and interface customization encourage engagement and continuous improvement. These functionalities make the application not only a communication tool but also an educational platform that

promotes inclusivity and awareness of sign language.

Additionally, the system provides opportunities for further enhancement. Future improvements may include expanding the FSL dataset to cover more complex gestures and vocabulary, improving gesture recognition accuracy under varying environmental conditions, and optimizing system performance for lower-end mobile devices. The inclusion of features such as offline functionality, multi-language support, and enhanced voice recognition could further improve accessibility and usability.

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To further support user engagement, the application may incorporate advanced features such as interactive tutorials, progress tracking, and personalized learning recommendations. Integrating cloud-based analytics could help monitor user interaction, system performance, and learning progress, enabling data-driven improvements. Adding community-based features, such as forums or collaborative learning spaces, may also enhance interaction between users and promote knowledge sharing. By addressing these recommendations, SignSaya can evolve into a more comprehensive, reliable, and user-friendly assistive technology. The system has the potential to significantly contribute to bridging the communication gap between deaf and hearing individuals, while promoting inclusivity, accessibility, and the widespread adoption of Filipino Sign Language in various social contexts. Furthermore, continuous enhancement of the application's features, learning modules, and translation

ACKNOWLEDGMENT

The successful completion of this capstone project is the result of the collective support and guidance of numerous individuals and institutions. Above all, we offer our deepest gratitude to Almighty God, who granted us the strength, wisdom, and perseverance to overcome the challenges encountered throughout this academic endeavor.

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We are also deeply grateful to our alpha and beta testers, including IT experts and selected deaf and hearing participants, whose feedback significantly contributed to the improvement of the system's design, functionality, and usability. Their active participation and honest evaluation provided meaningful insights that guided the enhancement of the SignSaya application.

We would also like to acknowledge the institutions, researchers, and authors whose works served as valuable references in the development of this study. Their contributions to related literature and technologies helped strengthen the foundation of this research and guided its overall direction.

Finally, we extend our sincere appreciation to our families, friends, and team members for their unwavering support, motivation, and understanding throughout the development of this project. Their encouragement and belief in our abilities served as our inspiration to complete this study successfully.

To everyone who contributed, directly or indirectly, to this achievement, we offer our heartfelt gratitude. Your support has made this academic milestone possible.

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StenoCoach: Stenography Learning Management System for Mabalacat City College

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ABSTRACT

StenoCoach is a web-based learning management system designed to enhance stenography learning among Bachelor of Science in Office Administration (BSOA) students of Mabalacat City College. The platform offers interactive lessons, real-time practice drills, a virtual stenotype keyboard, quizzes, progress tracking, and digital certificates to support effective skill development. StenoCoach was developed using the Modified Waterfall Model of the Software Development Life Cycle (SDLC) and evaluated based on ISO/IEC 25010 standards, including Functional Suitability, Compatibility, Interaction Capability, Security, Performance Efficiency, and Flexibility. Alpha testing achieved an overall mean score of 4.93, while beta testing obtained a mean score of 4.78, both interpreted as “Excellent.” The system aligns with Sustainable Development Goals (SDGs), particularly Quality Education (SDG 4), Decent Work and Economic Growth (SDG 8), Industry, Innovation, and Infrastructure (SDG 9), and Reduced Inequalities (SDG 10), by promoting accessible and technology-driven stenography education.

Keywords: Web-Based Learning Management System, Stenography, Interactive Learning, Machine Shorthand, Virtual Stenotype Keyboard, Real-Time Practice

INTRODUCTION

Technology has become an integral part of everyday life, continuously reshaping how people communicate, access information, and acquire new skills. Its rapid advancement has transformed traditional learning environments into flexible, digital spaces where knowledge can be accessed anytime and anywhere. Communication is now instantaneous, information is readily available, and learning has shifted from purely classroom-based instruction to technology-driven platforms that cater to diverse learning needs. As expectations for efficiency, accessibility, and adaptability increase, educational institutions are encouraged to adopt digital solutions that enhance teaching and learning processes (Kumar, 2024). Web-based learning platforms serve as centralized repositories of educational content, organizing courses into structured modules and providing tools such as progress tracking and interactive activities that enrich the overall learning experience for both students and instructors (G, 2021).

Stenography remains a vital skill in office administration, legal documentation, journalism, and professional transcription, where speed, accuracy, and real-time recording are essential. Often referred to as shorthand

writing, stenography enables professionals to capture spoken information efficiently using symbols, abbreviations, or machine shorthand systems. Despite advancements in automated transcription technologies, stenography continues to hold relevance due to its precision, contextual accuracy, and reliability in professional settings (IWP Academy, 2023). For Bachelor of Science in Office Administration (BSOA) students, proficiency in stenography is a core competency that significantly enhances employability and professional readiness. However, mastering stenography requires continuous practice, strong motivation, and access to structured learning tools, which are often limited in traditional classroom-based instruction (Valiente, 2022).

In the Philippines, the Commission on Higher Education (CHED) emphasizes the adoption of flexible and technology-driven learning approaches to ensure sustainable and quality education. Through CHED Memorandum Order No. 4, Series of 2020, higher education institutions are encouraged to integrate digital platforms and innovative teaching strategies to support student learning beyond conventional settings (Commission on Higher Education, 2020). At Mabalacat City College (MCC), BSOA students face challenges in learning stenography due to limited access to interactive learning resources, minimal real-time practice opportunities, and the absence of a dedicated web-based system for shorthand instruction. Traditional learning methods such as textbooks

and face-to-face drills may be time-consuming, costly, and less adaptable to individual learning paces, which can hinder skill mastery (Barrios et al., 2023).

To address these challenges, StenoCoach: Stenography Learning Management System for Mabalacat City College was developed as a web-based platform designed to modernize stenography education. The system provides interactive lessons, real-time practice drills, a virtual stenotype keyboard, quizzes, progress tracking, analytics, and digital certification features that support the development of both traditional and machine shorthand skills. By offering a structured, accessible, and technology-driven learning environment, StenoCoach aims to enhance student engagement, improve shorthand proficiency, and support the academic and professional preparation of BSOA students.

Through its user-friendly interface and role-based access for students, instructors, and administrators, StenoCoach streamlines the delivery and management of stenography instruction. It empowers learners by providing readily available learning materials and performance monitoring tools, while enabling instructors to manage courses and evaluate learning outcomes efficiently. Ultimately, the implementation of StenoCoach reflects MCC's commitment to quality education, innovation, and inclusive learning, ensuring that stenography remains a relevant and valuable skill in the evolving digital and professional landscape.

Objective of the Study

The general objective of this study was to develop a web-based platform entitled "StenoCoach: Stenography Learning Management System for Mabalacat City College", which is designed to enhance stenography learning through interactive lessons and tutorials.

In line with this, the study aims to achieve the following specific objectives:

- To gather information and best practices for system development by reviewing literature, studies, and references on e-learning, interactive modules, and educational technology.
- To identify the necessary hardware for system implementation, includes desktop and laptop requirements such as processor, RAM, storage, video RAM, and operating system. While software requirements consist of Visual Studio Code, Git, T3 Stack, TypeScript, React 19, Tailwind CSS,

PostgreSQL, Prisma ORM, NextAuth.js, tRPC, Canva, Node.js, and OneDrive.

- To design the StenoCoach system by applying system analysis and design methodologies such as flowchart, storyboard, use case diagram, visual table of contents, and Gantt chart.
- To develop the StenoCoach system by combining step-by-step lessons, interactive practice sessions, and personalized progress tracking, focusing on both traditional shorthand foundations and modern machine shorthand applications.
- To test the StenoCoach system through Alpha and Beta testing and evaluate its performance based on ISO 25010 standards, focusing on functional suitability, compatibility, interaction capability, security, performance efficiency, and flexibility.
- To completely deploy and implement the system, Vercel was selected as the hosting site, and stenocoach.xyz was used for the domain name.

These objectives collectively support the successful development, evaluation, and implementation of StenoCoach, ensuring that the system effectively enhances stenography learning, improves student engagement, and contributes to the academic and professional preparation of BSOA students at Mabalacat City College.

METHODOLOGY

The Modified Waterfall Model is used for the development of StenoCoach because it follows a structured and sequential approach, ensuring each phase is completed before the next begins. The system development consists of requirement gathering, design, implementation, testing, and operation & maintenance. Each phase will be carefully carried out to create a reliable and efficient stenography learning platform.

Requirements Gathering

The researchers identified the functional and technical requirements for developing StenoCoach: Stenography Learning Management System for Mabalacat City College by reviewing related literature, previous studies, and existing web-based learning platforms. Consultations were conducted with the technical adviser, stenography instructors, and IT experts to ensure alignment with the needs of BSOA students. The gathered information guided the definition of system objectives, scope, and core features. Hardware and software requirements were also identified, including desktop/laptop specifications and development tools such as

Visual Studio Code, Git, T3 Stack, PostgreSQL, and Canva.

Figure 1
Modified Waterfall Model

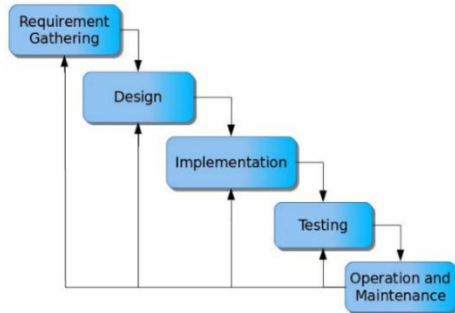
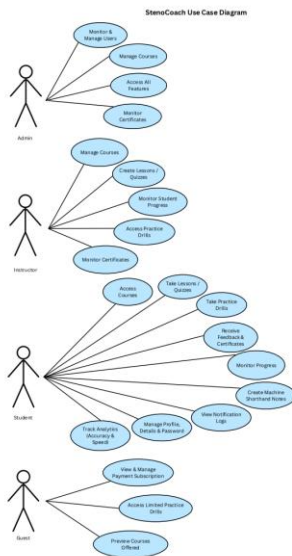


Figure 2
Use Case Diagram



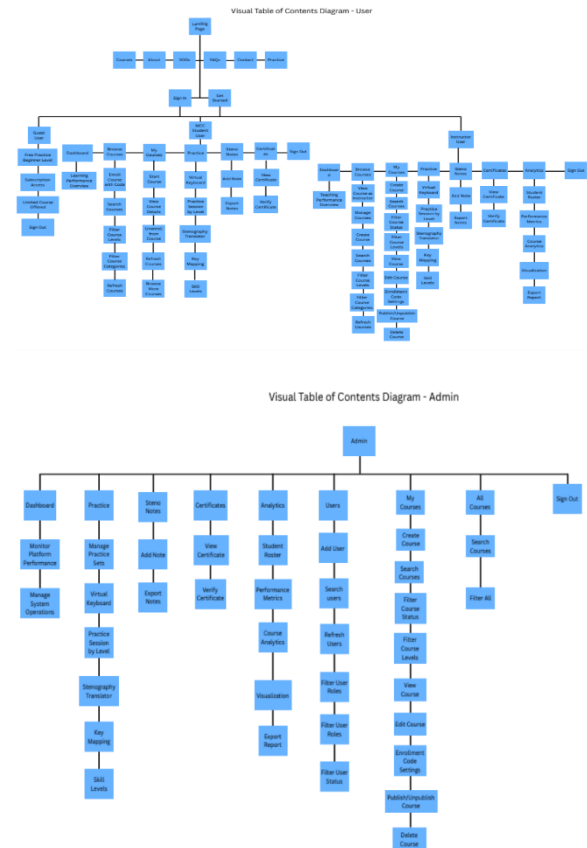
Design

The system design focused on organizing learning content and user interaction in a structured and intuitive manner. Flowcharts, storyboards, use case diagrams (see Figure 2), a visual table of contents (see Figure 3), and a Gantt chart were developed to illustrate system processes, user navigation, and project timelines. The interface was designed to be responsive, user-friendly, and suitable for students, instructors, administrators, and public users. Emphasis was placed on clarity of lessons, logical progression of modules, and accessibility across devices.

Implementation

StenoCoach was developed as a web-based platform using the T3 Stack, integrating TypeScript, React 19, Tailwind CSS, tRPC, NextAuth.js, Prisma ORM, and PostgreSQL. The implementation included interactive lessons, virtual stenotype keyboard practice, quizzes, progress tracking, certificates, and role-based access control. The system was hosted on Vercel with a secured domain to ensure availability, performance efficiency, and safe data handling.

Figure 3
Visual Table of Contents



Testing

The system underwent Alpha and Beta testing based on the ISO/IEC 25010 Software Product Quality Model. Evaluation focused on functional suitability, compatibility, interaction capability, security, performance efficiency, and flexibility. Alpha testing was conducted by IT experts to identify technical issues, while beta testing involved actual users to validate usability and learning effectiveness. Feedback from both phases was used to refine system features and performance.

Sampling Method

The study employed purposive sampling to select respondents relevant to the system evaluation. Alpha testers consisted of Information Technology experts, while beta testers included BSOA students, stenography experts, and selected external users. This method ensured that participants had sufficient experience and knowledge to assess the system's quality and functionality.

Instrumentation

A researcher-developed survey questionnaire anchored on ISO/IEC 25010 quality criteria was used as the primary research instrument. The questionnaire measured system performance in terms of functionality, compatibility, interaction capability, security, flexibility, and efficiency. The same instrument was used for both alpha and beta testing to maintain consistency in evaluation.

Ethical Consideration

Ethical standards were strictly observed throughout the study. Participation was voluntary, and respondents were informed of the purpose of the research. Data privacy and confidentiality were ensured, and all collected information was used solely for academic evaluation and system improvement. No personal data were disclosed or misused during the research process.

Questionnaire Administration

The survey questionnaires were administered after the respondents had sufficient time to explore and use the StenoCoach system. Clear instructions were provided to ensure accurate and honest responses. Alpha testing questionnaires were given to three (3) IT experts, while beta testing questionnaires were distributed to thirty (30) beta testers, consisting of BSOA students, stenography experts, and external users during the scheduled testing period.

Data Gathering

Data were gathered through the collection of completed alpha and beta testing questionnaires. Alpha testing was conducted on September 30, 2025, while beta testing started on October 2, 2025, involving a total of thirty (30) respondents. Responses were compiled, checked for completeness, and prepared for analysis.

Data Analysis

The study utilized descriptive statistical methods to analyze the collected data. Mean scores were computed to determine the overall evaluation of the system per quality criterion. Table 1, A five-point Likert scale was used to interpret the

results, translating numerical values into verbal descriptions such as Excellent and Very Good.

Table 1

The 5-point Likert Scale – level of agreement

Response Categories	Numerical Value	Range / Interval	Verbal Interpretation
Strongly Agree	5	4.21 – 5.00	Excellent
Agree	4	3.41 – 4.20	Very Good
Neutral	3	2.61 – 3.40	Acceptable
Disagree	2	1.81 – 2.60	Marginal
Strongly Disagree	1	1.00 – 1.80	Poor

Operation & Maintenance

After successful testing and refinement, StenoCoach was deployed through Vercel for public and institutional access. Operation includes continuous monitoring of system performance, user activity, and security. Maintenance involves regular updates, bug fixes, and content enhancements to ensure long-term reliability, usability, and alignment with instructional needs.

RESULTS

Alpha testing for StenoCoach: Stenography Learning Management System for Mabalacat City College was conducted on September 30, 2025, and involved three (3) Information Technology experts. The evaluation focused on verifying system stability, correctness of functions, and technicalities before exposing the platform to real end-users. During this phase, the experts examined the core modules, including lesson delivery, practice tools, quizzes, progress tracking, and user management. Minor technical concerns were identified and documented, which served as the basis for system refinement prior to beta testing.

Table 2

Overall Evaluation Results - Alpha Test

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.95	Excellent
Compatibility	4.88	Excellent
Interaction Capability	4.91	Excellent
Security	4.96	Excellent
Performance Efficiency	4.94	Excellent
Flexibility	4.94	Excellent
Overall Mean Score	4.93	Excellent

In the Alpha Test (see Table 2), StenoCoach demonstrated exceptional system quality, beginning with the highest-rated criterion, Security (4.96), which reflects users' strong confidence in the platform's ability to protect personal data and provide secure access throughout their use of the system. This was closely followed by Functional Suitability (4.95), showing that the platform's lessons, drills, and learning components performed their intended functions with accuracy and reliability. Equally impressive was the system's Performance Efficiency (4.94), as users experienced fast loading times, smooth processing, and stable operation during all learning activities. The same high standard was evident in the platform's Flexibility (4.94), confirming that StenoCoach accommodated diverse learning paces and allowed learners to revisit modules and practice drills as needed. The system's Interaction Capability (4.91) also received an excellent rating, indicating that users found the interface intuitive and responsive, enabling meaningful engagement with instructional content. Meanwhile, Compatibility (4.88) maintained a strong score, demonstrating that the system operated well across a variety of devices and browsers with minimal technical issues. Concluding these results, the overall mean score of 4.93 affirms that StenoCoach performed with remarkable consistency, meeting all ISO25010 criteria at an excellent level and showcasing its readiness for continued evaluation.

Table 3
Overall Evaluation Results - Beta Test

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.83	Excellent
Compatibility	4.68	Excellent
Interaction Capability	4.81	Excellent
Security	4.81	Excellent
Performance Efficiency	4.73	Excellent
Flexibility	4.85	Excellent
Overall Mean Score	4.78	Excellent

Following the incorporation of the alpha test feedback, beta testing was conducted starting October 2, 2025, involving a total of thirty (30) respondents composed of BSOA students, stenography experts, and selected external users. This phase aimed to assess the system's effectiveness in a real learning environment, emphasizing usability, clarity of content, and overall learning experience.

The Beta Test (see Table 3) similarly revealed strong performance across all ISO25010 criteria, beginning with the highest-rated aspect, Flexibility (4.85), which indicates that StenoCoach continued to support varied learning styles, pacing, and user preferences even under broader real-world usage conditions. Next, Functional Suitability (4.83) maintained an excellent rating, showing that the system reliably delivered its intended functions and supported stenography learning effectively. Both Interaction Capability (4.81) and Security (4.81) shared the next highest ratings, demonstrating that users experienced clear, responsive interactions while also feeling secure with how the system managed their data and access. The platform's Performance Efficiency (4.73) remained excellent despite being slightly lower than other criteria, suggesting that while some users experienced minor delays, overall system responsiveness and stability were still highly satisfactory. Meanwhile, Compatibility (4.68) received the lowest mean score in the Beta Test but still maintained an excellent interpretation, showing that although slight inconsistencies were observed across devices, the platform remained largely accessible and functional for users. Ending the evaluation, the overall mean score of 4.78 confirms that StenoCoach continued to deliver excellent system performance even when tested by a more diverse group, validating its effectiveness, reliability, and readiness for wider deployment.

To further illustrate system improvement and consistency, a comparison between the Alpha and Beta Test results was prepared (see Table 4).

Table 4
Overall Evaluation Results – Alpha and Beta Test

ISO 25010 Criteria	Mean Score (Alpha Test)	Verbal Interpretation (Alpha Test)	Mean Score (Beta Test)	Verbal Interpretation (Beta Test)
Functional Suitability	4.95	Excellent	4.83	Excellent
Compatibility	4.88	Excellent	4.68	Excellent
Interaction Capability	4.91	Excellent	4.81	Excellent
Security	4.96	Excellent	4.81	Excellent
Performance Efficiency	4.94	Excellent	4.73	Excellent
Flexibility	4.94	Excellent	4.85	Excellent
Overall Mean Score	4.93	Excellent	4.78	Excellent

The Functional Suitability scores were excellent for both testing phases, with the alpha test

achieving an impressive score of 4.95, while the beta test received a slightly lower but still outstanding score of 4.83, reflecting the system's strong functionality throughout the evaluation. Compatibility scores were strong in both phases, with the alpha test scoring 4.88 and the beta test scoring slightly lower at 4.68, demonstrating consistent compatibility performance throughout the evaluation. Interaction Capability scores were excellent in both the alpha and beta tests, with the alpha phase receiving a score of 4.91 and the beta phase slightly lower at 4.81, indicating a consistently user-friendly experience throughout the evaluation. Security scores were outstanding in both the alpha and beta phases, with the alpha test achieving a near-perfect score of 4.96 and the beta test receiving a strong score of 4.81, reflecting the platform's reliable security measures across evaluations. Performance Efficiency scores were excellent in both testing phases, with the alpha test scoring 4.94 and the beta test slightly lower at 4.73, demonstrating strong and consistent system performance throughout the evaluation. Flexibility scores were excellent during both testing phases, with the alpha test scoring 4.94 and the beta test improving slightly to 4.85, demonstrating the system's strong adaptability across different environments and platforms. The overall mean score slightly decreased from 4.93 in the alpha test to 4.78 in the beta test, with both scores still verbally interpreted as "Excellent," demonstrating the platform's strong performance and continued compliance with ISO 25010 standards.

DISCUSSION

The study entitled StenoCoach: Stenography Learning Management System for Mabalacat City College aimed to design, develop, and evaluate a digital learning platform that enhances stenography education for BSOA students. The development began with an extensive review of literature, existing e-learning systems, interactive learning strategies, and modern educational technologies to determine the essential features and best practices needed for the system. Through this process, the researchers identified the system's hardware and software requirements, ensuring that StenoCoach could operate efficiently on standard desktop and laptop specifications. The planning phase also involved applying system analysis and design methodologies, such as flowcharts, storyboards, use case diagrams, a visual table of contents, and a Gantt chart, which guided the structure and workflow of the platform.

The development of StenoCoach integrated structured lessons, interactive practice exercises, and personalized progress tracking, designed to strengthen students' foundational shorthand skills and introduce modern machine shorthand applications. The system's interface was crafted to be user-friendly, intuitive, and engaging, promoting independent learning and consistent practice. The system underwent Alpha testing by IT experts and Beta testing by target users to assess its quality based on ISO 25010 criteria. The Alpha test achieved an overall mean score of 4.93, while the Beta test obtained 4.78, both rated as Excellent. These results confirm that StenoCoach met ISO 25010 quality standards, demonstrating reliable, secure, compatible, and efficient performance, with minor score variations reflecting real-world user perspectives.

After testing, StenoCoach was deployed online via Vercel with stenocoach.xyz as its official domain, ensuring stable performance and accessibility. The results confirm that the system met its objectives by providing a functional and accessible learning platform that supports stenography education at Mabalacat City College.

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The completion of this capstone project, StenoCoach: Stenography Learning Management System for Mabalacat City College, was made possible through the guidance, support, and collaboration of individuals and institutions who generously contributed their time, knowledge, and encouragement. First and foremost, we extend our profound gratitude to Almighty God for providing wisdom, strength, and perseverance as we carried out this study and system development. We sincerely thank our Technical Adviser, Ms. Dessa Lyn J. De Castro, and Ms. Ritchell Z. Escoto, Capstone Instructor, for their invaluable guidance, constructive feedback, and unwavering support. Their professional insights were essential in refining the system and strengthening this research. Our deepest appreciation is also extended to Dr. Myrna C. Calma, CPA, FRIAcc, Ph.D., for her unwavering support in recognizing the relevance, feasibility, and academic value of this project. Her guidance and approval were instrumental in ensuring that the study was carried out with clarity of purpose and adherence to scholarly standards. We are equally grateful to Ms. Rowena G. Venzon, Stenography Instructor, whose professional expertise, constructive insights, and continuous encouragement greatly contributed to shaping

the system. Her real-world experience in teaching stenography ensured that the features, content, and instructional approaches embedded in the platform closely reflect actual classroom practices and learner needs. Special thanks are given to our Alpha testers—Information Technology experts, whose evaluation, observations, and constructive critiques significantly strengthened the system's interaction capability and functionality. We also extend our gratitude to our Beta testers—students from the Bachelor of Science in Office Administration (BSOA) program of Mabalacat City College, whose active participation and honest feedback were vital in validating StenoCoach as an effective learning management platform for stenography. Lastly, we recognize the dedication and teamwork of every member of the Group 4 research team. Each individual's effort, cooperation, and commitment were instrumental in the successful completion of this project. To everyone who supported, guided, and believed in this study—your assistance and encouragement are deeply appreciated.

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TrikeCuayan: A Tricycle Navigation and Booking System for Cuayan TODA

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ABSTRACT

In Cuayan, Angeles City, tricycles remain one of the primary modes of transportation managed by the Cuayan Tricycle Operators and Drivers Association (TODA). Despite their importance, passengers often experience challenges such as difficulty locating available tricycles, fare disputes, inconsistent pricing, and limited access to transportation information. To address these issues, this study developed TrikeCuayan: A Tricycle Navigation and Booking System for Cuayan TODA, a mobile-based platform designed to provide tricycle booking, route navigation, fare estimation, and communication between passengers and drivers. The system was developed using the Modified Waterfall Model and utilized Flutter, Firebase, Dart, Google Maps API, Android Studio, Visual Studio Code, and Vercel as development tools. The application was evaluated through Alpha and Beta Testing using the ISO 25010 Software Quality Model. Three IT experts participated in Alpha Testing, while fifteen (15) passengers and fifteen (15) TODA drivers participated in Beta Testing. Evaluation results revealed high levels of user satisfaction, obtaining overall mean scores of 4.71 for Alpha Testing, 4.71 from passengers, and 4.74 from drivers. Findings indicated that the system effectively improved booking convenience, fare transparency, communication, and transportation efficiency within the Cuayan community. The study concluded that TrikeCuayan is a reliable, user-friendly, and sustainable transportation solution that supports community mobility and aligns with Sustainable Development Goal 11: Sustainable Cities and Communities.

Keywords: Tricycle Booking System, Fare Estimation, GPS Navigation, Mobile Application Transportation Management

INTRODUCTION

Transportation plays a vital role in the daily lives of people by providing access to workplaces, schools, healthcare facilities, and other essential services. In Cuayan, Angeles City, tricycles serve as one of the primary modes of transportation for residents and visitors. However, commuters often encounter challenges such as difficulty locating available tricycles, fare disputes, inconsistent pricing, and limited access to transportation information. These issues can result in inconvenience for passengers and operational inefficiencies for drivers. Studies have shown that fare transparency and service reliability are among the most important factors affecting passenger satisfaction in local transportation services (Ong et al., 2023).

Although various ride-hailing and transportation applications have been developed to improve mobility and fare transparency, most are designed for large-scale transportation networks and may not adequately address the specific needs of local tricycle operations. Existing

studies have explored GPS-based fare estimation and mobile transportation systems; however, there remains a need for a localized platform that supports booking, navigation, and fare estimation specifically for tricycle services within local communities (Ulay et al., 2025).

In particular, Cuayan, one of the active barangays in Angeles City, relies heavily on its local tricycle operators under the Cuayan Tricycle Operators and Drivers' Association (TODA) to meet the daily transportation needs of residents and visitors. However, despite being a daily necessity, commuting by tricycle is not without its challenges. One of the most common issues faced by passengers is the lack of a standardized and transparent fare system. Fare disputes frequently occur, particularly among those unfamiliar with local rates such as tourists, new residents, or even locals traveling outside their usual routes. Without a centralized fare reference or digital tool, commuters are often left guessing or negotiating fares, which sometimes leads to overpricing, especially during peak hours or bad weather conditions.

To address this gap, the researchers developed TrikeCuayan: A Tricycle Navigation and Booking System for Cuayan TODA, a mobile-based

application that integrates ride booking, route navigation, fare estimation, and communication features into a single platform. The system aims to improve transportation accessibility, promote fare transparency, enhance operational efficiency, and provide a more convenient commuting experience for both passengers and drivers. By utilizing GPS technology and mobile-based services, the system offers a practical solution to the transportation challenges experienced within the Cuayan community (Team, 2020).

Objective of the Study

The primary objective of this study was to develop a smart and user-friendly fare estimation system for tricycle commuters under Cuayan TODA in Angeles City. In line with this, the study aimed to achieve the following specific objectives:

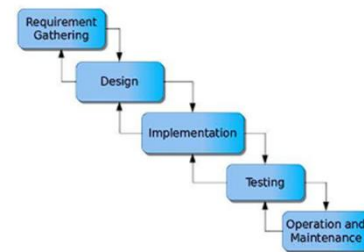
- To gather scholarly and published literature from related literatures, data gathering, and brainstorming,
- To identify the necessary hardware and software requirements for developing the mobile application system, utilizing a software stack comprising Android studio, flutter, firebase, vercel, VS code, and dart
- To design the software by employing various modeling and analysis tools, including storyboards, use case diagrams, gantt charts, flowcharts and wireframes.
- To create and develop the system with features such as User registration and login for passengers and tricycle drivers, Driver and passenger profile management, Real-time tricycle booking and ride request functionality, GPS-based location tracking and route navigation, Fare estimation and trip information display, Booking status updates and notifications, Ride history and transaction records, Emergency contact and safety features, Administrative dashboard for monitoring and managing system operations.
- To test the system through alpha and beta testing phases.
- To evaluate the system's performance based on ISO 25010 criteria: Functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility.
- To deploy and implement the system for community use

Each specific objective interconnect to support the successful development, deployment, and operation of the TrikeCuayan application.

METHODOLOGY

The research employed the Modified Waterfall Model, a structured yet flexible approach that facilitated iterative refinements at each development stage (See Figure 1). This methodology provided systematic development processes while allowing adaptability to user feedback and challenges, ensuring quality, consistency, and maintainability of the system.

Figure 1
The Modified Waterfall Model



Requirements

The researchers analyzed the essential hardware and software components required for the development and deployment of TrikeCuayan application. The development of the system was carried out using a mid-range computer capable of running programming tools, database servers, and web development environments. The device used features the following specifications: The researchers used a device with an AMD Ryzen 3 as processor, which provided enough power for coding, testing, and running the system. It also had 8 GB of RAM, allowing smooth multitasking while working with the development tools. A 119 GB SSD was used to store the project files and relied on AMD Radeon integrated graphics, for designing the interface and performing visual tests of the application.

Design

During the designing phase of TrikeCuayan, researchers came to concentrate on system design and also to understand how users would use the app. Storyboards were devised in order to visualize the steps involved for both passenger and driver users: reserving their ride, checking a driver's availability, and confirming a pickup. Use Case Diagrams were also constructed to describe the various system functions and user roles. These design tools assisted them in defining clearly how the system should function, and that all its features were truly made for the Cuayan TODA community.

The smart application utilized a client-server architecture in which the mobile application

(client) communicates with a backend server to support real-time fare estimation and data management. The mobile application, developed by the project's developers, offered a user-friendly interface that enabled commuters to compute fare estimates based on distance and, when necessary, time-based variables.

On the backend, the server, also designed and configured by the developers, handled core system operations, including the storage of tricycle driver profiles, commuter data, and fare information. It also performed the implementation of fare calculation algorithms and managed the communication processes between the mobile app and registered tricycle drivers.

Figure 2
Storyboard

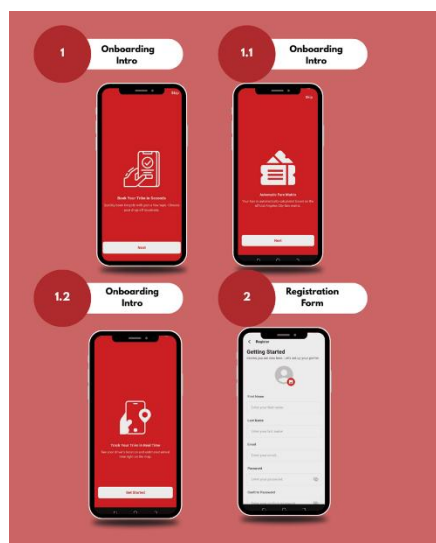


Figure 3
Wireframes

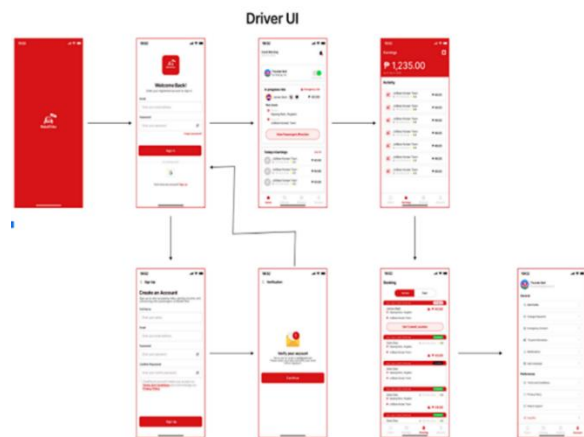


Figure 4 Use Case Diagrams

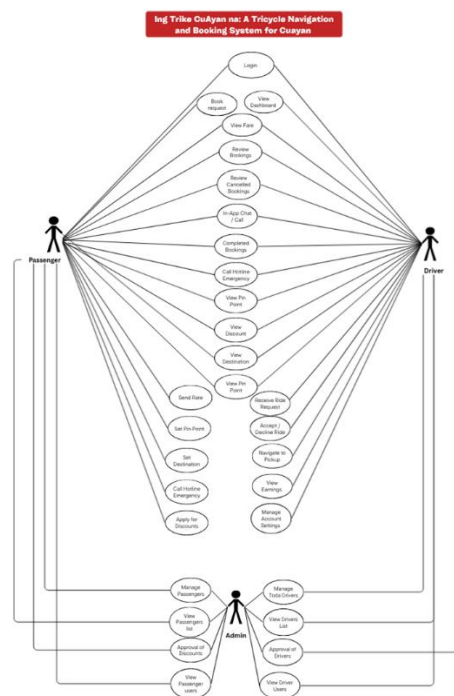
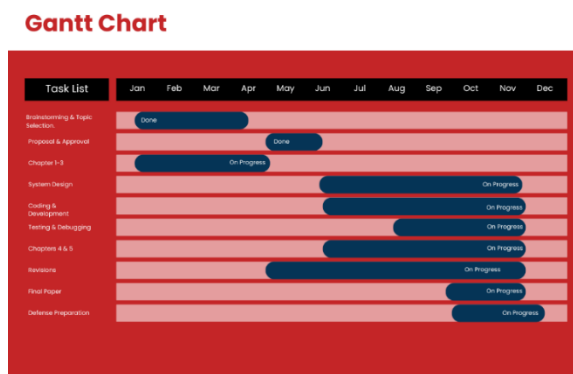


Figure 6
Gantt Chart



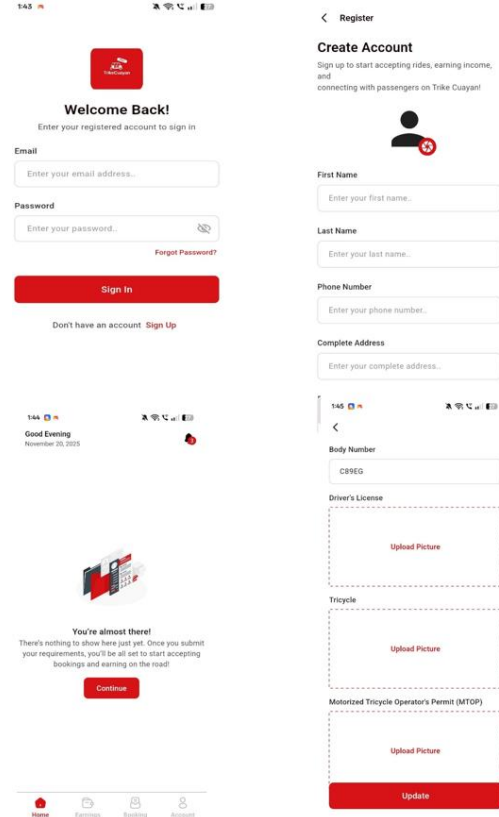
Development

The researchers were able to build the system step by step and coordinate their activities smoothly because of the design and planning tools they employed in the implementation of TrikeCuayan.

The Storyboard was an important in showing the way users would go through the application. The whole process from requesting a tricycle ride to getting the driver confirmed was shown on a

sequence of screens. This helped the researchers to create a user experience that was clear and easy to use.

Figure 7
Registration Page



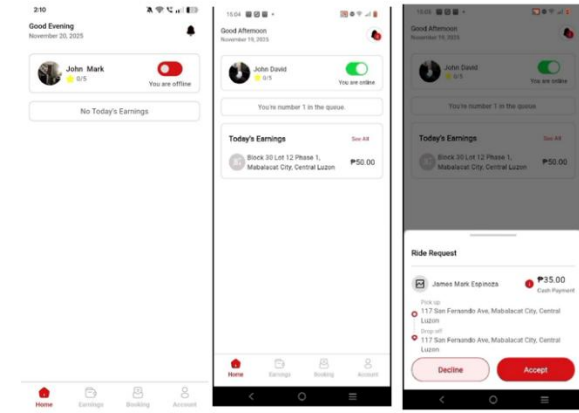
The researchers also made Wireframes for each screen showing where buttons, menus, and content would be placed. The use of Wireframes made the team prioritize the structure and the usability before coming up with the final color, icons, or designer elements. As a result, the app could still have a simple and well-organized interface during the whole process of development.

A Use Case Diagram gave the system's different users, such as passengers, drivers, and the TODA office their rights, and defined what actions each user can perform. The diagram was a helper to the developers in realizing the system's really core functions like sending booking requests, accepting rides, and viewing trip details.

The researchers created a Gantt Chart to oversee the project schedule. This tool was dividing the project into phases such as design, coding, testing, and system refinement. It was beneficial to the team in terms of monitoring

project status, controlling time limits, and keeping the project on time. These tools helped the researchers a lot in terms of the orderly and structured development of TrikeCuayan, besides being efficient.

Figure 8
Dashboard



TESTING

The developed system underwent evaluation following an initial assessment during the testing phase. The researchers employed multiple testing methods, including unit testing, integration testing, system testing, as well as alpha and beta testing, to ensure the accuracy and reliability of the application. Prior to deploying the system for actual use, the validity of the research questionnaire was also examined to confirm its suitability for data collection. The procedures for gathering, analyzing, and processing data along with the sampling methods and research instruments utilized were thoroughly addressed to guarantee the credibility and integrity of the study's findings.

To ensure a structured evaluation, the researchers conducted Alpha Testing with three Information Technology (IT) experts who reviewed the system's technical functions, identified bugs, and assessed its adherence to software quality standards. Their recommendations guided the refinement of the system prior to user-level evaluation. For Beta Testing, the researchers collaborated with 15 Cuayan TODA drivers and 15 tricycle passengers, all belonging to the target user group. These respondents were selected based on their active participation in daily tricycle operations and commuting activities within the Cuayan TODA area.

This combination of expert evaluators and actual system users strengthened the validity and reliability of the study's findings. By selecting participants through homogeneous purposive sampling, the researchers ensured that the system was assessed by individuals who shared similar traits, experiences, and familiarity with the operational context, resulting in highly relevant, credible, and meaningful evaluation outcomes.

Following the testing phases, a quantitative descriptive research method was employed to objectively evaluate the system's quality and performance. A structured survey questionnaire was created based on the ISO 25010 software quality product model, which evaluated critical attributes such as Functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility. The results were statistically analyzed using a 5-point Likert scale to describe the overall quality level of the system (see Table 1).

Table 1
Likert Scale used by the Researchers

Response Categories	Numerical Value	Range Interval	Verbal Interpretation
Strongly Agree	5	4.21 – 5.00	Excellent
Agree	4	3.41 – 4.20	Good
Neutral	3	2.41 – 3.20	Acceptable
Disagree	2	1.81 – 2.60	Marginal
Strongly Disagree	1	1.00 – 1.8	Poor

Operation and Maintenance

The developed system was successfully deployed and made accessible through mobile application platforms for both passengers and drivers. The capstone project consists of two separate mobile applications: the Passenger Application and the Driver Application. These applications are available for download through APKPure using the following links. The User Application can be accessed at https://apkpure.com/trikecuayan/com.mcc.rideatrike_passenger, while the Driver Application can be accessed at https://apkpure.com/p/com.mcc.rideatrike_driver. After the verification phase, the maintenance phase was initiated. The system was deployed to its designated server. The researchers continued to monitor its overall performance. Key indicators such as user feedback, system usage patterns, and operational performance data were regularly

reviewed to ensure the system's reliability, stability, and effectiveness.

RESULTS

The Alpha Testing phase was conducted to evaluate the initial functionality, usability, and overall performance of TrikeCuayan using the ISO 25010 Software Quality Model. Three (3) IT experts tested the early version of the system and rated its performance based on five key criteria: Functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility and demonstrated excellent performance across all criteria.

Table 2
Summary of Alpha Test Results

ISO 25010 Criteria	Mean Score (Alpha Test)	Verbal Interpretation
Functional Suitability	4.80	Excellent
Compatibility	4.53	Excellent
Interaction Capability	4.60	Excellent
Security	4.89	Excellent
Flexibility	4.75	Excellent
Overall Mean Score	4.71	Excellent

Based on the results of the Alpha Test (see Table 2) it shows that the system performed excellently across all criteria. Functional Suitability rated by the alpha testers with a total of 4.80, indicating that the system's features are complete, accurate, and meet the intended requirements. Compatibility garnered a total of 4.53 and has the lowest rating but still means the system works across different devices that is used during testing.

For Interaction Capability, the system gathered a score of 4.60, means that users found the interface easy to understand and navigate. Security scored the highest with 4.89, showing that users strongly agreed that the system provides safe and protected access to information. Meanwhile, Flexibility was rated with a total of 4.75, indicating that users found the system adaptable and able to accommodate different usage scenarios.

The overall mean score for the Alpha Test is 4.71, interpreted as Excellent. This result demonstrates that the early version of TrikeCuayan successfully met user expectations and aligned with the ISO 25010 standards for software quality.

The results for 15 Cuayan TODA drivers show that the system performed very well across all ISO 25010 criteria. Functional Suitability scored 4.72, indicating that the system met the intended functions of navigation and booking.

Compatibility received 4.71, showing that the system worked smoothly across different devices. Interaction Capability scored 4.75, reflecting that the interface was easy to use and responsive. Security was rated 4.71, demonstrating that the drivers felt their data and transactions were safe. Flexibility scored the highest at 4.80, indicating that the system can adapt well to different usage scenarios. The total mean score for the drivers' evaluation was 4.74 (Strongly Agree), showing that the drivers were satisfied with the performance, usability, and reliability of TrikeCuayan. Meanwhile the results for 15 passengers show that the system was effective and user-friendly.

Table 3
Summary of Beta Test Results

Beta Testing Results (Passenger)

ISO 25010 Criteria	Mean Score (Beta Test) for Passengers	Verbal Interpretation
Functional Suitability	4.71	Excellent
Compatibility	4.69	Excellent
Interaction Capability	4.70	Excellent
Security	4.61	Excellent
Flexibility	4.84	Excellent
Overall Mean Score	4.71	Excellent

Beta Testing Results (Driver)

ISO 25010 Criteria	Mean Score (Beta Test) for Cuayan TODA Drivers	Verbal Interpretation
Functional Suitability	4.72	Excellent
Compatibility	4.71	Excellent
Interaction Capability	4.75	Excellent
Security	4.71	Excellent
Flexibility	4.80	Excellent
Overall Mean Score	4.74	Excellent

Functional Suitability received a mean score of 4.71, showing that the app met the intended functions for booking and navigation. Compatibility scored 4.69, means smooth operation across different devices. Interaction Capability was rated 4.70, shows that passengers found the interface easy to use. Security received 4.61, showing that passengers felt their personal data and booking information were safe. Flexibility scored the highest at 4.84, demonstrating that the system can adapt to different user needs and situations.

The total mean score for passengers was 4.71 (Excellent), means that they were satisfied with the performance, usability, and reliability of TrikeCuayan.

DISCUSSION

The results indicate that TrikeCuayan consistently performed well across all ISO 25010 criteria. Functional Suitability received slightly higher ratings during Alpha Testing 4.80 compared to Beta Testing for passengers 4.71 and drivers 4.72, reflecting that while the system met the intended functions internally, actual users also considered it highly functional for practical use. The overall mean scores are quite high and it shows that TrikeCuayan is a reliable, user-friendly, and well-received system. The differences between Alpha and Beta Testing highlight that actual user generally think that the system is feasible and would be effective in a real-world environment.

Based on the previous findings, the researchers concluded that the research objectives were fully met. TrikeCuayan effectively improved the traditional tricycle booking system. The platform streamlined the process of booking rides and navigating routes, reducing waiting times for passengers and improving operational efficiency for TODA drivers.

The system met the functional and quality requirements of its users. Both drivers and passengers rated the platform highly in terms of functionality, usability, security, compatibility, interaction, and flexibility, confirming that the system fulfilled its intended purposes.

TrikeCuayan is user-friendly and accessible. The interface was perceived as intuitive and easy to navigate by both passengers and drivers, allowing users to efficiently request and manage rides without difficulty.

The system enhanced security and reliability. Personal and ride-related data were adequately protected, and the platform operated consistently without major errors, ensuring trust and dependability for users.

The platform was adaptable to different user needs and scenarios. It accommodated variable pickup locations, adjusts routes as needed, and functions effectively across devices, demonstrating flexibility for practical, real-world use.

With all the evidences present on the study the researchers therefore concluded that the overall objective of the study was met. TrikeCuayan provides a practical, reliable, solution that improves tricycle operations in Cuayan. It supports both TODA drivers and passengers by offering a secure, convenient, and efficient

platform for ride booking and navigation, while demonstrating potential for further enhancements and scalability.

To further enhance the application, advanced features could be incorporated such as, integrating digital payment methods such as GCash, PayMaya, or credit/debit cards to improve passenger convenience and driver transactions. Consider extending the pickup radius if TODA regulations allow, to serve more passengers while ensuring fairness for drivers. Provide dashboards for TODA administrators to monitor driver activity, peak hours, and service efficiency for better management. Offer training sessions for TODA drivers and passengers to maximize use of the system's features and improve service efficiency. Incorporate an in-app feedback system to allow users to suggest improvements and report issues, ensuring continuous system enhancement. Develop a Lite Version of TrikeCuayan to accommodate users with low-end devices or limited internet connectivity. By addressing these recommendations, TrikeCuayan can evolve into a more comprehensive, secure, and user-friendly application that continues to meet the needs of the Cuayan community.

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We are also grateful to our Alpha testers, a group of IT experts, who provided crucial feedback on the system's functionality. Similarly, we thank our Beta testers—for the community of Cuayan for their active participation and honest responses, which significantly contributed to the study's validation process.

Finally, we acknowledge and deeply appreciate the dedication, effort, and collaboration of every member of the research team. Each individual's specialized contributions played a vital role in completing this project.

To all those who supported and guided this journey, your assistance and encouragement are deeply appreciated.

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Visondyna Job Board: Web-Based Hiring System for Manpower Solutions

CEDRIC JOHN Z. ALVAREZ
CHARLS JOHN S. DELA CRUZ
SHANELLE ANNE R. HERNANDEZ
GILBERT G. GONZALES, MIT (Capstone Adviser)

ABSTRACT

The study developed the Visondyna Job Board, a web-based job application and job listing management system for Visondyna Manpower General Services. It was designed to address limited online job visibility, manual applicant tracking, fragmented records, and slow communication with job seekers. Built using Next.js, Prisma, PostgreSQL, and shadcn/ui, the system integrates user authentication, applicant profiling, job posting and status management, work experience and skill-based recommendations, digital application forms, data export, visualization tools, HR direct messaging, and in-app and email notifications. The system design was guided by storyboards, system flowcharts, functional decomposition diagrams, entity-relationship diagrams, use case diagrams, and a Gantt chart, and was developed using the Agile Scrum approach. It was tested through alpha testing with three IT experts and beta testing with ten admin/HR users and twenty job-seeker users. Evaluation used ISO/IEC 25010-based survey instruments focusing on Functional Suitability, Interaction Capability, Flexibility, and Security. Alpha testing obtained an overall weighted mean of 3.73 (Very Good), while beta testing produced Excellent results, with weighted means of 4.32 for admin/HR users and 4.49 for job-seeker users. The findings show that the system performed well in technical validation and achieved stronger user acceptance after revisions. By digitizing key recruitment processes while remaining compatible with Visondyna's semi-digital operations, the system improves application tracking, reduces administrative workload, enhances communication, and strengthens applicant engagement. It also provides a practical model for manpower agencies and supports more efficient labor matching aligned with Sustainable Development Goal 9.

Keywords: Web-Based Hiring System, Manpower Solutions, Job Board, Applicant Tracking, Recruitment Management, Agile Scrum

INTRODUCTION

Manpower solutions are essential in connecting organizations with workers for temporary, project-based, or long-term positions. As labor demand changes quickly, agencies need recruitment systems that make job openings visible, organize applicant data, and speed up communication. Studies on web-based recruitment systems show that digital platforms can improve applicant tracking, record management, and hiring efficiency compared with manual or semi-digital processes [1]. The continuing need for better labor-market coordination also highlights the value of structured digital manpower solutions [2][4]. Visondyna Manpower General Services, established in 2003 and based in Mabalacat City, Pampanga, provides staffing services for manufacturing, retail, electronics, janitorial, hospitality, clerical, and labor-related positions. Consultations with the agency showed that recruitment still depended on Facebook posts,

office tarpaulins, paper submissions, spreadsheets, and individual phone, text, and email follow-ups. Although this semi-digital workflow supported current operations, it limited consistent job visibility, centralized applicant tracking, and timely communication with job seekers.

Stakeholder interviews identified several operational problems: job openings lacked a dedicated online space, applicant information was stored across paper folders and spreadsheets, and there was no centralized mechanism for receiving online applications, monitoring applicant progress, or sending timely notifications. These issues increased staff workload, delayed responses to applicants, and made it more difficult for the agency to respond quickly to client manpower requests.

To address these challenges, the study developed the Visondyna Job Board as a web-based hiring system. The platform was designed to centralize recruitment data and support both administrative staff and applicants through features such as user authentication, applicant profiles, job listings, application forms, work experience, and skill-based recommendations, applicant status tracking, notifications, HR

direct messaging, dashboards, and data export. The system was intended to complement rather than replace Visondyna's semi-digital process by digitizing critical recruitment tasks while preserving selected offline steps.

The study also draws from the strengths of manpower and recruitment platforms that use online job boards, applicant portals, and digital submission processes to improve access and organization [3][5]. Within this context, the Visondyna Job Board was designed as a localized, manpower-focused solution that addresses recruitment visibility, applicant management, and communication in a single platform.

Objective of the Study

The general objective of this study was to design and develop the "Visondyna Job Board: Web-Based Hiring System for Manpower Solutions" for Visondyna Manpower General Services.

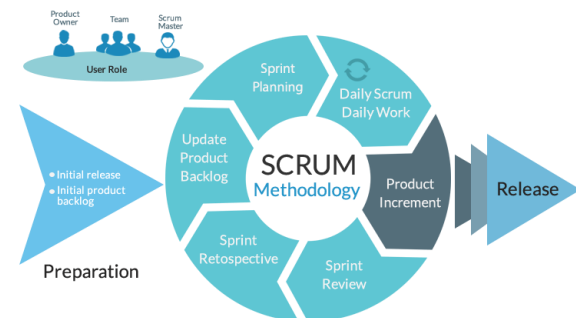
Specifically, the study aimed to:

- To gather and analyze information on manpower solutions and applicant and job listing management systems from reputable sources, including stakeholder interviews, scholarly articles, published books, and previous capstone projects.
- To design the developed system using analysis and modeling tools such as a system flowchart, storyboard, functional decomposition diagram, entity-relationship diagram, use case diagram, and Gantt chart.
- To develop the web-based system by implementing the designed modules and features, including user management and authentication, applicant profiles, account suspension and ban mechanisms, job board, job application form, work experience and skill-based recommendation system, job listing and status management, applicant management and status tracking, application form export, in-app and email notifications, HR Direct Message Chat, search and filtering functions, data visualization, applicant dashboard, and administrator dashboard.
- To test the system through alpha and beta testing in order to determine its performance, identify issues, and support further refinement.
- To evaluate the effectiveness and quality of the system using survey instruments based on the ISO/IEC 25010 software quality model, in order to gather user feedback, assess system usability, and measure overall user satisfaction with the Visondyna Job Board.

METHODOLOGY

The study used Agile Scrum as the Software Development Life Cycle (SDLC) model for the Visondyna Job Board. Agile Scrum emphasizes short sprint cycles, collaboration, inspection, and continuous refinement, making it suitable for projects that require iterative development and regular feedback [11].

Figure 1
Agile Scrum Methodology



Requirements Gathering

Requirements were identified through stakeholder interviews and consultations with Visondyna Manpower General Services, especially its Human Resource Head, together with the review of literature, related studies, and comparable recruitment systems. The gathered information revealed limited online job visibility, fragmented applicant records, and slow communication as the main issues to be addressed. These findings guided the functional and non-functional requirements of the system.

Design

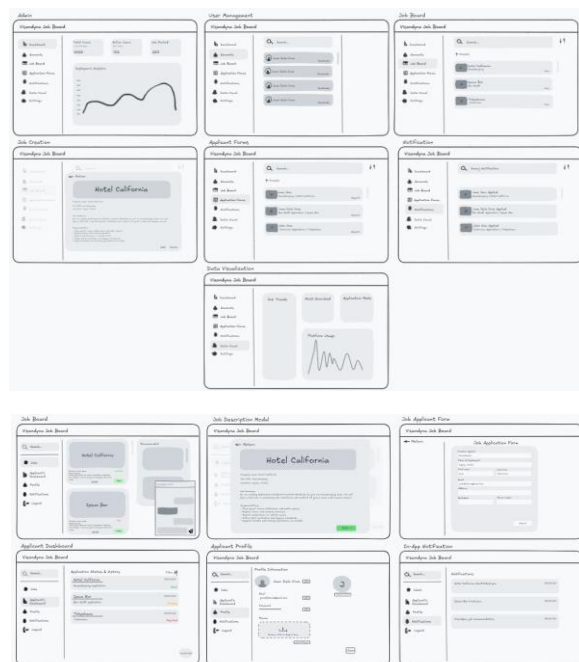
The system was planned using a storyboard (see Figure 2), system flowchart (see Figure 3), functional decomposition diagram, entity-relationship diagram, use case diagram, and Gantt chart. These tools mapped user workflows, data relationships, system scope, and project scheduling, ensuring that the design aligned with the needs of admin/HR users and job-seekers [10].

Implementation

The system was implemented as a web-based platform using Next.js, shadcn/ui, Prisma ORM, and PostgreSQL, supported by Docker for containerization[7][9][12]. Additional tools and technologies included OAuth 2.0, bcrypt, JSON Web Tokens, Nodemailer, and Socket.IO. The final release integrated user management and

authentication, applicant profiles, account suspension and ban tools, job listings, digital application forms, work experience- and skill-based recommendations, job and applicant status management, application data export, in-app and email notifications, HR direct message chat, search and filtering, data visualization, and applicant/admin dashboards.

Figure 2
Storyboard



Testing and Evaluation

Formal testing involved alpha testing with three IT experts and beta testing with actual users from Visondyna Manpower General Services. The beta group comprised ten admin/HR users and twenty job-seeker users, selected through purposive sampling because they matched the intended user profiles of the system. Evaluation used researcher-made questionnaires based on the ISO/IEC 25010 quality model, focusing on Functional Suitability, Interaction Capability, Flexibility, and Security [6]. Each item used a five-point Likert scale.

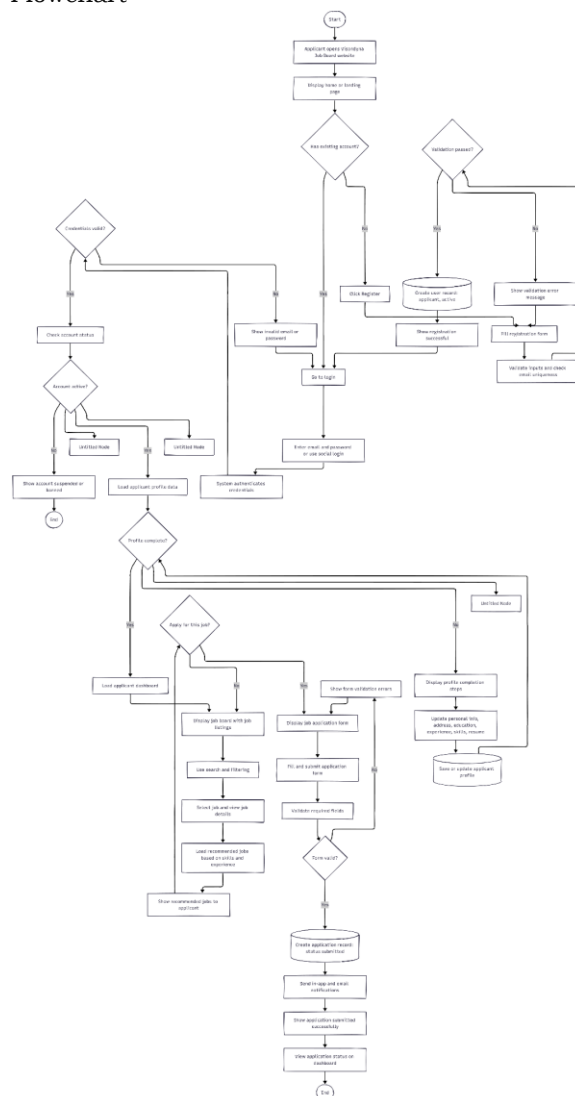
Instrumentation and Data Analysis

Descriptive statistics were used to analyze the responses. Weighted means were computed for each criterion, dimension, and respondent group. The resulting values were interpreted using the five-point Likert scale shown in Table 1.

Deployment and DevOps Practices

For development and testing, the project used GitHub-based version control, build and testing steps, and Dockerized deployment of the application and its PostgreSQL database. This workflow supported reliability, environment consistency, and maintainability during iteration and pilot use.

Figure 3
Flowchart



RESULTS

The Visondyna Job Board was successfully developed as a web-based recruitment platform for Visondyna Manpower General Services. The completed system centralized job posting, applicant profiling, digital applications, status

tracking, notifications, HR direct messaging, search and filtering, dashboards, and reporting functions. During implementation and pilot use, administrators and HR users could publish and manage job listings more consistently, while applicants could register, build profiles, apply to jobs, and monitor application progress without relying entirely on in-person follow-ups.

Table 1
Five-point Likert Scale - Level of Agreement

Response Category	Numerical Value	Range / Interval	Verbal Interpretation
Strongly Agree	5	4.21–5.00	Excellent
Agree	4	3.41–4.20	Very Good
Neutral	3	2.61–3.40	Good
Disagree	2	1.81–2.60	Fair
Strongly Disagree	1	1.00–1.80	Poor

Table 2
Alpha Evaluation Results

ISO/IEC 25010 Criterion	Mean Score	Verbal Interpretation
Functional Suitability	3.76	Very Good
Interaction Capability	3.78	Very Good
Flexibility	3.67	Very Good
Security	3.73	Very Good
Overall Mean Score	3.73	Very Good

Alpha testing (see Table 2) established a Very Good baseline for the system, with an overall mean score of 3.73. Interaction Capability (3.78) received the highest dimension score, followed by Functional Suitability (3.76), Security (3.73), and Flexibility (3.67). The results indicate that the system was already functionally sound during expert validation, although recommendation behavior and responsiveness across different usage conditions still required refinement before wider release.

Table 3
Beta Evaluation Results - Admin/HR Users

ISO/IEC 25010 Criterion	Mean Score	Verbal Interpretation
Functional Suitability	4.23	Excellent
Interaction Capability	4.33	Excellent
Flexibility	4.33	Excellent
Security	4.38	Excellent
Overall Mean Score	4.32	Excellent

After revisions based on alpha feedback, beta testing with ten admin/HR users yielded an overall mean of 4.32, interpreted as Excellent. Security (4.38) was the highest-rated dimension,

while Functional Suitability (4.23) received the lowest dimension score but still remained in the Excellent range. These results show that administrative users found the platform effective for posting vacancies, reviewing applications, updating statuses, and managing recruitment records in an organized manner (see Table 3). Beta testing with twenty job-seeker users produced an overall mean score of 4.49, also interpreted as Excellent. Functional Suitability (4.55) and Security (4.54) received the strongest ratings, followed by Interaction Capability (4.47) and Flexibility (4.42). The findings suggest that applicants were able to register, browse job openings, submit applications, and monitor status updates with ease (see Table 3).

Table 4. Beta Evaluation Results - Job-Seeker Users

ISO/IEC 25010 Criterion	Mean Score	Verbal Interpretation
Functional Suitability	4.55	Excellent
Interaction Capability	4.47	Excellent
Flexibility	4.42	Excellent
Security	4.54	Excellent
Overall Mean Score	4.49	Excellent

A comparison of the alpha and beta results shows clear improvement after revisions were introduced. Flexibility improved from 3.67 in alpha testing to 4.33 among admin/HR users and 4.42 among job-seekers, while Security improved from 3.73 to 4.38 and 4.54 in the two beta groups. This pattern indicates that revisions to responsiveness, workflow clarity, and user-facing interactions strengthened the practical usability and acceptance of the platform.

DISCUSSION

The study achieved its objective of designing and developing a manpower-focused web system that addresses limited job visibility, fragmented records, and slow applicant communication. Consistent with literature on web-based recruitment systems, the Visondyna Job Board demonstrates how centralized digital tools can improve recruitment organization, accessibility, and applicant management within a localized manpower context.

The Agile Scrum approach allowed the proponents to refine the system incrementally. Expert feedback during alpha testing identified gaps in recommendation behavior and cross-device smoothness, while later beta evaluations confirmed that revisions improved user acceptance. The higher beta scores suggest that

iterative development and user feedback were critical in aligning the platform with the practical workflows of both administrative staff and applicants.

From an operational standpoint, the system complemented Visondyna's semi-digital process rather than replacing it entirely. Job posting, applicant profiling, digital applications, status tracking, and in-system communication became more organized and transparent, while offline interviews and physical document verification could still be preserved. This balance made the platform practical for actual adoption in the agency's existing recruitment environment.

Overall, the Visondyna Job Board met its intended objectives within the defined scope of development and evaluation. It provided a functional, user-accepted, and secure recruitment platform that reduced administrative fragmentation and improved applicant engagement. The findings also support its relevance as a practical model for manpower agencies seeking a web-based hiring system aligned with Sustainable Development Goal 9 on industry, innovation, and infrastructure. Future enhancements may focus on broader mobile optimization, expanded analytics, improved recommendation accuracy, and formal assessment of other ISO/IEC 25010 quality characteristics such as Performance Efficiency, Compatibility, and Maintainability.

ACKNOWLEDGEMENT

The completion of this capstone project, "Visondyna Job Board: Web-Based Hiring System for Manpower Solutions," was made possible through the support and guidance of individuals who contributed to the study. The proponents sincerely thank Mr. Onofre S. Atienza Jr., Human Resource Head of Visondyna Manpower General Services, for allowing the study to be conducted in the agency and for sharing valuable operational insights. They likewise extend their deepest gratitude to Mr. Gilbert G. Gonzales, MIT, for his guidance as Capstone Adviser, and to Ms. Ritchell Z. Escoto, MIT, for her support as Capstone Instructor. Appreciation is also extended to the panel members, Visondyna applicants, and HR staff who participated in testing and surveys, the Institute of Business and Computing Education of Mabalacat City College, and the families and friends of the proponents for their encouragement throughout the project. The

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Oral Defense

November 17, 2025					November 17, 2025				
DEFENSE ROOM 1					DEFENSE ROOM 2				
MONDAY	Group #	Members	Adviser	Panel Members	MONDAY	Group #	Members	Adviser	Panel Members
8:00 - 10:00AM	8	Lacanlale, Arvin B.	Dennis Tacadena	Frederick Santos	8:00 - 10:00AM	7	Fanugon, Arthur Louise C.	Dessa Lyn De Castro	Mark Superio
		Matchado, Danica C.	Khyle Alegre	Lovely Ruth Santos					
		Muñoz, Angelo M.	Robbert Bamba	Ritchell Escoto					
		Quiambao, Arian R.							
8:00 - 10:00AM	26	Frias, Elaiza	Lovely Ruth Santos	Robbert Bamba	10:00 - 12:00NN	11	Buluan, Angelito C.	Dessa Lyn De Castro	Mark Superio
		Gonzales, Gellaine Eunize M.	Emie Lee Pineda	Lovely Ruth Santos					
		Libo, Liam L.	Frederick Santos	Ritchell Escoto					
		Libo, Tricia L.							
10:00 - 12:00NN	24	Bautista, Emmanuel	Robbert Bamba	Ernie Lee Pineda	1:00 - 3:00PM	13	Garbo, Chezly S.	Lovely Ruth Santos	Mark Superio
		Esguerra, Reign	Frederick Santos	Dessa Lyn De Castro					
		Gamboa, Jan Michael	Khyle Alegre	Ritchell Escoto					
		Manaloto, Aaron Ken							
3:00 - 5:00PM	14	Santos, Karl D.	Dennis Tacadena	Ritchell Escoto	3:00 - 5:00PM	18	Udiong, Mark Andrei L.	Khyle Alegre	Robbert Bamba
		Candelaria, Ielmar Carlo	Frederick Santos	Mark Superio					
		Gamboa, Filip Carlos G.	Dessa Lyn De Castro	Lovely Ruth Santos					
		Tapang, Cariven Ayzel							
November 18, 2025					November 18, 2025				
DEFENSE ROOM 1					DEFENSE ROOM 2				
TUESDAY	Group #	Members	Adviser	Panel Members	TUESDAY	Group #	Members	Adviser	Panel Members
8:00 - 10:00AM	16	Baculi, Amarie M.	Lovely Ruth Santos	Frederick Santos	8:00 - 10:00AM	17	Lansangan, Don Marco S.	Ritchell Escoto	Mark Superio
		Cabrera, Ashlee D.	Dennis Tacadena	Robbert Bamba					
		Sunga, Jayson Kim D.	Dessa Lyn De Castro	Khyle Alegre					
		Dela Cruz, David Josh D.							
10:00 - 12:00NN	12	Lopez, Arianne C.	Dennis Tacadena	Ritchell Escoto	10:00 - 12:00NN	19	Cabrera, Omnio B.	Dessa Lyn De Castro	Mark Superio
		Mendoza, Mc Khyle Dean Y.	Frederick Santos	Robbert Bamba					
		Quiambao, Angela Kyla A.	Lovely Ruth Santos	Khyle Alegre					
1:00 - 3:00PM	20	Manalang, Steven Allen P.	Dessa Lyn De Castro	Dennis Tacadena	1:00 - 3:00PM	22	Denola, Geonna Lyyzet B.	Khyle Alegre	Robbert Bamba
		Salangsang, Kim Vincent G.	Frederick Santos	Mark Superio					
		Tuazon, Khaz Leewen C.	Ritchell Escoto	Lovely Ruth Santos					
		Cunanan, Kenji Martell M.							
3:00 - 5:00PM	25	Abri, Cris Anne N.	Khyle Alegre	Dennis Tacadena	10:00 - 12:00NN	23	Antibero, Cristine Joy E.	Ritchell Escoto	Ernie Lee Pineda
		Lazundin, Jonathan U.	Dessa Lyn De Castro	Robbert Bamba					
		De Leon, Chynna D.	Ritchell Escoto	Lovely Ruth Santos					
		Galvan, Jasper G.							
November 19, 2025					November 19, 2025				
DEFENSE ROOM 1					DEFENSE ROOM 2				
WEDNESDAY	Group #	Members	Adviser	Panel Members	WEDNESDAY	Group #	Members	Adviser	Panel Members
8:00 - 10:00AM	3	Alvarez, Cedric John Z.	Gilbert Gonzales	Ronalyn Domingo	8:00 - 10:00AM	1	Morales, Reuben F.	Dennis Tacadena	Ernie Lee Pineda
		Dela Cruz, Charls John S.	Robbert Bamba	Ritchell Escoto					
		Lacandola, Jonas B.	Dessa Lyn De Castro	Lovely Ruth Santos					
		Hernandez, Shanelle Anne R.							
10:00 - 12:00NN	21	Angeles, Algemon C.	Fred Santos	Dennis Tacadena	10:00 - 12:00NN	2	Garcia Danica D.	Khyle Alegre	Ronalyn Domingo
		Enobio, Maria Angelica	Dessa Lyn De Castro	Lovely Ruth Santos					
		Sanchez, Allen	Emie Lee Pineda	Ritchell Escoto					
1:00 - 3:00PM	4	Baratilla, Giecel Ira D.	Dessa Lyn De Castro	Ernie Lou Pineda	1:00 - 3:00PM	5	Atkinson, Kate Ashley F.	Lovely Ruth Santos	Ronalyn Domingo
		Calaguas, Fiona Mae T.	Dennis Tacadena	Robbert Bamba					
		Cruz, Francesca Nicole B.	Khyle Alegre	Ritchell Escoto					
		David, Erika M.							
3:00 - 5:00PM	6	Umali, Ritchelle M.	Ritchell Escoto	Dennis Tacadena	3:00 - 5:00PM	9	Delos Reyes, Cesar P.	Emie Lee Pineda	Ronalyn Domingo
		Sanguesa, Mara S.	Dessa Lyn De Castro	Lovely Ruth Santos					
		Silapan, Mikaela R.	Khyle Alegre	Robbert Bamba					
		Paran, Christian Miguel P.							
November 20, 2025					November 20, 2025				
DEFENSE ROOM 1					DEFENSE ROOM 2				
THURSDAY	Group #	Members	Adviser	Panel Members	THURSDAY	Group #	Members	Adviser	Panel Members
8:00 - 10:00AM	27	Aguilar, Alexander L.	Dennis Tacadena	Ritchell Escoto	8:00 - 10:00AM	15	Espinoza, James Mark	Khyle Alegre	Frederick Santos
		Ballesteros, Gwen P.	Substitute	Cabillo, Abigail			Dennis Tacadena		
		Penino, Jericho C.	Lovely Ruth Santos	Hipolito, Jamila Joy A.			Robbert Bamba		
		Vargas, Iver Allen N.							
10:00 - 12:00NN	10	Basilio, Alejandro	Robbert Bamba	Frederick Santos			Duldulao, Kurt Elijah		
		Magsino, Jemima Grace	Khyle Alegre						
		Victoria, Jomari	Dennis Tacadena						
		Maglalarang, Keryll							

Group 7: Meditrack+: A Smart Solution for Medical Services Record.



Group 8: PetKlinika: A Web-Based Appointment System with Pet Diseases Verification and QR-Code Pet Locator for Mabalacat Pet Clinic

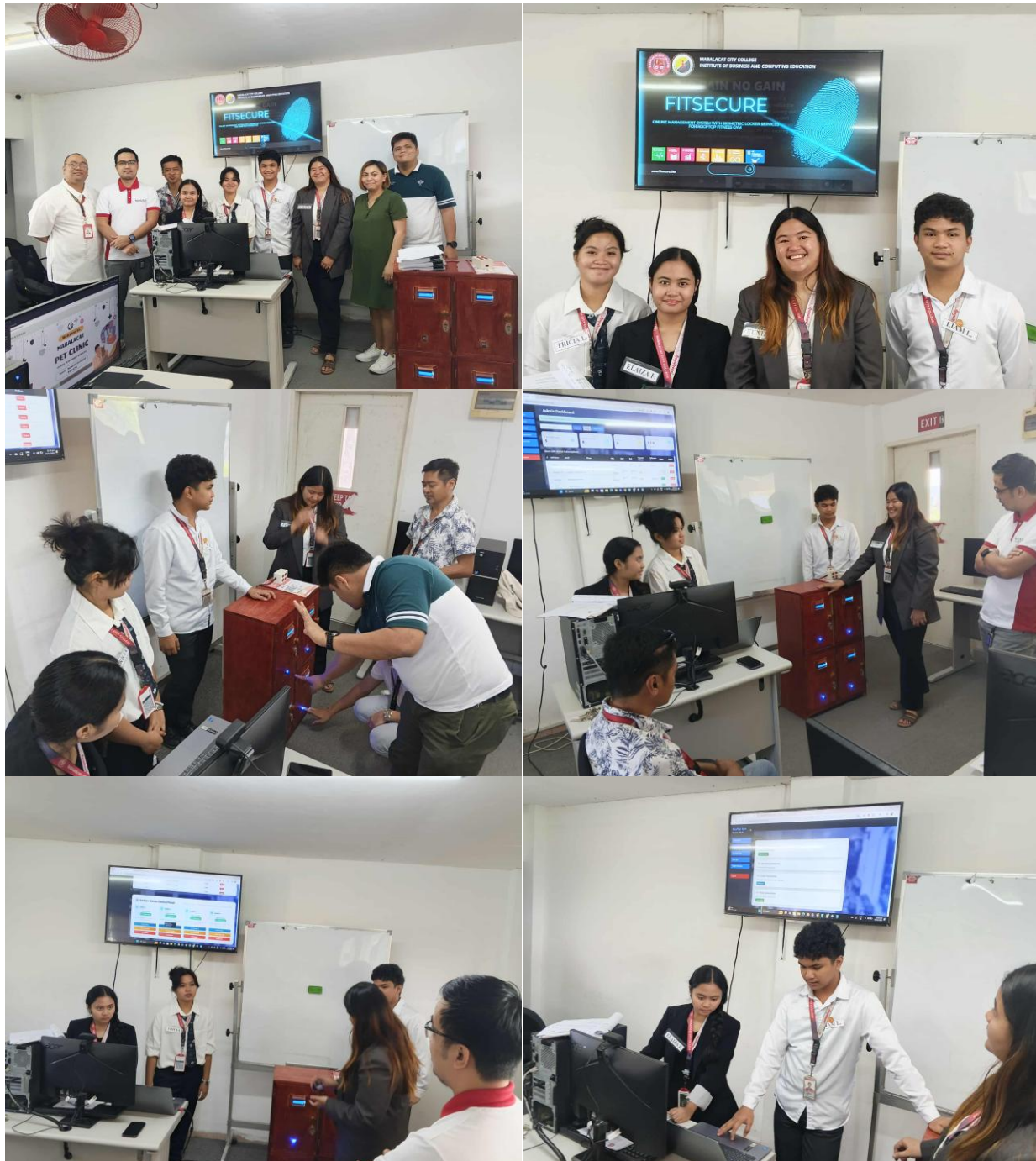




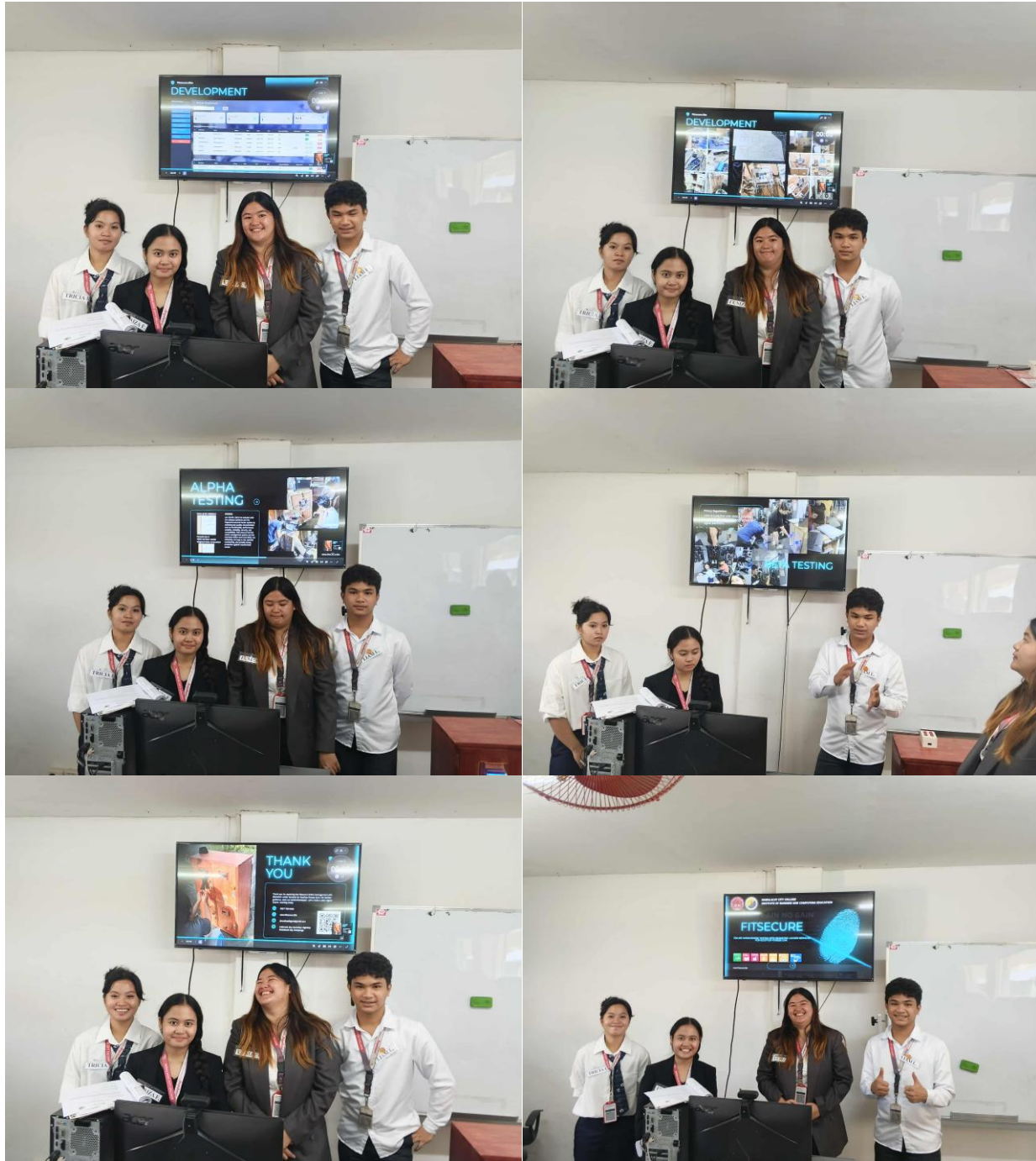
Group 11. ArborWatch: A Web-Based Mapping and Monitoring System for Conservation of Trees in Mabalacat City



Group 26. FITSECURE: Online Management System with Biometric Locker Services for RoofTop Fitness Gym



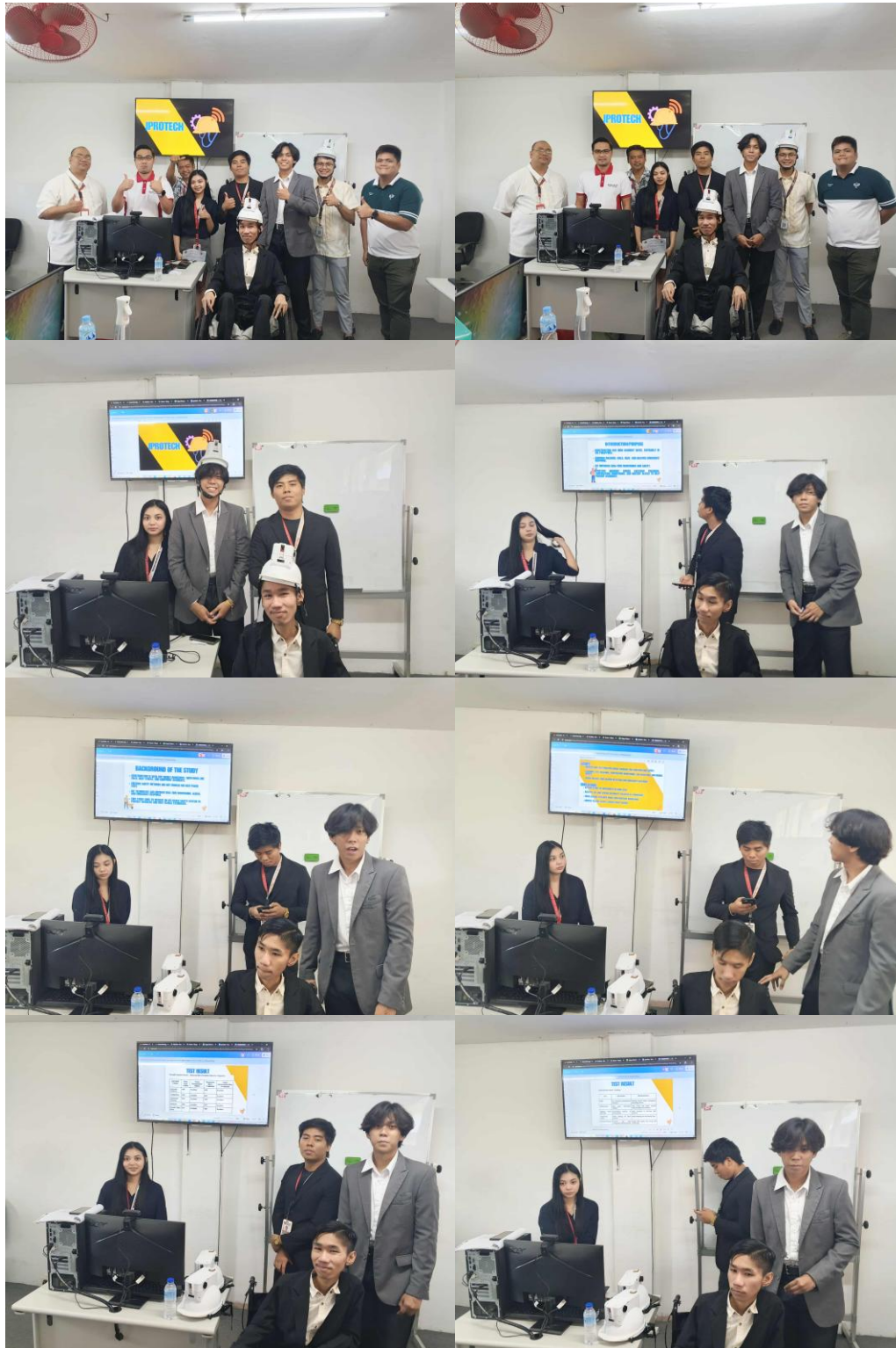




Group 13. GradWay: A Capstone Management System for Computing Studies of MCC



Group 24. IproTech: Microcontroller-Based Location Tracking with Temperature Alarm and Monitoring User Interface for Construction







Group 18. Kapanimpla: A Web-based Ordering and Customization System for Silung Coffee.

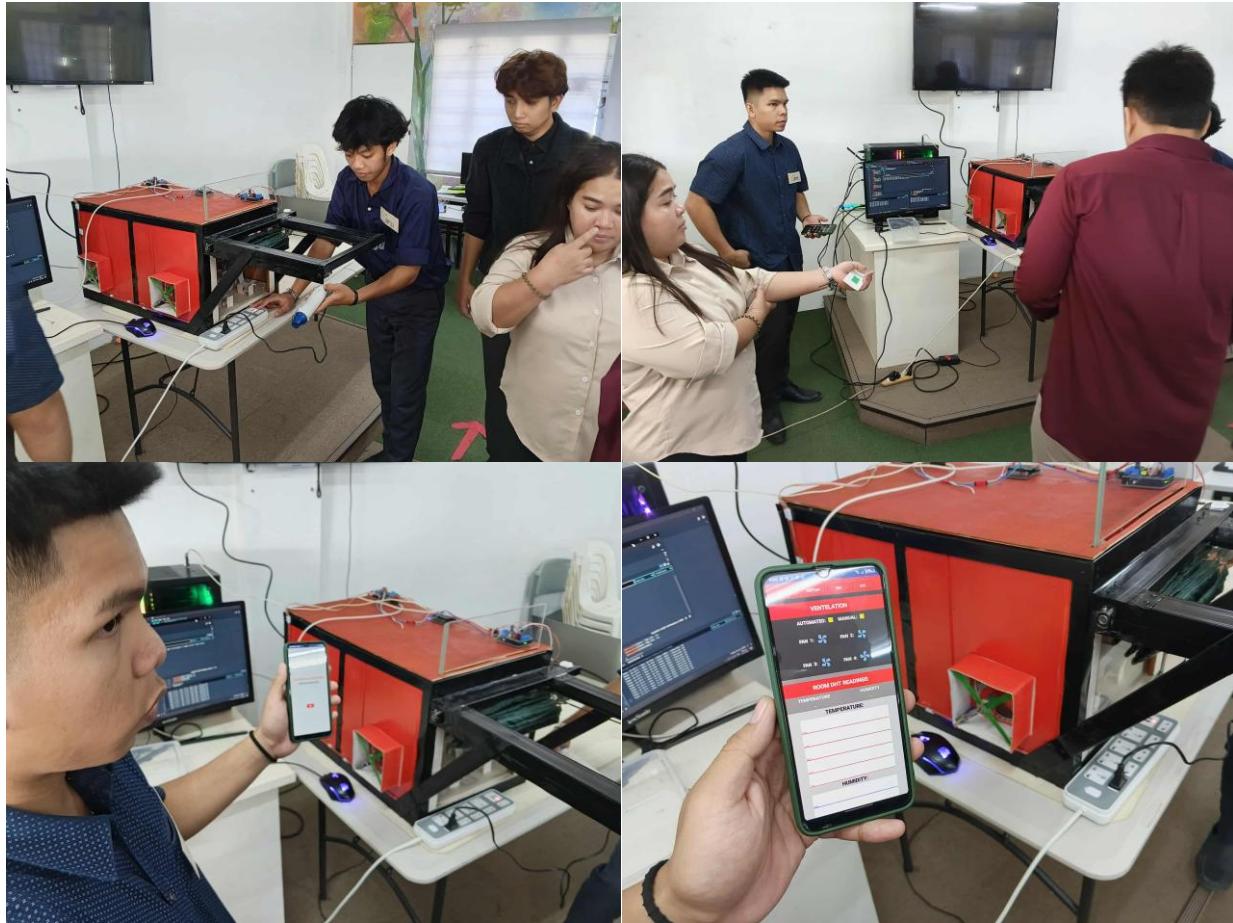


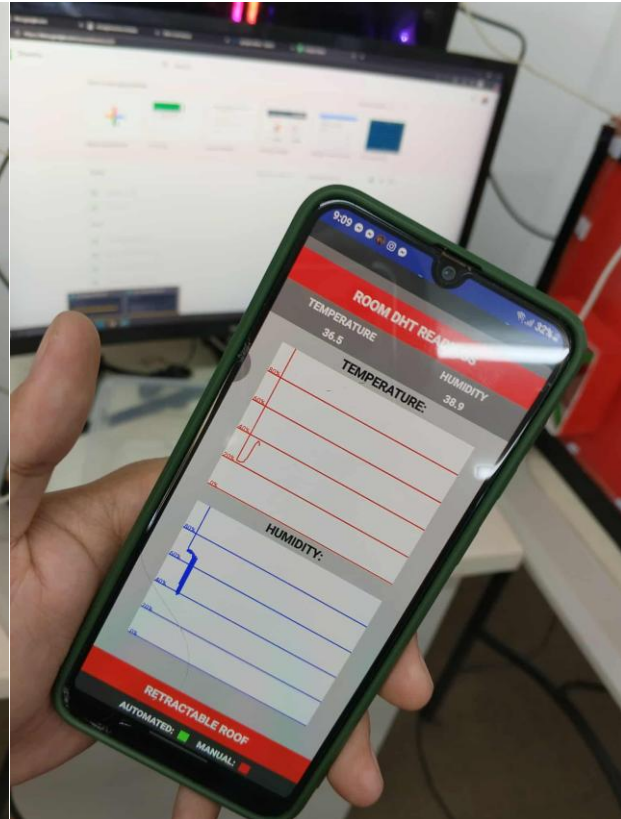
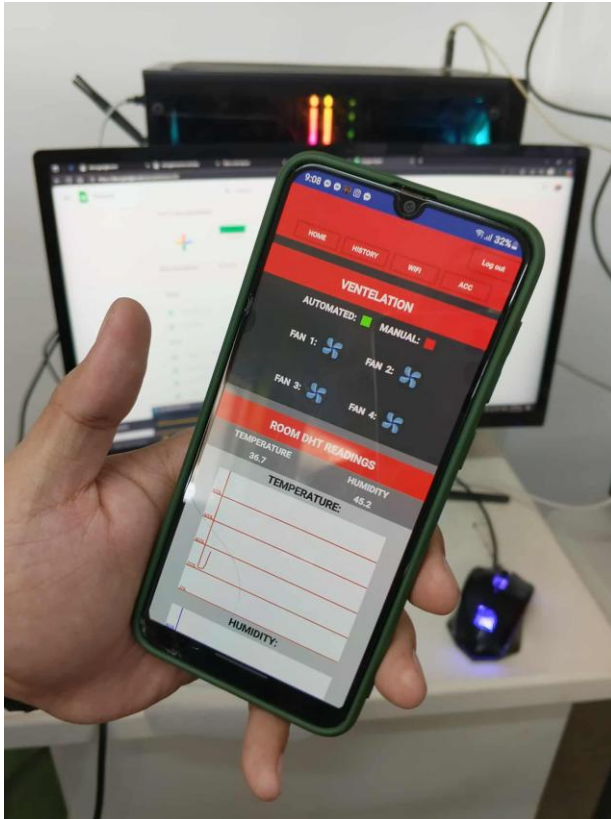




Group 16. MediCall: An IoT-Based Enhancing Emergency Response System in Mabalacat City College Dapdap



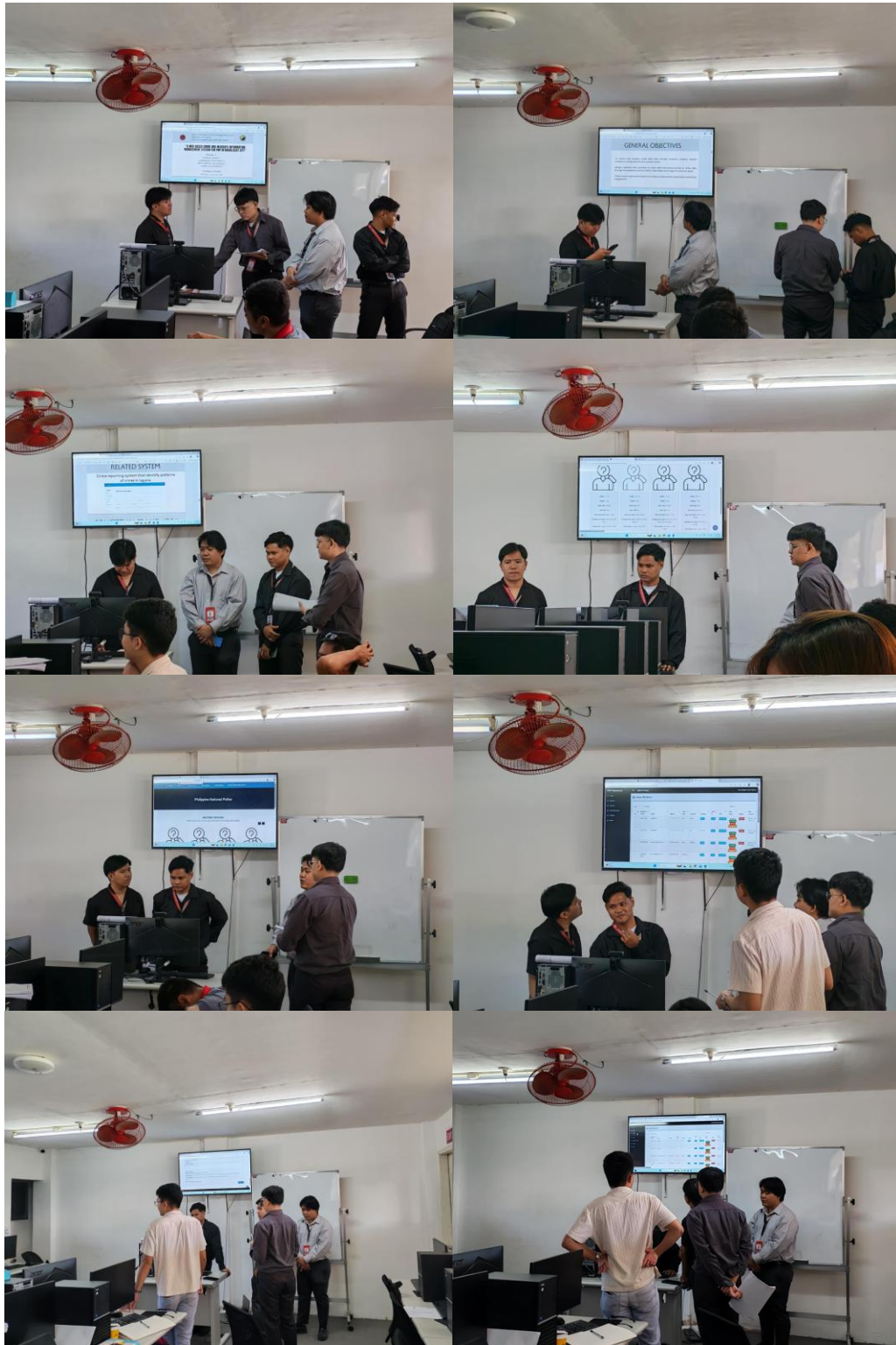




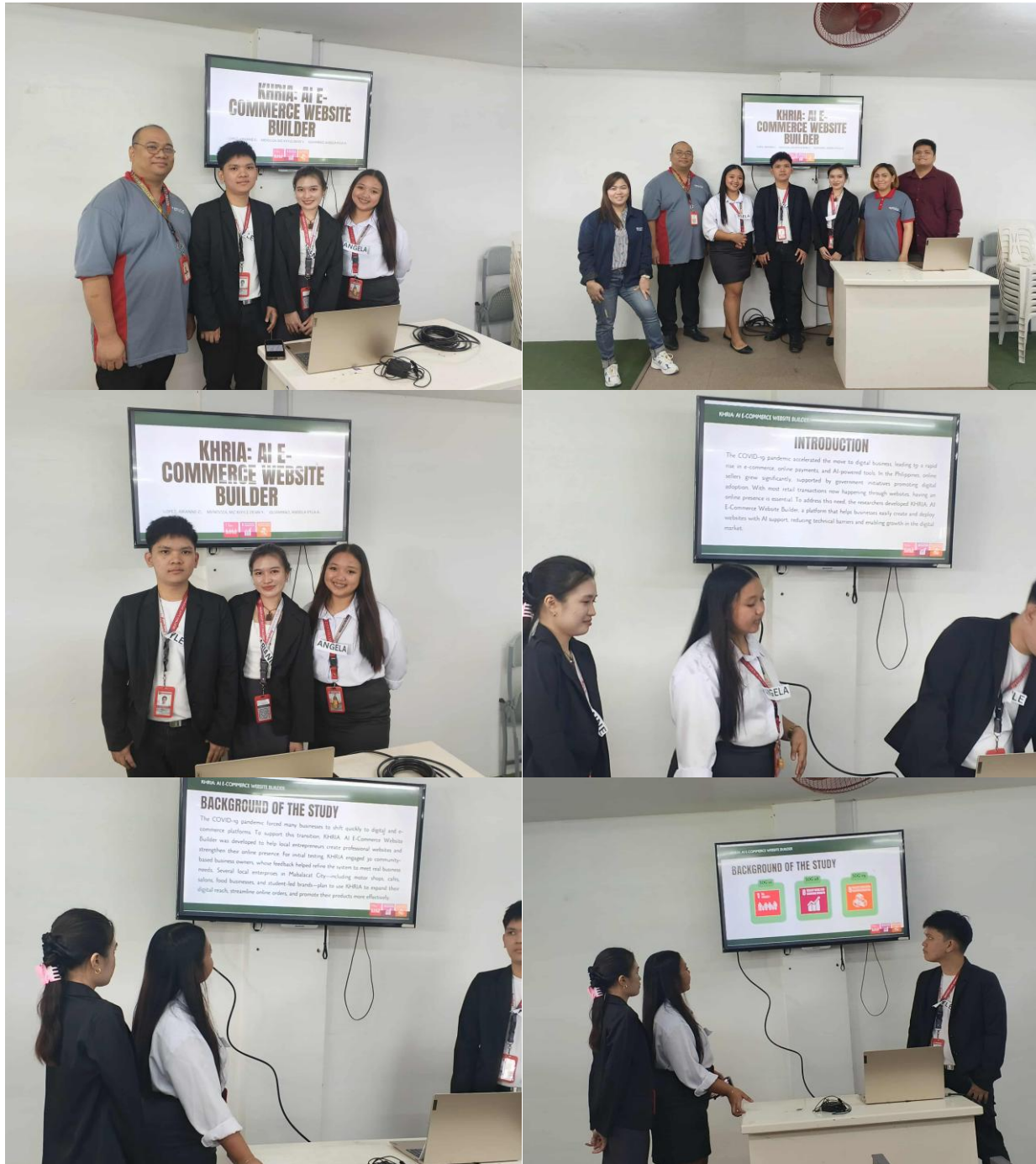




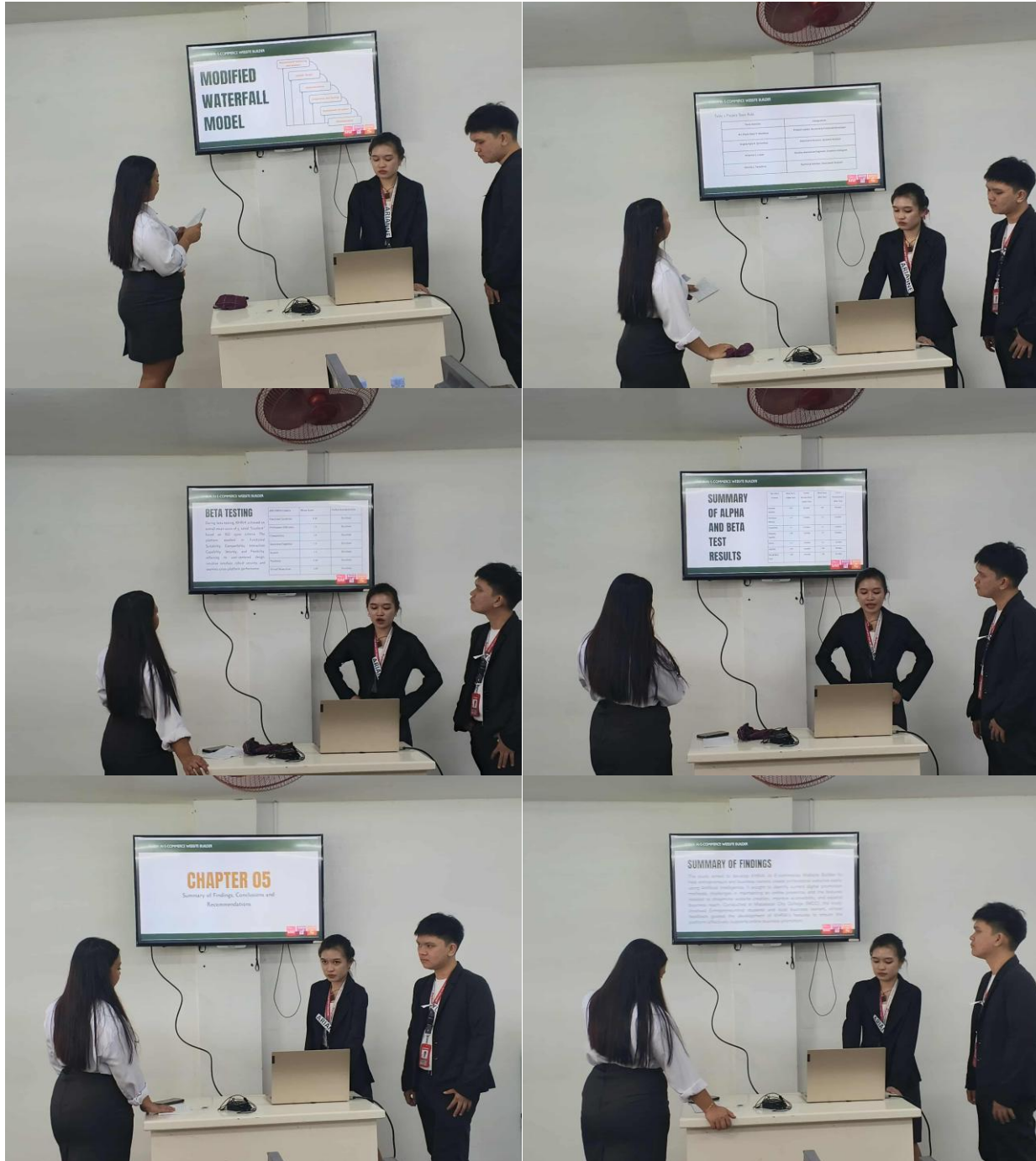
Group 17 A Web-Based Crime and Incidents Information Management System for PNP in Mabalacat City



Group 12. KHRIA: AI E-commerce Website Builder

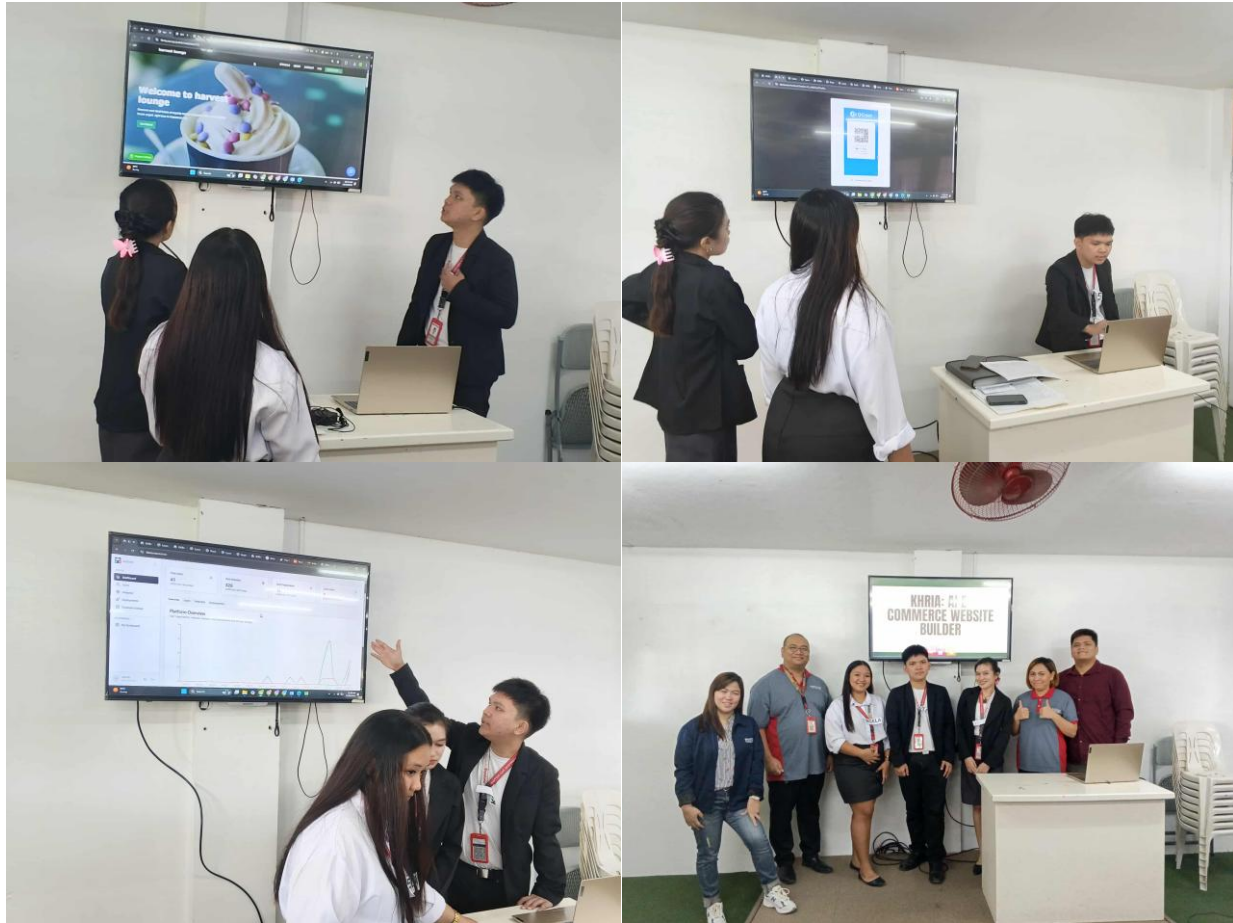












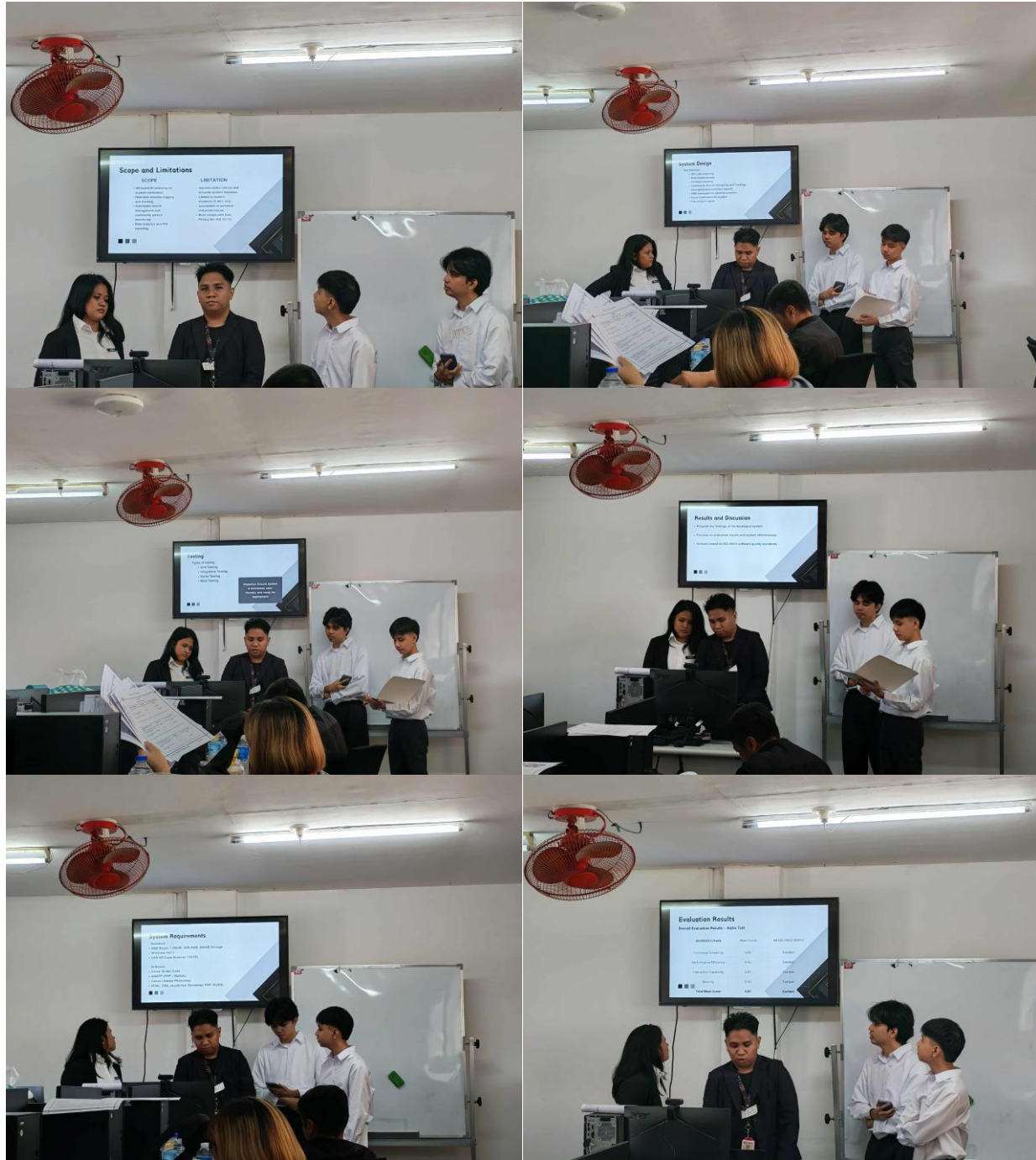
Group19 MCCARE: A Web-Based Guidance Counseling System for Mabalacat City College





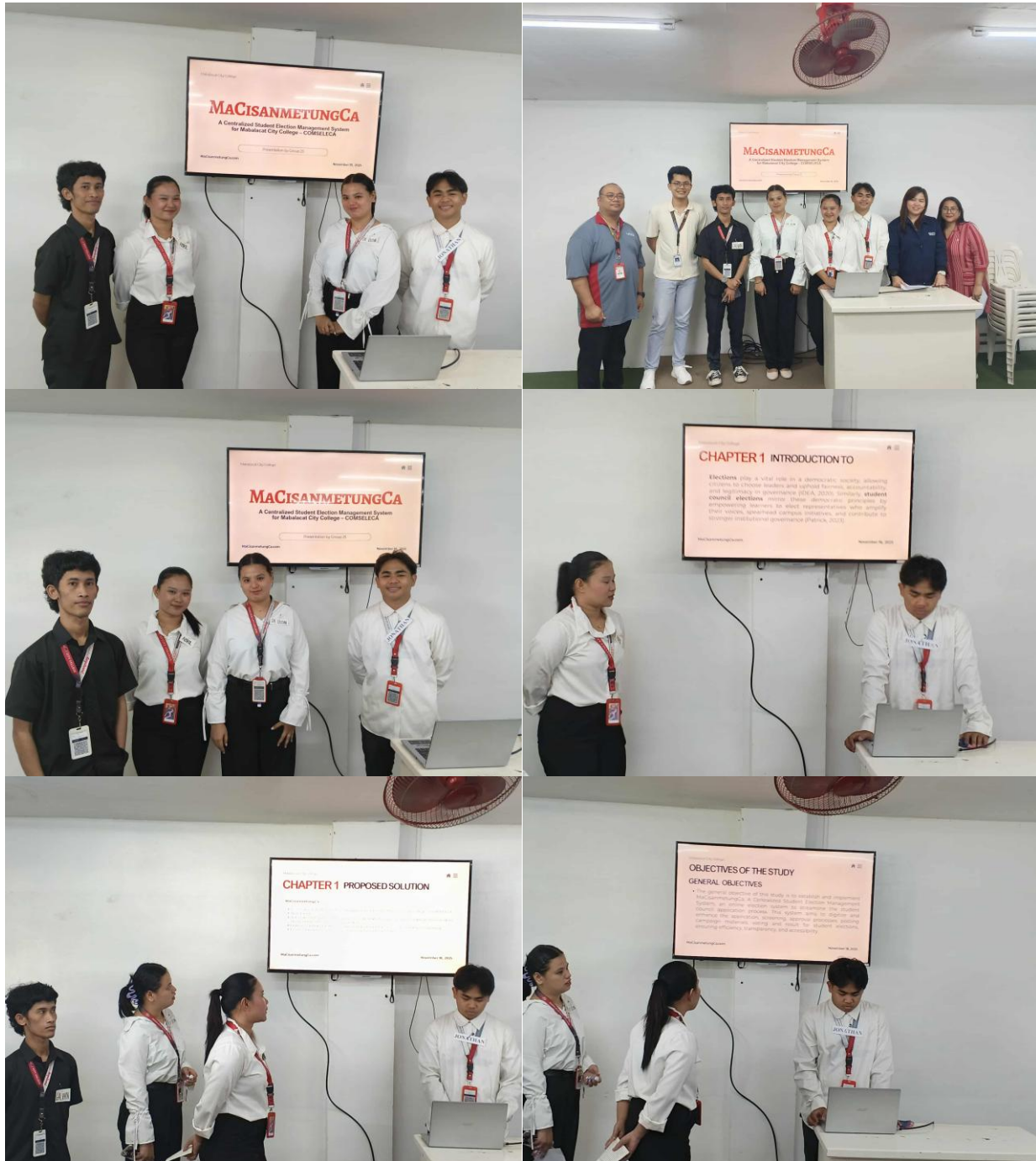
Group 22. Moral Matrix: A Role-Based System for Violation and Sanction Tracking for the Center for Character Development Unit of Mabalacat City College

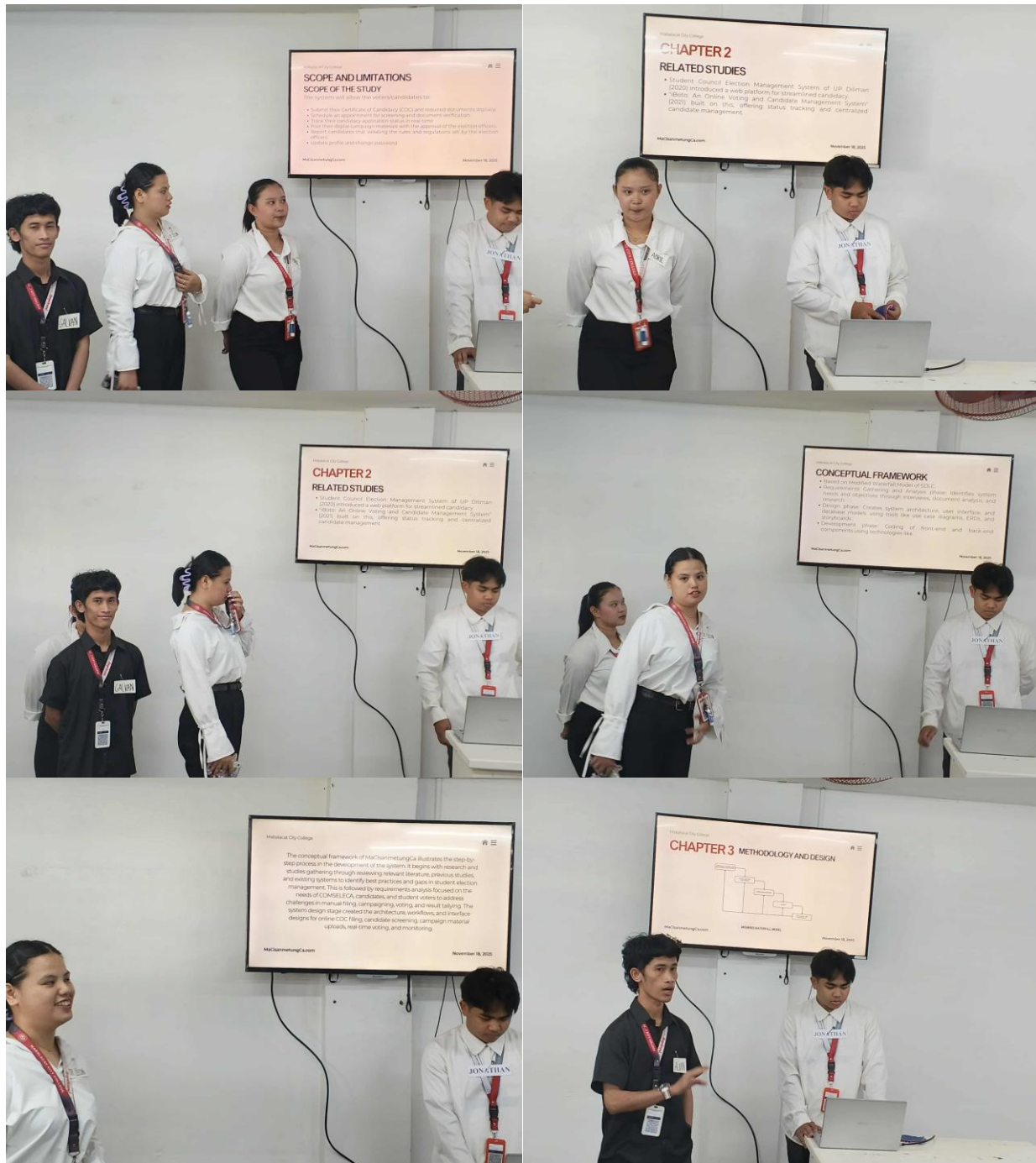


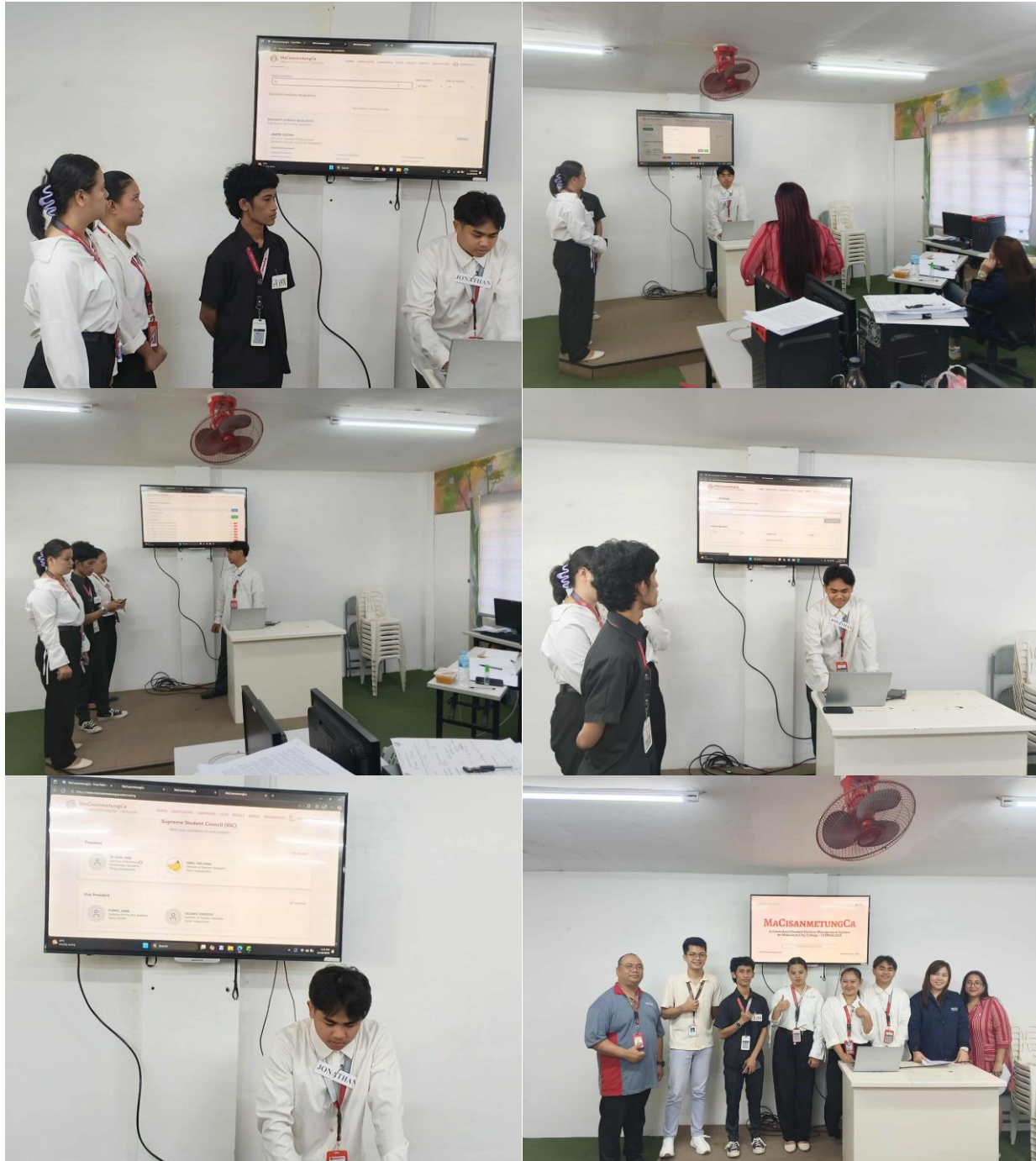




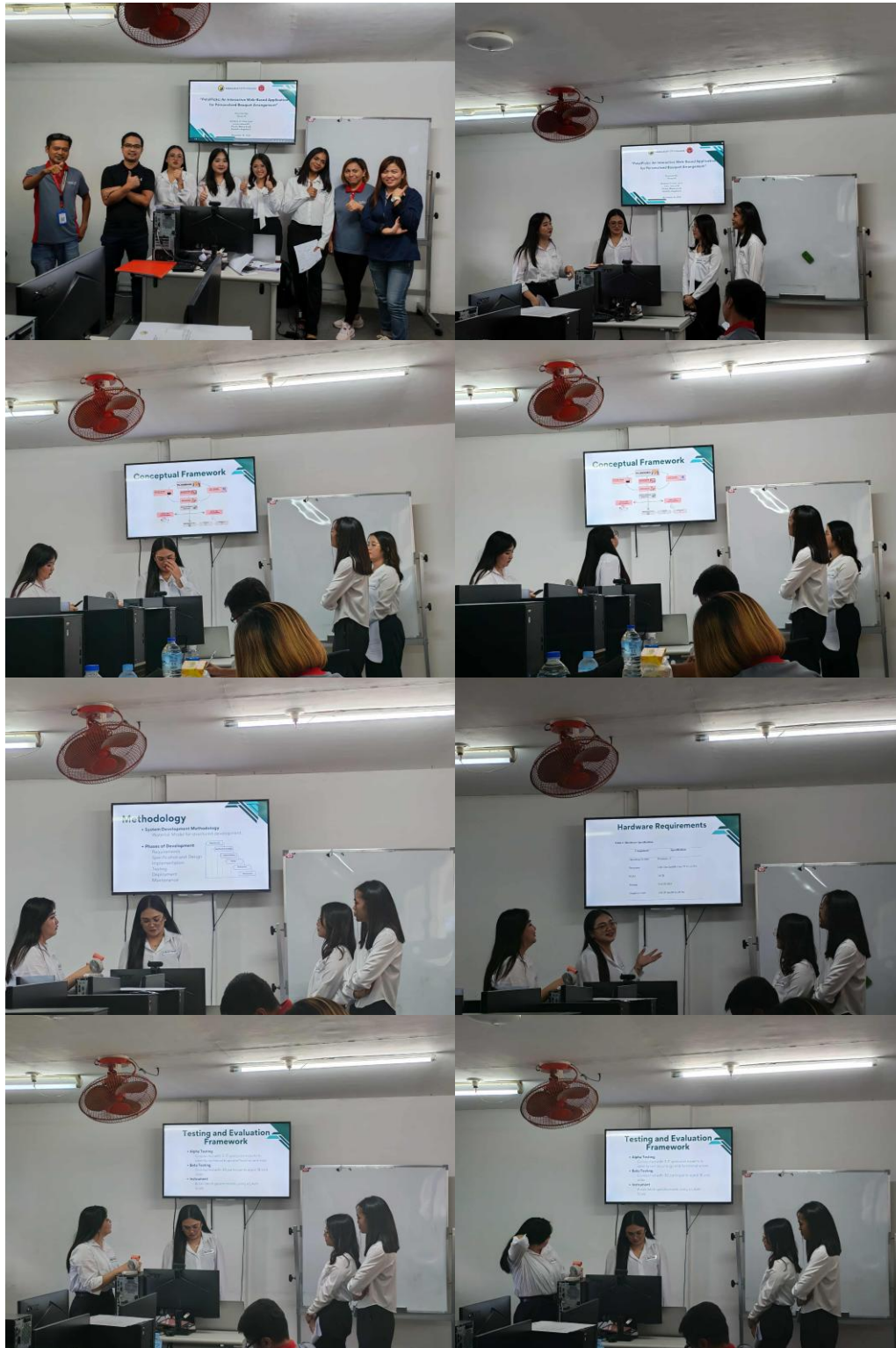
Group 25. MaCisanmetungCa: A Centralized Student Election Management System for Mabalacat City College – COMSELECA

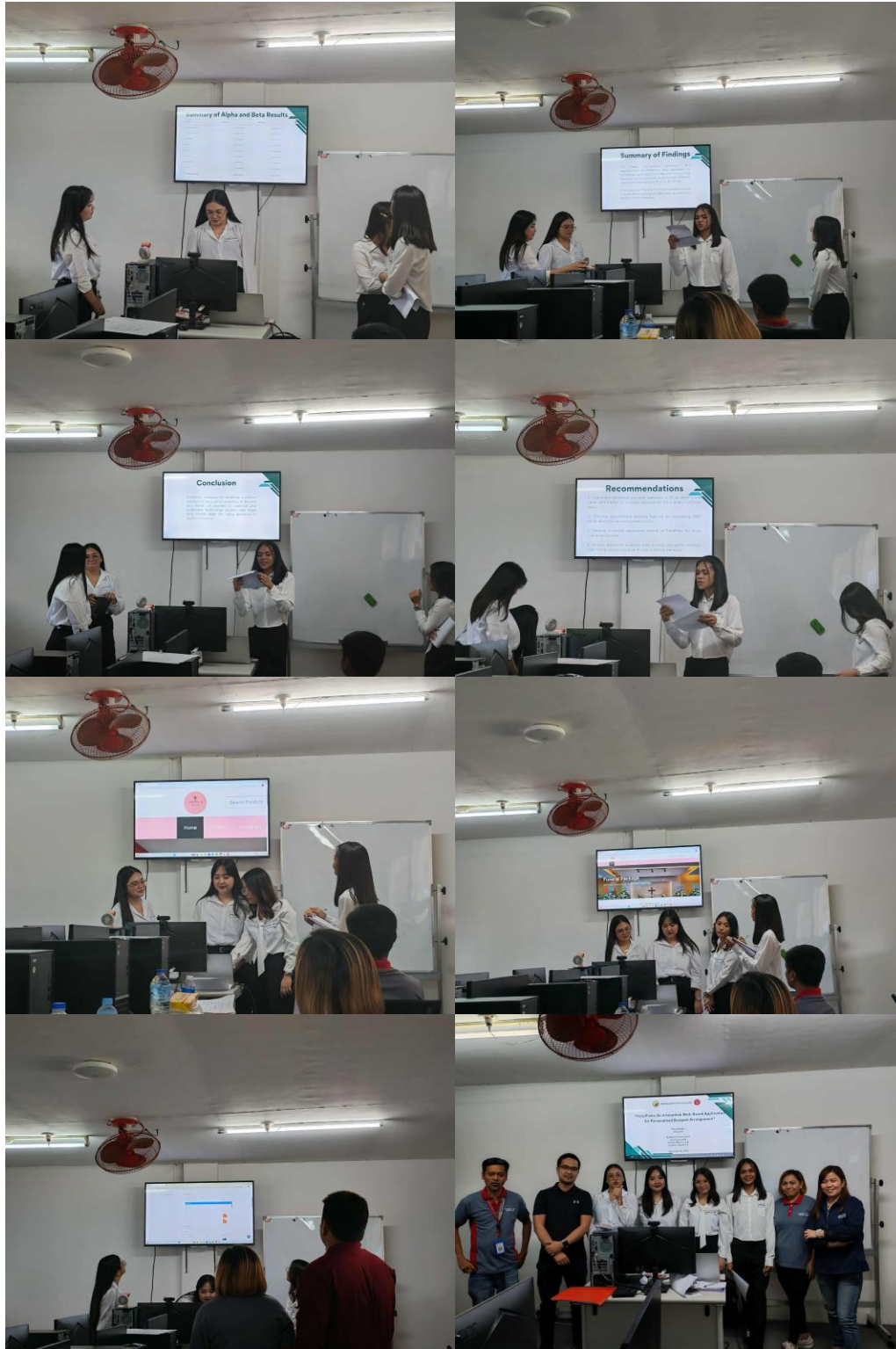




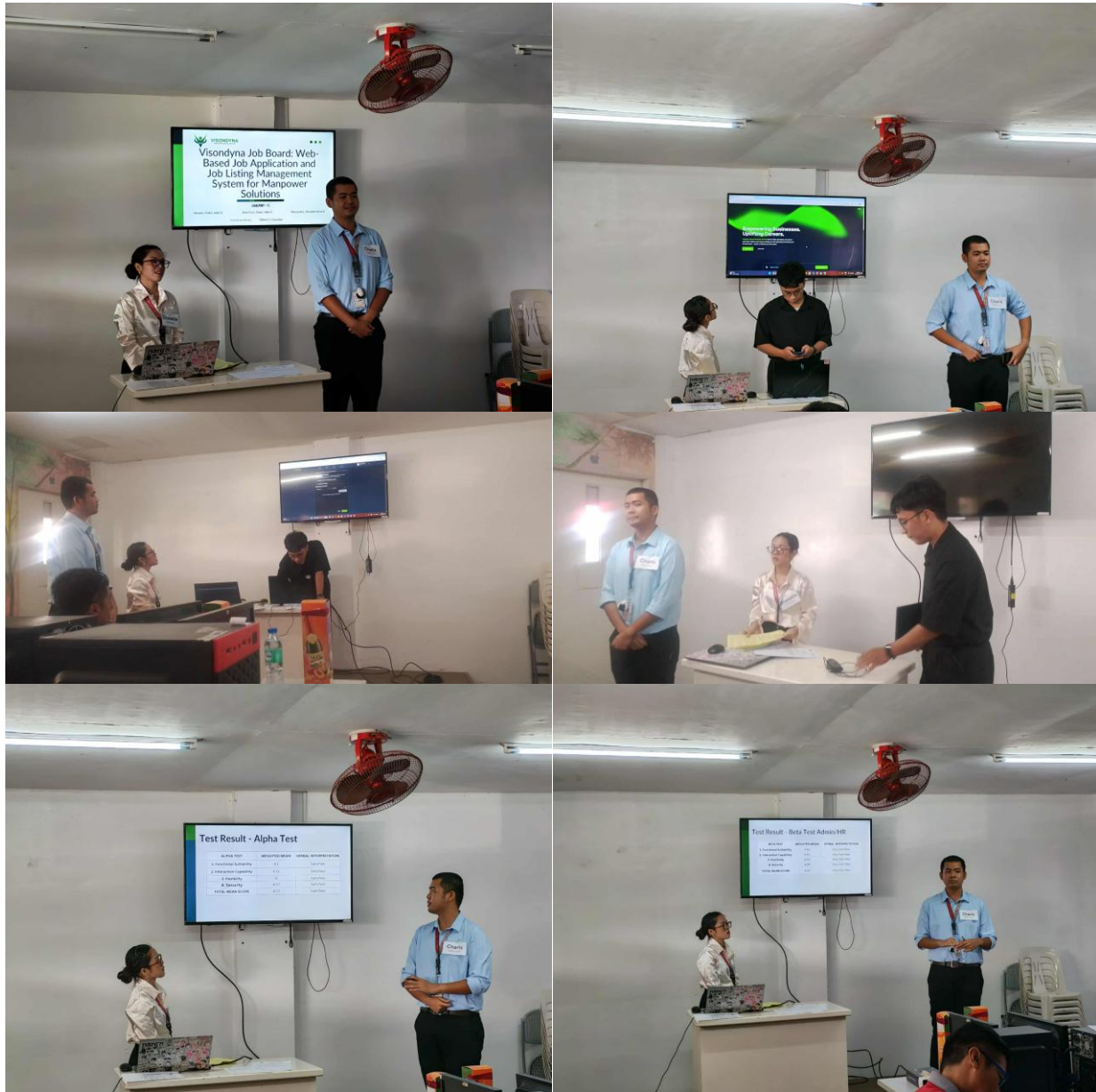


Group 23. PetalPicks: An Interactive Web-Based Application for Personalized Bouquet





Group 3. Visondyna Job Board: Web-Based Job Application and Job Listing Management System for Manpower Solutions



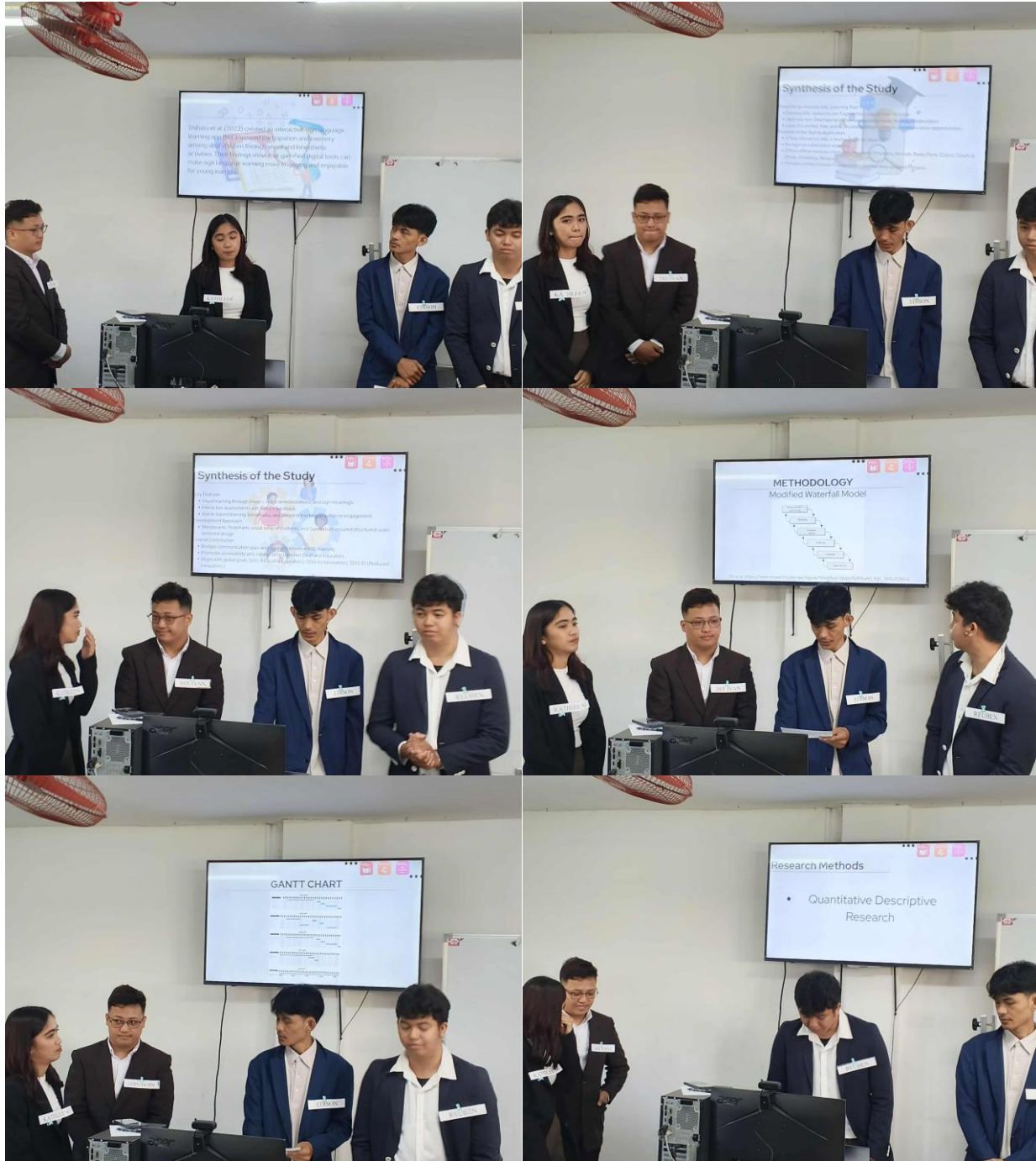


Group 1. SIGNIFY: An Interactive E-Learning Application for Deaf and Educators.

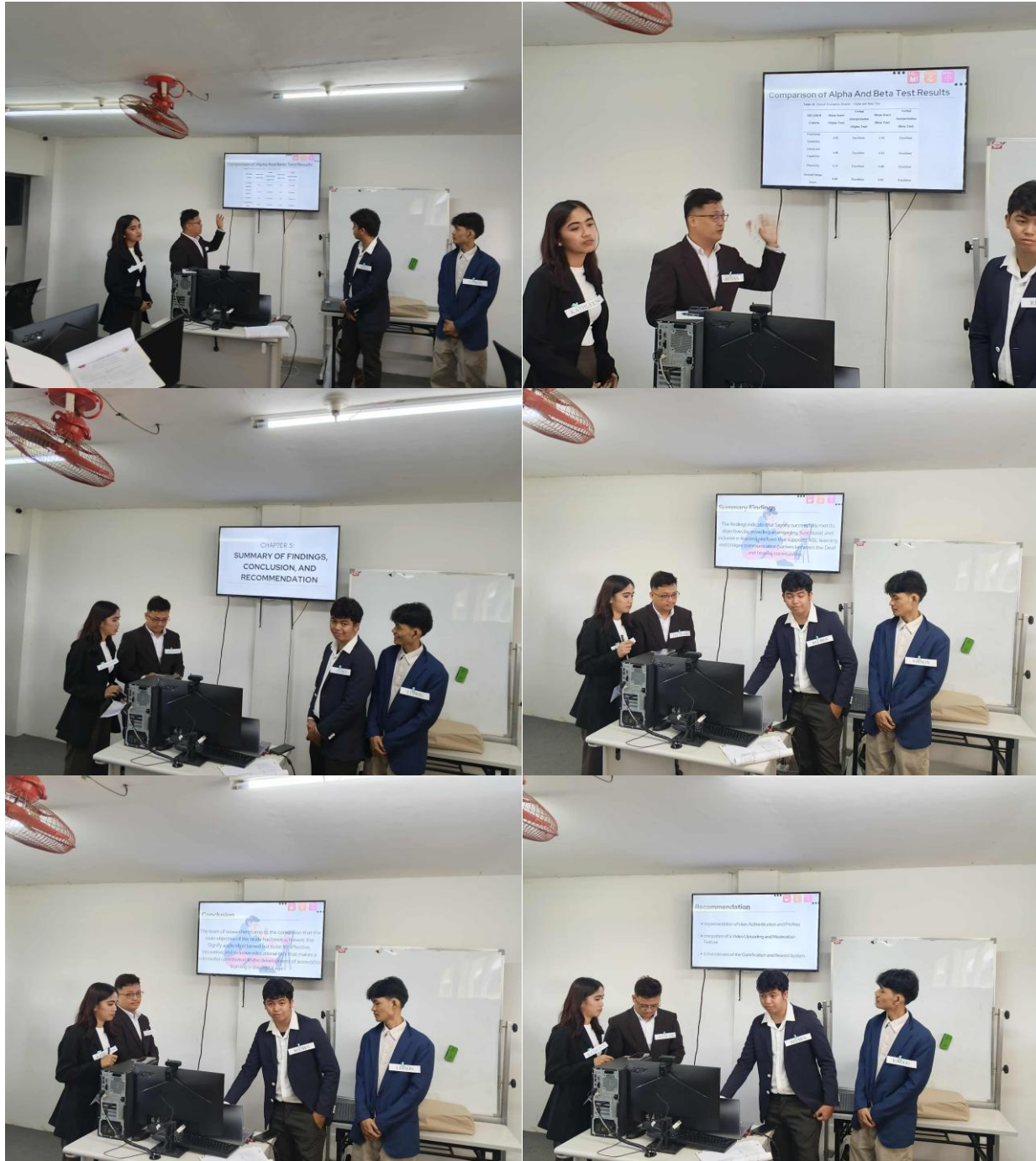








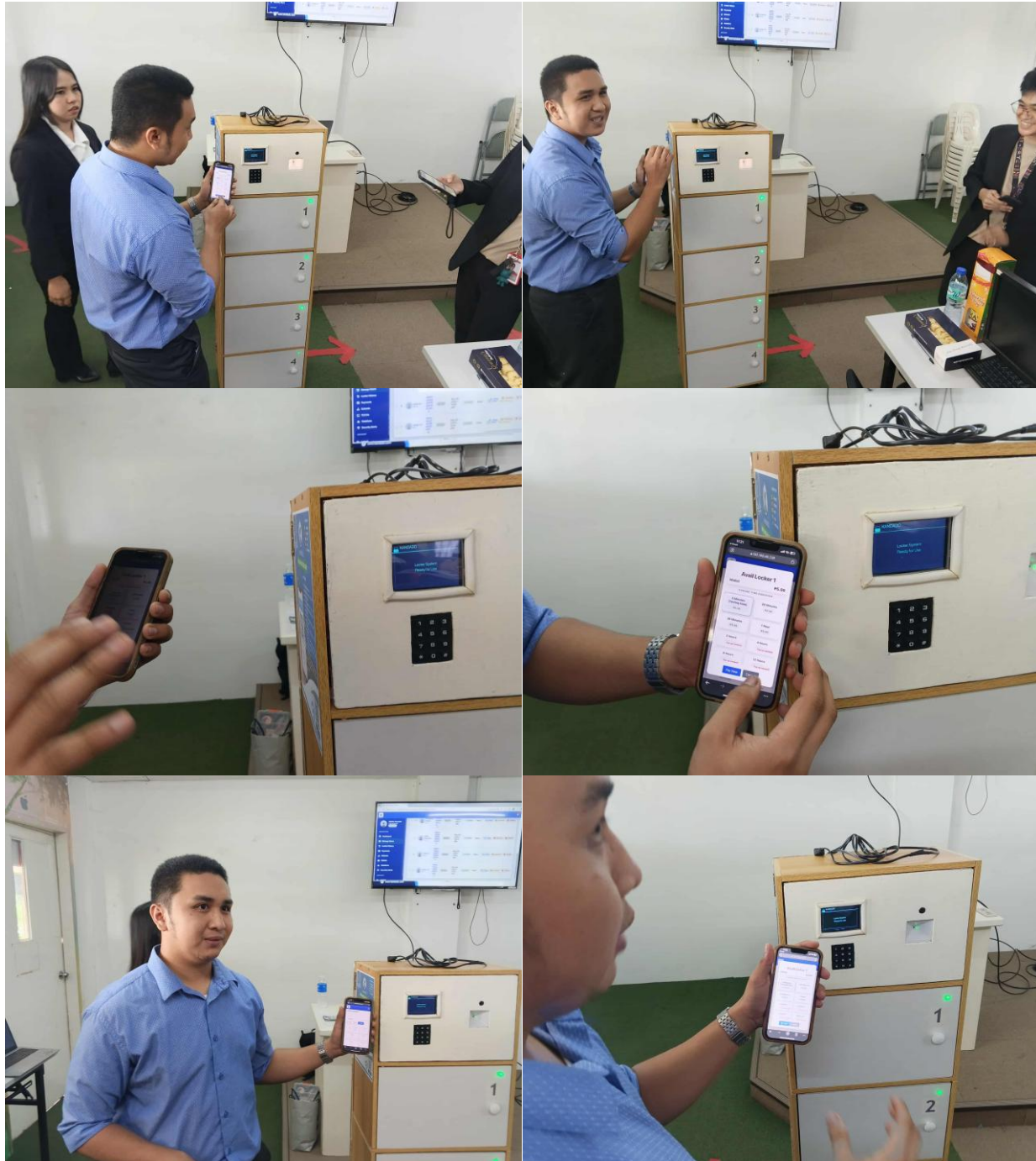






Group 21. KANDADO: An IoT-Based Public Locker System with Randomized QR Codes

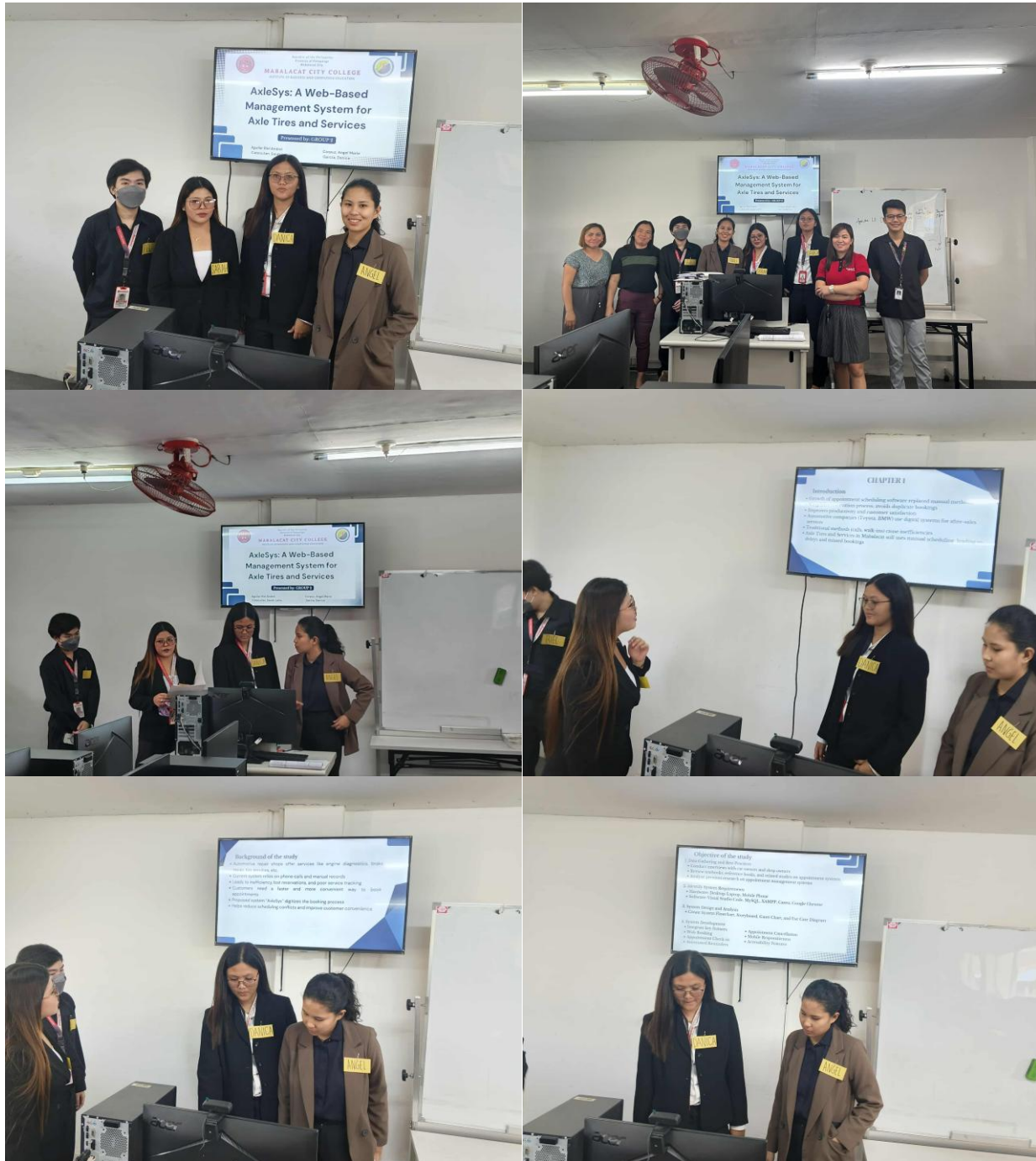


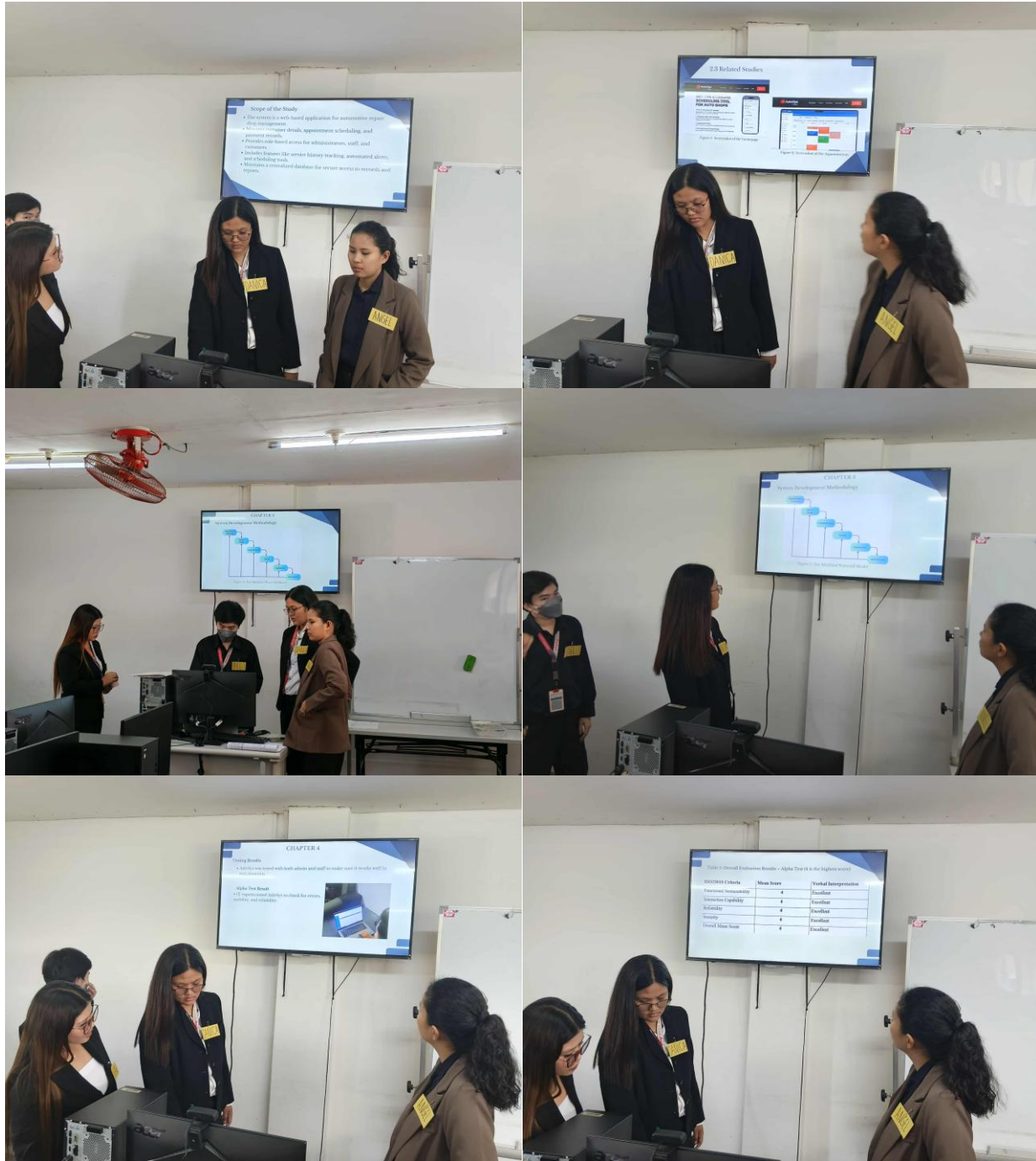






Group 2. AxleSys: A Web-Based Management System for Axle Tires and Services.









Group 4. StenoCoach: Stenography Learning Management System for Mabalacat City College

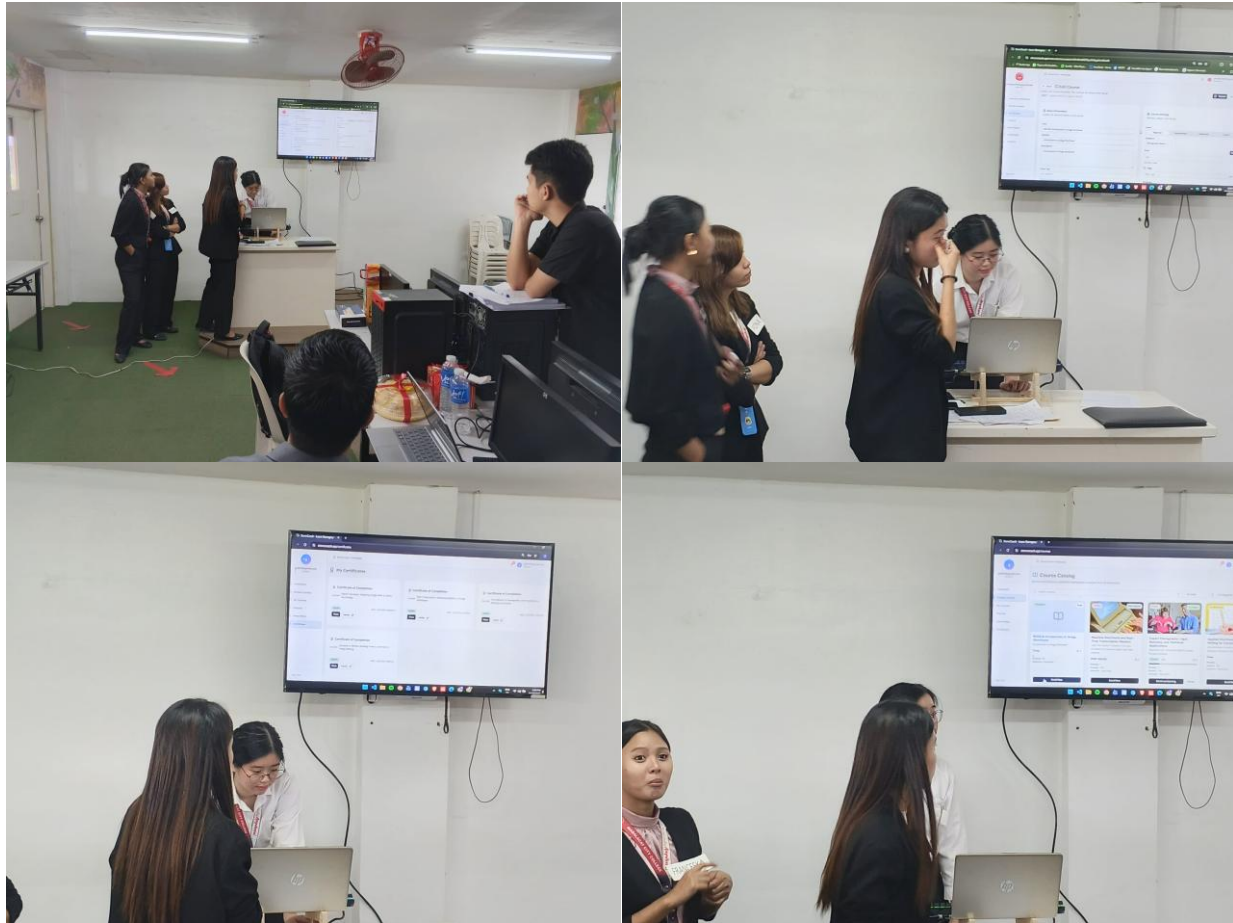






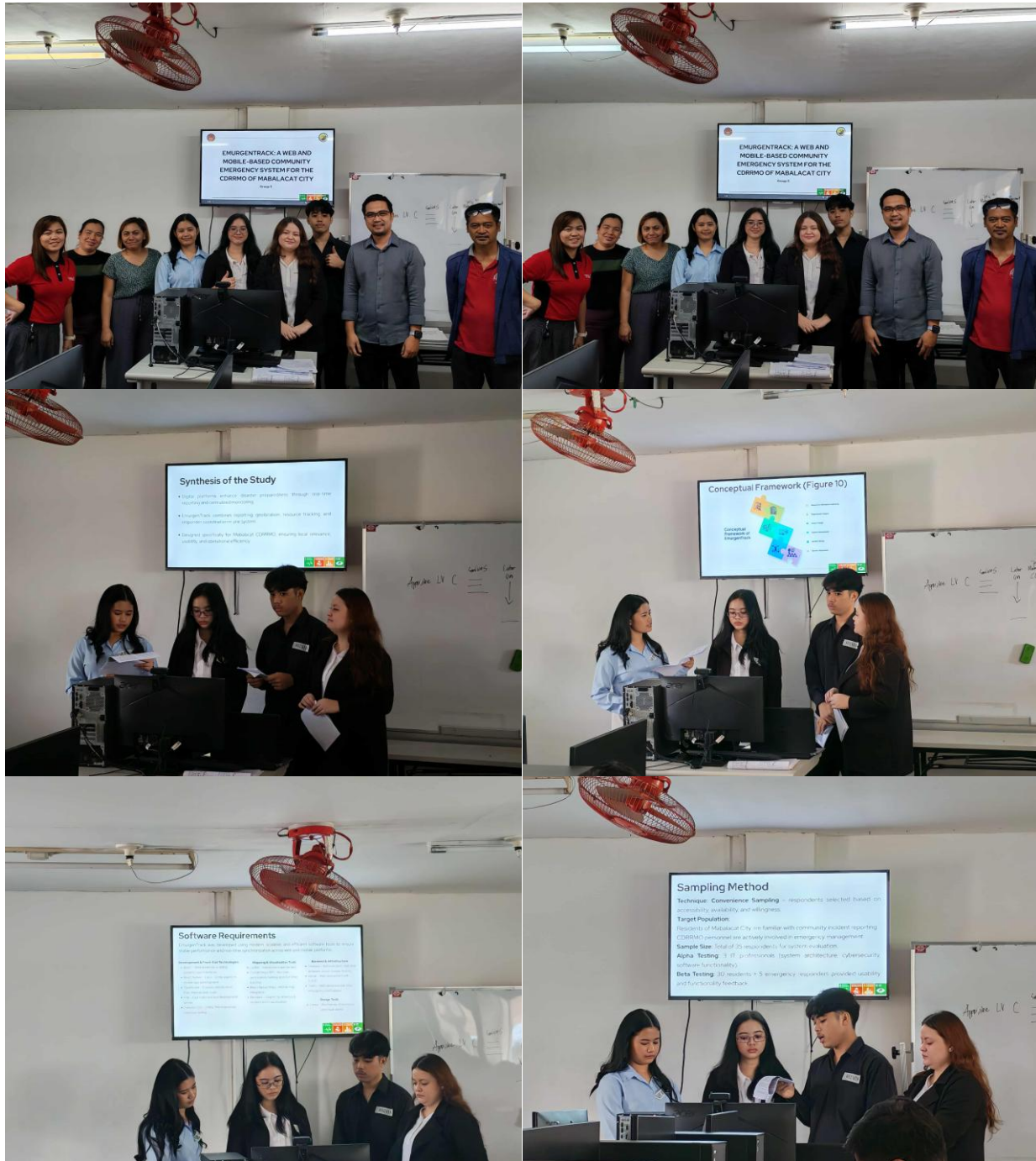


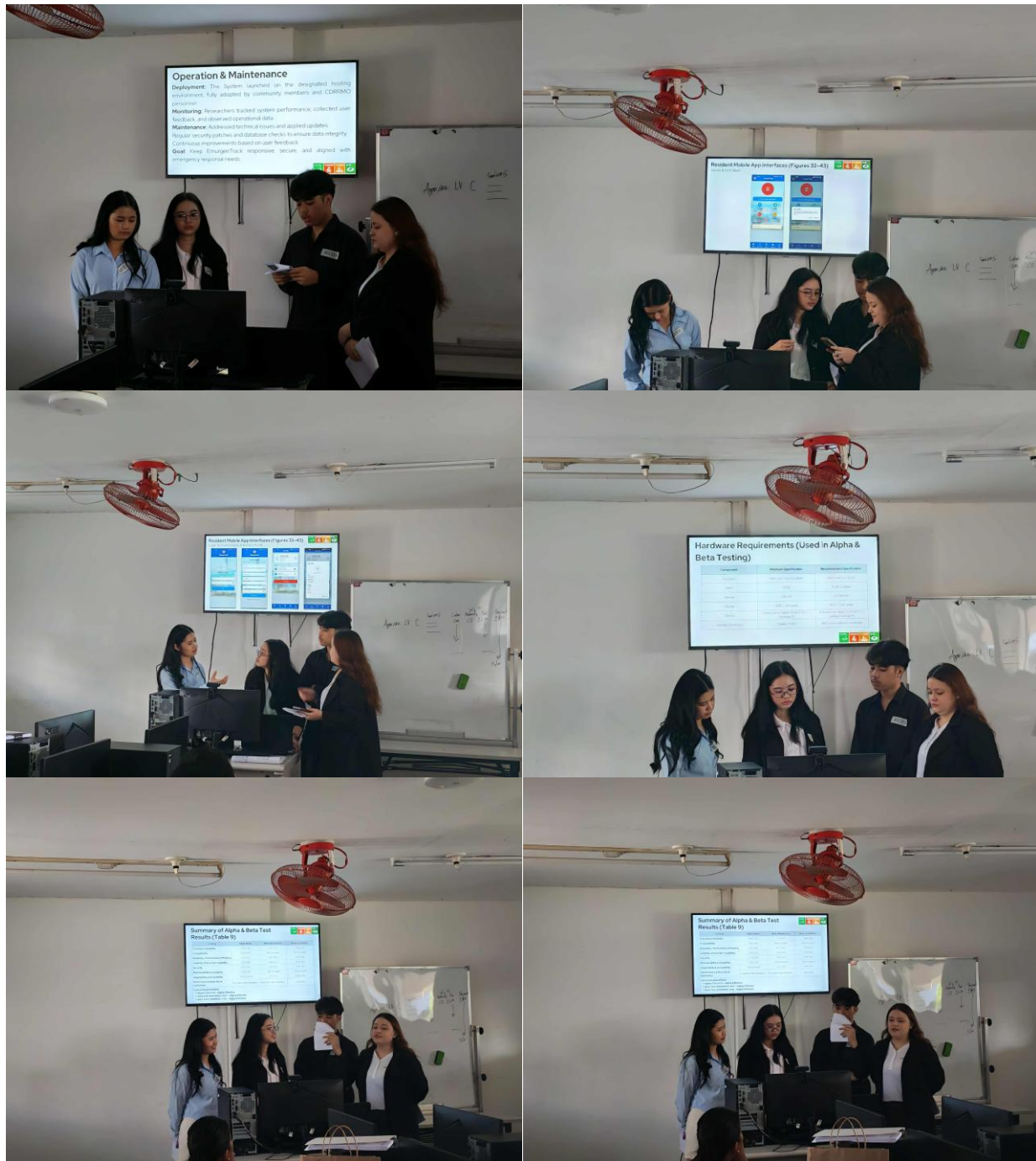






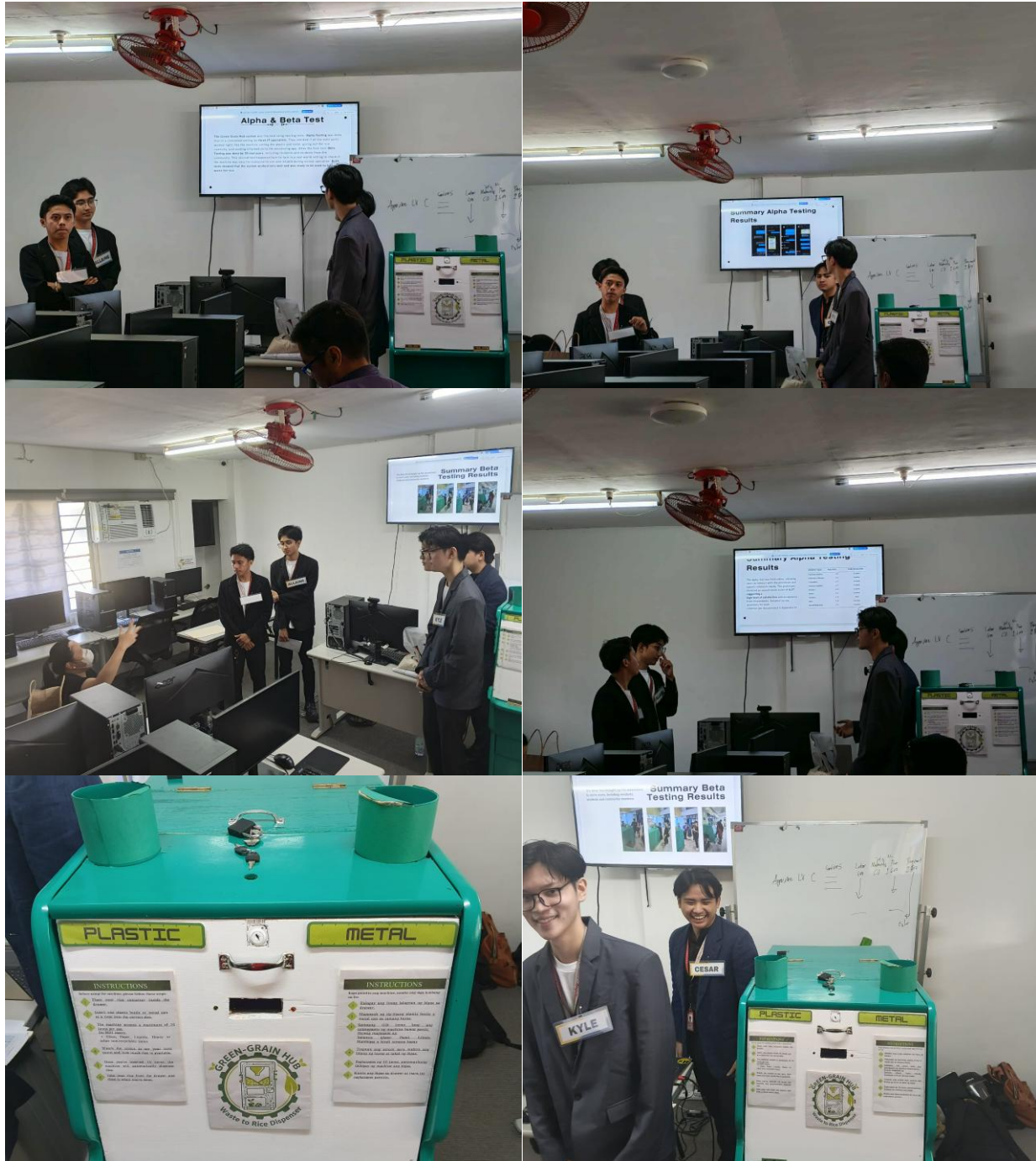
Group 5. EmurgenTrack: A Web and Mobile-Based Community Emergency System for the CDRRMO of Mabalacat City

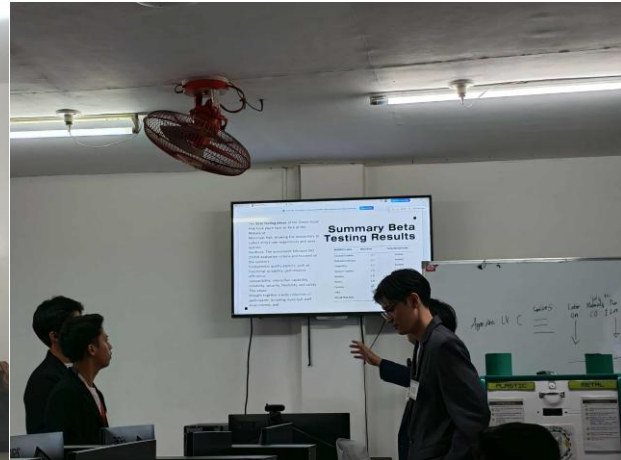




Group 9 Green-Grain Hub: A Microcontroller-Based Waste to Rice Dispenser







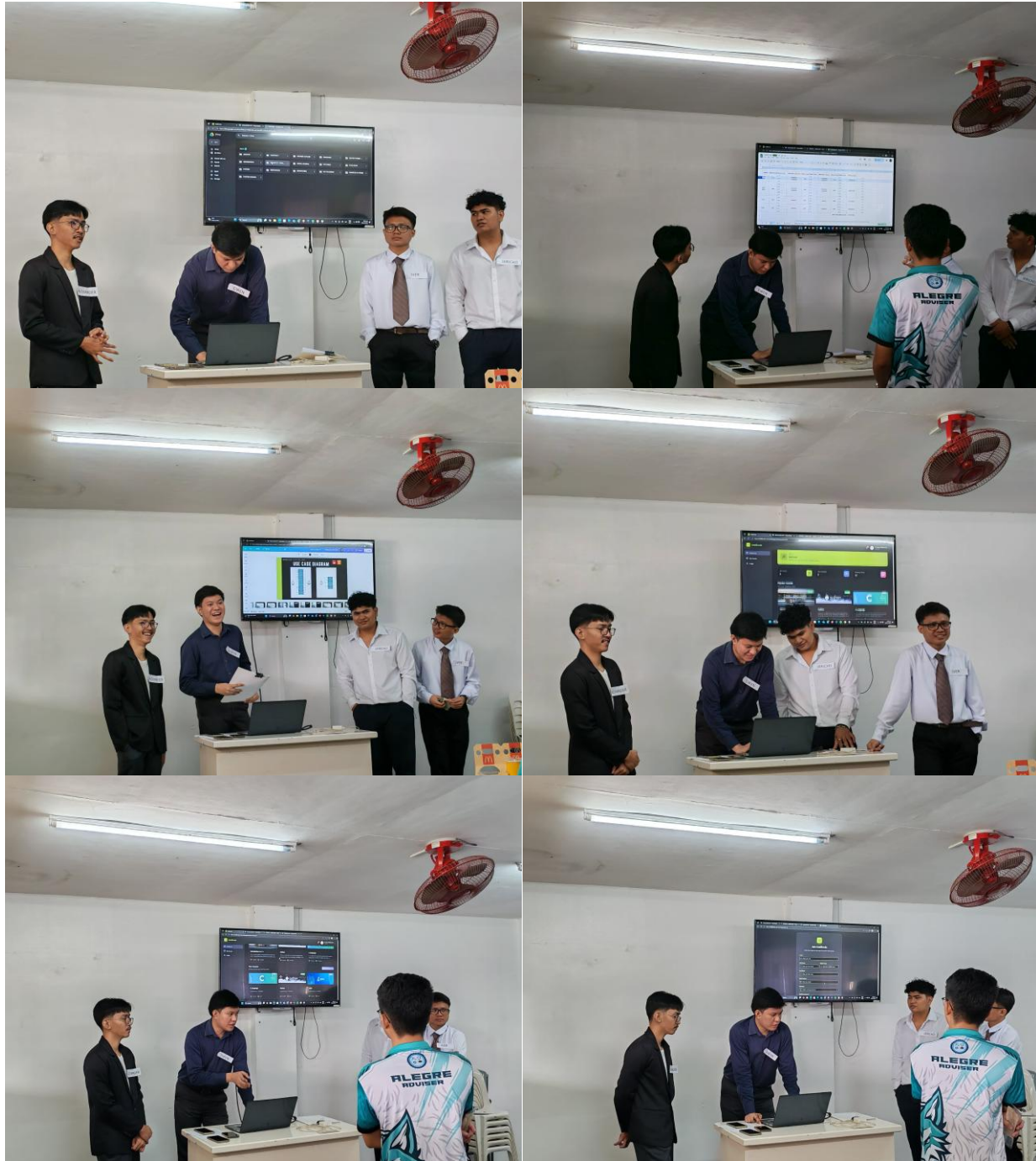






Group 27. INTELLICODE: Learning Tool and Personalized Coding Assessment

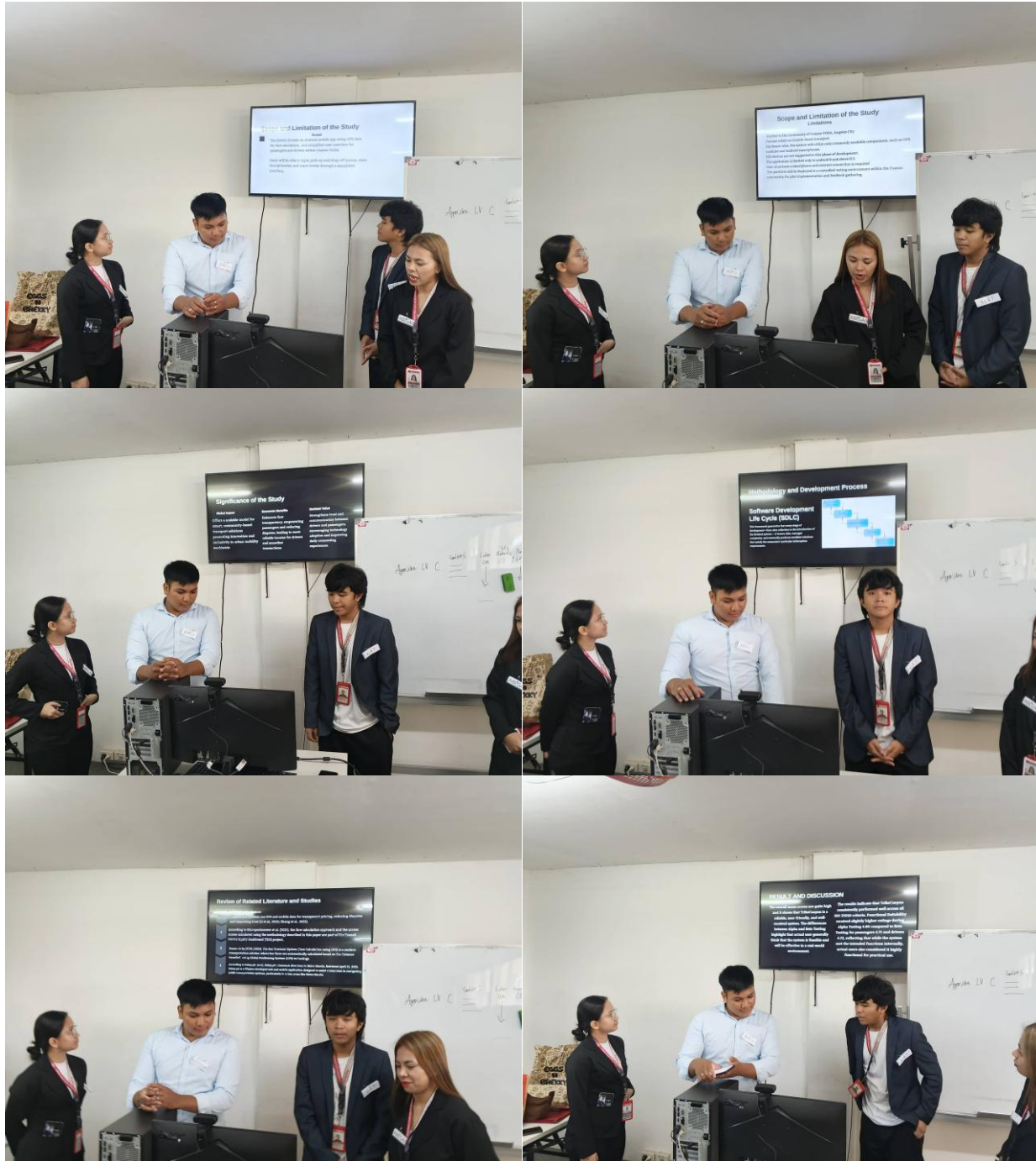






Group 15. Ing Trike Cuayan na: A Tricycle Navigation and Booking System for Cuayan TODA

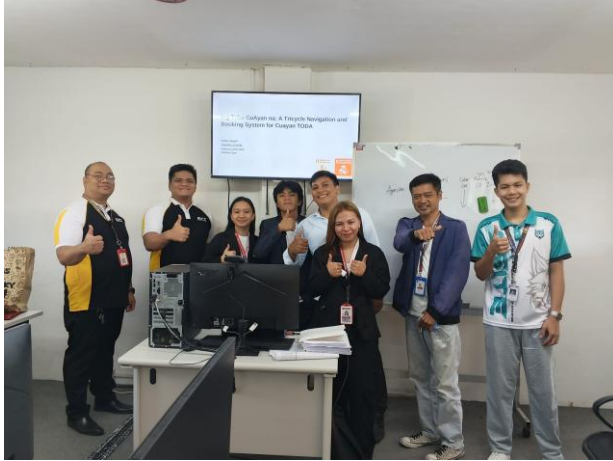












Group 10. AloHOA: A Web-Based Homeowners Association Management System for Xevera Subdivision, Mabalacat City.









Group 14. I-TUNGKOD: A Smart Assistive Cane with Ultrasonic Proximity Sensing, GPS tracking, and Emergency Communication Features

INTRODUCTION

- The Health Problems Encountered by Senior.
- Older adults have vision problems and over one-third have hearing difficulties, impacting their independence (WHO, 2021).
- Limited access to assistive devices is a global issue (WHO, 2021)
- Need for smarter, technology-assisted mobility solutions
- Solution: I-TUNGKOD: Smart Cane System
- Ultrasonic obstacle detection for safer navigation and GPS tracking for real-time location monitoring

BACKGROUND OF THE STUDY

- Modern technology enables smarter assistive mobility devices
- Smartphone adoption strengthens mobile-connected health solutions
- Gap exists in accessible, intelligent mobility aids
- Need for smarter, technology-assisted mobility solutions and real-time monitoring and emergency response tools

SUSTAINABLE DEVELOPMENT GOALS (SDGs)

- SDG 3: Good Health and Well-being
 - Focuses on reducing health risks, preventing injuries, and improving quality of life.
- SDG 9: Industry, Innovation, and Infrastructure
 - Encourages the creation of inclusive, accessible, and resilient solutions.
- SDG 4: Quality Education
 - Supports skills development, research, and technological literacy.

OBJECTIVES OF THE STUDY

ENHANCE MOBILITY, SAFETY, AND INDEPENDENCE FOR ELDERLY AND VISUALLY IMPAIRED USERS IN THE PHILIPPINES

SPECIFIC OBJECTIVE

- To gather information through internet and library research, interviews, academic journals, government sites, and publish news articles.
- To identify hardware and software developmental requirements
- To design the system using diagrams and analysis tools.
- To create a microcontroller-based IoT Smart Cane prototype
- To connect to a mobile phone

SCOPE & LIMITATION

SCOPE

- Designed for elderly and visually impaired users
- Detects obstacles using ultrasonic sensors
- Tracks real-time location via GPS
- Provides simple user interface for easy adoption
- Focused on improving safety, independence, and mobility

LIMITATION

- Water detection should be manually dry
- Slow GPS connection
- Hinders recognition to poorly lit/dark areas
- Camera false object recognition
- SMS sending might be slow

SIGNIFICANCE OF THE STUDY

Global Context	Societal Context
-Enhance safety and independence of elderly populations worldwide	-Support independence, social inclusion, and family/caregiver connections
Economic Context	Academic and Research Context
-Reduce healthcare costs and create opportunities in the assistive technology market	-Advance knowledge in smart assistive technology and user-centered design
Environmental Context	
-Promote energy efficiency, durability, and reduce electronic waste	

DEVELOPMENT MODELS AND METHODOLOGIES

- Software Development Life Cycle (SDLC)
- Modified Waterfall Model

CHAPTER 4
RESULT AND DISCUSSION

- Displays the results obtained from the developed system.
- Emphasizes the evaluation outcomes and the overall effectiveness of the system.
- Provides analysis using the ISO 25010 software quality standards as the basis for assessment.

OVERALL TEST RESULT

ISO 25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.36	Very great extent
Compatibility	4.47	Very great extent
Usability	4.25	Very great extent
Portability	4.21	Very great extent
Overall Mean Score	4.32	Very great extent

ALPHA TEST RESULT

ISO 25010 Criteria	Mean Score	Verbal Interpretation
Functional Suitability	4.34	Very great extent
Compatibility	4.3	Very great extent
Usability	4.2	Very great extent
Portability	4.32	Very great extent
Overall Mean Score	4.29	Very great extent

BETA TESTING:

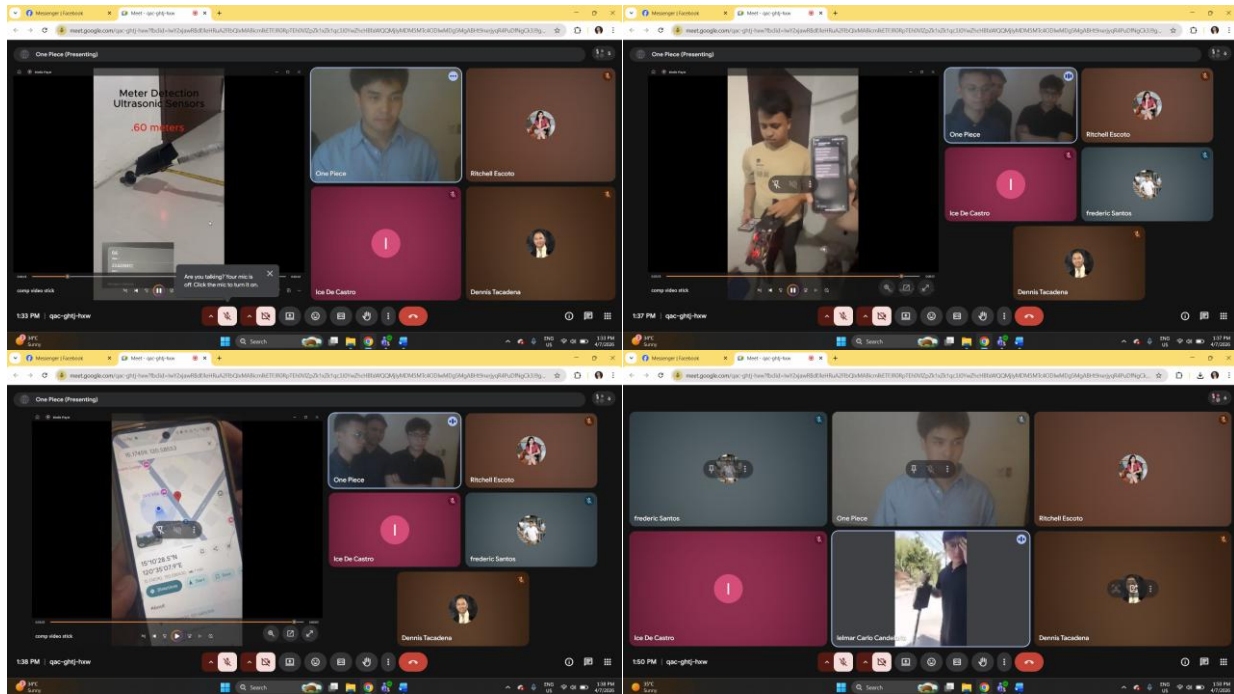
ALPHA TESTING

ALPHA TESTER: NALU ANH L A, IT INSTRUCTOR, MASTERS IN IT, SENIOR HIGH SCHOOL OIC ASSISTANT IN SYSTEMS PLUS COLLEGE FOUNDATION

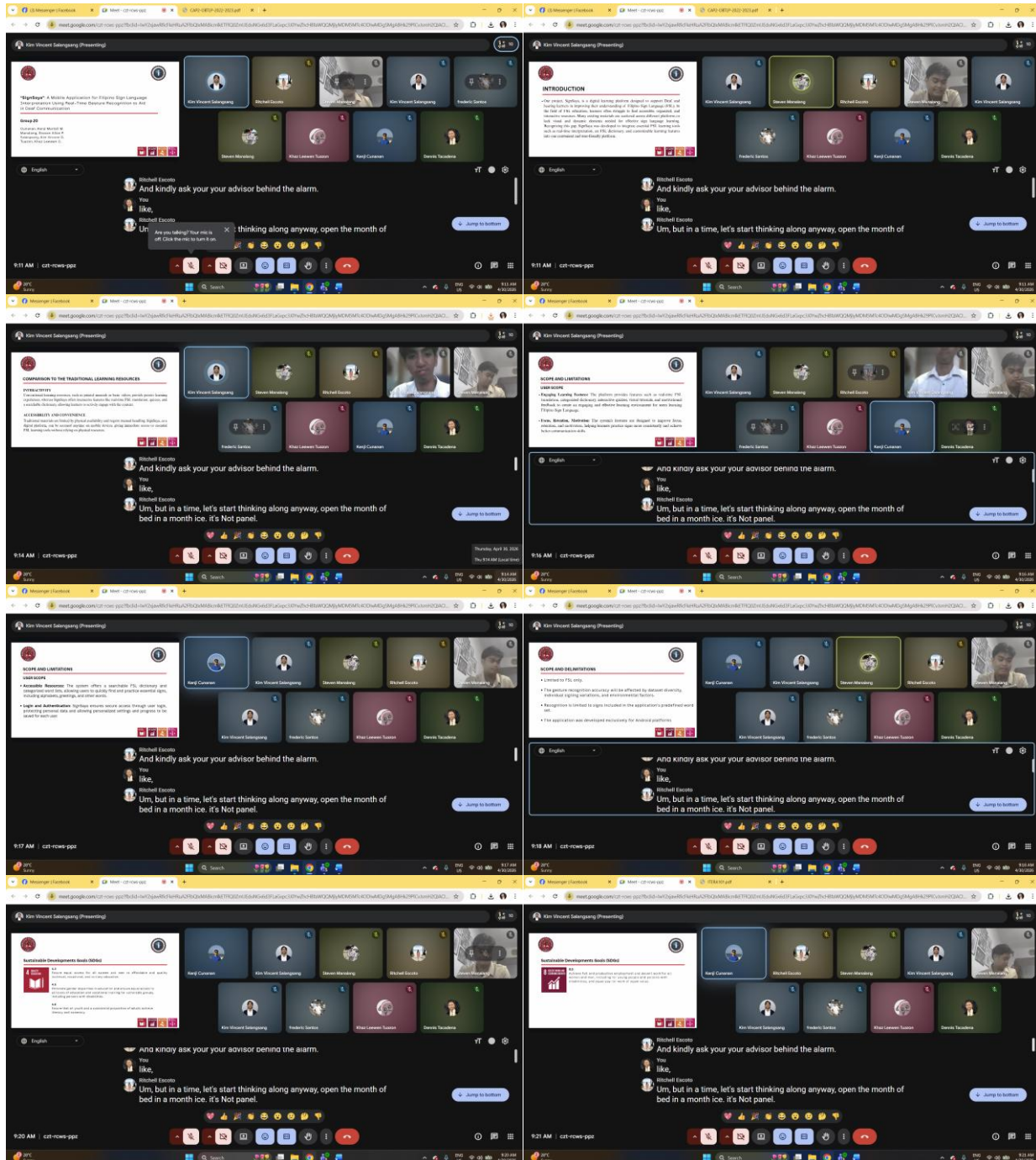
ALPHA TESTER: NUGUID, CRISTIAN JOSH (IT INSTRUCTOR IN SYSTEM PLUS COLLEGE FOUNDATION)

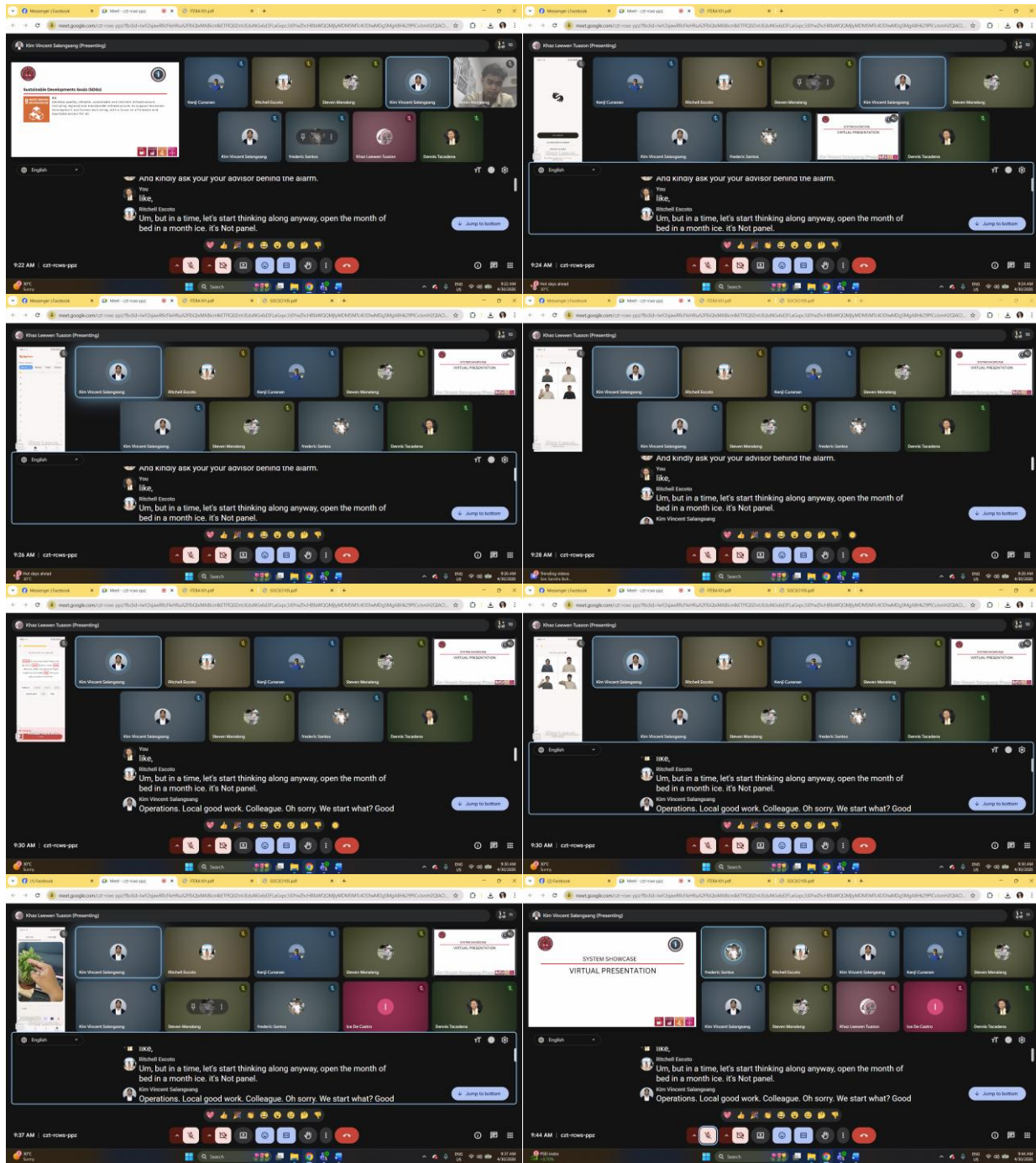
Meter Detection Ultrasonic Sensors

20 Meters



Group 20. SignSaya: A Mobile Application for Filipino Sign Language Interpretation using Real-Time Gesture Recognition to Aid in Deaf Communication.





Research Poster



ALOHOA

A Web-Based Homeowners Association Management System for Xevera Subdivision, Mabalacat City




ABSTRACT

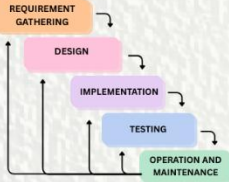
This study presents the development of AloHOA, a web-based Homeowners Association Management System designed to streamline administrative processes, enhance security, and improve resident engagement for Xevera Subdivision, Mabalacat City. The system features amenity booking, online payment integration via Xendit gateway, incident reporting, chat support, Two-Factor Authentication (2FA), and Role-based Access Control (RBAC). It also provides a dedicated module for homeowners and tenants to manage monthly rents and process move-out clearances. Developed using the modified Waterfall Model of the Software Development Life Cycle (SDLC), the system was built with the VILT stack, comprising Vue.js v3, Inertia.js v1, Laravel v10, and Tailwind CSS v3. The system underwent rigorous evaluation based on ISO 25010 standards, assessing Functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility. Alpha testing yielded an overall mean score of 4.77, while beta testing demonstrated improvement with a mean score of 4.78, both categorized as "Excellent." The developed system aligns with Sustainable Development Goals (SDGs) 4 (Quality Education), 9 (Industry, Innovation, and Infrastructure), and 11 (Sustainable Cities and Communities).

OBJECTIVES

1. To gather relevant literature and data on existing HOA management systems
2. To identify hardware and software requirements for development
3. To design software using various analysis diagrams
4. To develop the HOA Management System with key features including Role-Based Access Control (RBAC), Two-Factor Authentication (2FA), amenity booking, Xendit online payment integration, real-time chat support, and an incident reporting module.
5. To test the system through Alpha and Beta testing tools.
6. To Evaluate the system's performance based on ISO25010 standards
7. To deploy the system on a PLDT bare-metal server

METHODOLOGY

The research employed the Modified Waterfall Model, a structured yet flexible approach that facilitated iterative refinements at each development stage. This approach ensured adaptability to user feedback and addressed challenges effectively.



REQUIREMENT GATHERING

The requirements gathering phase established hardware specifications including an Intel Core i5-13th generation desktop with 16GB RAM and 500GB SSD, alongside software tools such as Visual Studio Code for development. The technology stack comprised Vue.js v3, Laravel v10, Inertia.js v1, and Tailwind CSS v3 for frontend and backend development, with PHP 8.3 and MySQL v8 handling server-side operations and data management. Supporting tools included Laravel for local development, Node.js for dependency management, Canva for design, Miro for planning, and Git for version control, creating a comprehensive development environment for the AloHOA system.

DESIGN

The system design utilized Storyboards, Use Case Diagrams, Data Flow Diagrams, ERDs, and Gantt Charts to visualize user interfaces, functionality, and workflows while ensuring alignment with user needs and effective project management. The AloHOA system processes community management inputs, including resident needs analysis, payment tracking, and security protocols, through iterative development phases that incorporate features like resident registration, online payments, amenity booking, incident reporting, and real-time communication. The architecture consists of a secure database managing resident information, payments, bookings, and incidents, paired with an intuitive user interface that enables seamless access to services and efficient community operations management.

IMPLEMENTATION

The development and deployment of the Web-Based Homeowners Association Management System for Xevera Subdivision has been completed and approved by the capstone adviser, technical adviser, alpha and beta testers, and the panel of reviewers. The researchers integrated Xendit as the primary payment processor to enable residents to pay association dues through multiple channels including E-Wallets (GCash, GrabPay, PayMaya), bank transfers, and credit/debit cards, while utilizing VueJS and InertiaJS for dynamic client-side interactions, Laravel for server-side operations, and Tailwind CSS for responsive interface design. The platform was deployed on a web hosting service with the domain <https://www.xevera-hoa.online>, with comprehensive testing performed to ensure all functionalities such as resident registration, integrated billing, secure admin dashboard, and notifications work seamlessly.

TESTING

The AloHOA: A Web-Based Homeowners Association Management System for Xevera Subdivision, Mabalacat City underwent a comprehensive testing phase using a quantitative descriptive research method anchored on the ISO 25010 Software Product Quality Standard. Alpha testing involved three IT experts who identified bugs and areas for improvement, while beta testing engaged 30 participants consisting of 5 HOA staff and 25 residents to evaluate system functionality and usability. The quantitative evaluation employed structured questionnaires based on ISO 25010 criteria, including Functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility, with statistical analysis of numerical data to objectively assess the system's quality and performance.

OPERATION & MAINTENANCE

After the approval and deployment of ALOHOA: The Web-Based Homeowners Association Management System for Xevera Subdivision, the operation and maintenance phase were initiated. The system was successfully implemented on the PLDT Vitro bare-metal Linux-based server and made accessible through its designated domain. During this phase, the researchers continuously monitored system performance, user activity, and feedback from residents and HOA administrators to ensure the system's reliability, stability, and effectiveness. Regular maintenance procedures such as system monitoring, performance checks, bug fixing, and software updates were conducted to address issues and enhance functionality.

RESULTS

The AloHOA platform was evaluated during alpha testing by three IT experts and beta testing by 30 participants consisting of 5 HOA staff and 25 residents, using ISO 25010 software quality standards focusing on Functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility. Alpha testing achieved an overall mean score of 4.77 interpreted as "Excellent," with Functional Suitability scoring highest at 4.85, while beta testing showed improvements with an overall mean score of 4.78, with Security receiving the highest score of 4.85. All evaluated criteria achieved "Excellent" ratings across both testing phases, confirming the system's effectiveness in meeting user needs, robust security, seamless compatibility, and readiness for deployment. The beta test results demonstrated the platform's significant improvements since alpha testing, with enhanced usability and adaptability that effectively meet ISO 25010 standards and user expectations.

DISCUSSION

The development of AloHOA: A Web-Based Homeowners Association Management System for Xevera Subdivision addressed manual system limitations by providing a comprehensive, user-centered platform. Research with residents, HOA staff, and administrators shaped features meeting specific operational needs. The study concluded AloHOA delivers a secure environment through Two-Factor Authentication, Role-Based Access Control, amenity booking, incident reporting with geolocation, real-time chat, and Xendit payment processing. The platform emphasizes ease of use, benefiting residents through convenient services while providing administrators efficient resident management, payment tracking, monitoring, and incident tracking capabilities. Future enhancements include native mobile applications for iOS and Android, expanded payment options including cryptocurrency, and RFID system integration for automated vehicle identification and entry point synchronization.

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4
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EDUCATION

9
INDUSTRY INNOVATION
AND INFRASTRUCTURE

11
SUSTAINABLE CITIES
AND COMMUNITIES

264



ARBORWATCH:

A WEB-BASED MAPPING AND MONITORING SYSTEM FOR CONSERVATION OF TREES IN MABALACAT CITY



Authors


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Urban forest management has grown more critical as climate change and urban heat island effects threaten both human well-being and the ecological health of green spaces. In Mabalacat City, the absence of an effective digital tool has limited the capacity of the City Environment and Natural Resources Office (CENRO) to fully implement conservation efforts.

Objectives of the Study

1. The general objective of this study is to design and develop a user-friendly and efficient system "ArborWatch: A Web-Based Mapping and Monitoring System for Conservation of Trees in Mabalacat City".
2. To gather scholarly published literature on monitoring and conserving of trees that will help establish the system point and provide backup information.

Abstract

In Mabalacat City, the absence of an effective digital tool has limited the capacity of the City Environment and Natural Resources Office (CENRO) to fully implement conservation efforts. This study introduces ArborWatch, a web-based system developed to digitize and streamline tree conservation and record-keeping. ArborWatch enables CENRO to maintain accurate tree records and visualize them on an interactive map – bridging the gap between traditional monitoring and modern digital management. Built using back-end technologies (TypeScript, JavaScript, Firebase) and a front-end powered by Tailwind CSS and Vite.js, the system delivers a user-friendly interface and robust database management. Testing results yield high user satisfaction: 4.32 in alpha testing and 4.47 in beta testing, reflecting its reliability, usability, and security. By aligning with the Sustainable Development Goals (SDGs), ArborWatch promotes sustainability, supports climate action, enhances terrestrial ecosystems, and strengthens community engagement in environmental planning.

Development

During the development phase, the researchers used field tools and mobile apps for accurate data collection, while the system itself was built using React.js, TypeScript, Vite, Tailwind CSS, Wouter, Recharts, and Firebase. React-Leaflet enabled interactive mapping, and Git/GitHub, VS Code, and Vercel supported development and deployment. These tools and technologies allowed the team to create a functional, user-friendly platform with features like tree maps, filters, dashboards, announcements, and report generation.

Methodology

The research employed the Modified Waterfall Model to develop ArborWatch: A Web-Based Mapping and Monitoring System for Conservation of Trees in Mabalacat City.

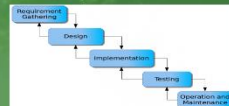


Figure 1: The Modified Waterfall Model

Design

The system design phase, the researchers used tools such as storyboards, Use Case Diagrams, ERDs, DFDs, and a Gantt Chart to visualize interactions, define requirements, map data structures, and track development progress. These tools streamlined planning and ensured a clear, organized, and user-centered approach to building ArborWatch.

Requirements Gathering

The Requirement Gathering process for ArborWatch involved brainstorming, community interviews, and literature reviews, with feedback from CENRO staff, Biology students, and web developers helping refine system features and usability. The team identified key hardware (Intel i7, 16GB RAM, Windows 11 Pro) and development tools (VS Code, Vite, Canva, Git/GitHub, Vercel) needed for efficient coding and deployment. These resources ensured stable performance and a smooth development workflow.

Maintenance

Regular maintenance protocols ensured ArborWatch's reliability, with continuous monitoring of system performance, user interactions, and accessibility. User and admin feedback guided updates and enhancements, keeping the system stable, functional, and effective for tree conservation in Mabalacat City.

Testing

After development, ArborWatch underwent alpha and beta testing using ISO/IEC 25010-based questionnaires, with feedback from IT experts, CENRO personnel, Biology students, and general users. The results, analyzed through descriptive statistics and Likert scales, highlighted system strengths, user satisfaction, and areas for improvement, ensuring a reliable and user-centered platform.

Deployment

The ArborWatch system was deployed on a secure server with full access granted to CENRO for real-time tree mapping and monitoring. Public beta testing with administrators, students, and community users provided feedback that helped refine system features before official use.

Results and Outcomes

This results presents the key findings of ArborWatch, showing its effectiveness in supporting CENRO's tree monitoring and conservation efforts. Alpha and beta testing revealed high performance across usability, functionality, compatibility, reliability, and security, while features like interactive mapping, data management, and reporting tools enhanced tree tracking and community engagement.

Data & Gathering Requirements

The requirement gathering for ArborWatch involved brainstorming, interviews, and literature review to identify essential features and confirm the system's need in Mabalacat City. Input from CENRO personnel, Biology students, and web developers refined key functions, while hardware and software requirements were defined to ensure an efficient and reliable tree monitoring platform.

Test Results

Alpha and beta testing results based on ISO 25010 show notable improvements across categories: Functional Suitability rose from 4.29 to 4.41, Performance Efficiency from 3.93 to 4.51, and Security from 4.47 to 4.59, while Compatibility (4.42→4.48), Usability (4.40→4.42), and Reliability (4.39→4.39) remained consistently high. These gains reflect enhancements in loading speed, feature responsiveness, and data protection. Overall, the system's mean score increased from 4.32 in Alpha to 4.47 in Beta, demonstrating a more refined, efficient, and reliable platform.

Conclusion

ArborWatch provided CENRO with a user-centered platform for efficient tree monitoring, integrating interactive mapping, data management, reporting, and citizen feedback. Evaluation showed improved accessibility, usability, and compatibility, demonstrating its effectiveness in supporting tree conservation and community engagement.

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AXLESYS: A WEB-BASED AUTOMOTIVE SERVICE AND TIRE SALES MANAGEMENT SYSTEM



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ABSTRACT

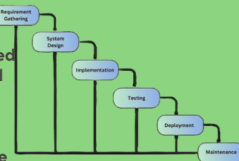
This study describes the development and implementation of AxleSys, a web-based appointment and management system designed to address inefficiencies in the manual operations of Axle Tires and Services. The traditional reliance on phone calls and walk-in scheduling led to overlapping appointments, extended waiting times, data loss, and poor tracking of service histories. To resolve these issues, the system was developed using the Modified Waterfall Model and incorporates modules for online appointment booking, automated reminders, inventory and sales management, service monitoring, administrative dashboards, and report generation. The results indicate that AxleSys significantly reduces scheduling errors, improves customer satisfaction, and streamlines administrative workflows, thereby enhancing overall operational efficiency. The study concludes that digitizing service management processes through a scalable and modular system offers a practical and sustainable solution for modernizing small to medium-sized automotive service businesses.

REQUIREMENTS GATHERING

The requirement gathering process for AxleSys was conducted collaboratively to ensure alignment with the operational needs of Axle Tire and Service Center. The researchers identified core system features through internal discussions and gained deeper insights into existing scheduling problems such as overlapping appointments, long waiting times, and the absence of centralized workload tracking through informal interviews with staff and management. To strengthen the system design, the team analyzed related web-based appointment systems and reviewed academic literature on service automation and digital transformation. Overall, this combined approach of stakeholder consultation and literature review provided a solid foundation for developing a functional, efficient, and industry-aligned automotive service scheduling system.

METHODOLOGY

The study used the Modified Waterfall Model to provide a structured yet flexible development process, covering all SDLC phases from requirements gathering to maintenance. Operational issues in the manual scheduling system were identified through consultations with Axle Tire and Service Center personnel and resolved through proper system design and implementation. Supporting diagrams clarified system processes, leading to the successful development of AxleSys as a reliable and user-friendly web-based appointment scheduling system.



TESTING

AxleSys underwent comprehensive evaluation through Alpha and Beta testing to verify system readiness and performance. Alpha testing, conducted by three external IT experts, focused on usability, interface clarity, stability, and security. Issues such as misaligned layouts, incorrect appointment behaviors, and form validation errors were identified and resolved through multiple test cycles. Evaluation based on ISO 25010 criteria confirmed functional suitability, interaction capability, reliability, and security, demonstrating that core modules—including real-time scheduling, service management, inventory tracking, and reporting—functioned accurately and consistently. Beta testing was conducted at Axle Tires and Services with staff and administrative personnel to assess real-world usability. Thirty participants completed tasks including appointment scheduling, service monitoring, inventory management, and sales recording, evaluating system responsiveness, stability, and effectiveness on both desktop and mobile devices. Feedback and observations confirmed that AxleSys accurately supports operational workflows, maintains high reliability, and delivers a user-friendly interface. Overall, the testing results validated AxleSys as a secure, efficient, and functional web-based appointment and management system.

CONCLUSION

AxleSys successfully addressed the operational challenges of manual scheduling at Axle Tire and Service Center by providing a user-friendly, functional, and efficient web-based system. Developed using the Modified Waterfall Model, the system integrates core modules for appointment scheduling, service tracking, inventory management, and sales monitoring. Alpha and beta testing confirmed that AxleSys minimizes scheduling conflicts, reduces customer waiting times, and enhances administrative efficiency, meeting its intended purpose of optimizing automotive service workflows. Evaluated against ISO 25010 criteria, the system demonstrated functional suitability, usability, reliability, and security, delivering accurate outputs, stable performance, intuitive interfaces, and secure access controls. Its modular and scalable design allows future enhancements such as SMS notifications, advanced analytics, and additional service features. Overall, AxleSys exemplifies how digitizing appointment and service processes can improve operational efficiency, accuracy, and customer satisfaction, establishing it as a secure, sustainable, and effective solution for modernizing small to medium-sized automotive service businesses.

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OBJECTIVE

- < The study aims to develop and implement an appointment and management system for Axle Tires and Services using a structured and systematic approach.
- < It seeks to gather relevant information and best practices through interviews with car owners and shop owners, reviews of textbooks and reference materials, analysis of related systems, and examination of previous research on appointment management systems.
- < The study identifies the required hardware and software specifications, including the use of desktop or laptop computers and mobile devices, as well as development and testing tools such as Visual Studio Code, MySQL, XAMPP, Canva, and Google Chrome.
- < It aims to design the system using standard system analysis and modeling tools, including system flowcharts, storyboards, Gantt charts, and use case diagrams.
- < The system development focuses on integrating key features such as web-based appointment booking, check-in functionality, automated reminders, appointment cancellation, accessibility features, and mobile responsiveness.
- < The study includes system testing through alpha testing for internal functionality and bug detection, and beta testing involving staff and customers to evaluate usability and performance.
- < Finally, the study aims to deploy the system through a pilot implementation followed by full deployment to ensure smooth integration into daily operations and effective real-world use.

DESIGN

During the design phase, the researchers employed structured analysis tools to develop an efficient and user-friendly appointment scheduling system. The Context Diagram defined the system boundaries and interactions with external users, while the Data Flow Diagram detailed internal data processes such as appointment handling, technician assignment, and service updates. The System Flowchart illustrated the step-by-step operational flow of the booking and service process. Collectively, these design tools enabled the researchers to clearly define system behavior, reduce potential inefficiencies, and ensure that AxleSys would provide a streamlined and intuitive user experience upon deployment.

IMPLEMENTATION

During the implementation phase, AxleSys was developed using integrated front-end and back-end technologies to ensure functionality, responsiveness, and alignment with the operational requirements of Axle Tire and Service Center. Visual Studio Code and XAMPP supported system development and local testing, while MySQL managed appointment and service-related data. The front-end was built using web technologies to provide a user-friendly and mobile-responsive interface, while back-end processes handled appointment management, technician tracking, authentication, and system logic. Continuous debugging and testing ensured reliable system performance, and administrative tools were incorporated to support reporting and service monitoring. Overall, this phase focused on delivering a secure, efficient, and user-centered web-based appointment management system.

RESULTS

AxleSys underwent a comprehensive evaluation through internal Alpha Testing and real-user Beta Testing at Axle Tires and Services. These tests verified the system's readiness for deployment. The public appointment module at axletsc.com and the admin dashboard were tested to confirm that all functions met the project's requirements. Testing confirmed that AxleSys reliably prevented duplicate bookings, accurately updated service status, and correctly generated reports. Issues detected during alpha testing were resolved, and beta testing concluded with high acceptance ratings.



CrimeTrack

A Web-Based Case Information Management System for Mabalacat City Police Station



ABSTRACT

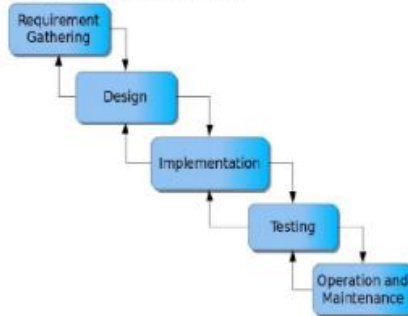
CrimeTrack: A Web-Based Case Information Management System for Mabalacat City Police Station was developed to enhance the efficiency of crime reporting, incident monitoring, record management, and information dissemination. The system was designed to assist both Philippine National Police (PNP) personnel and the citizens of Mabalacat City by providing a centralized platform for managing crime and incident-related information. It addresses the challenges of delayed reporting, manual record-keeping, limited public awareness, and difficulties in accessing accurate public safety information. The system aims to strengthen the relationship between law enforcement authorities and the community by promoting transparency, accessibility, and efficient communication. Through its web-based platform, users can submit incident and blotter reports, monitor case status, view crime-related information, and access public safety resources. These features facilitate faster data collection, improve coordination between citizens and police officers, and support timely responses to incidents. Furthermore, CrimeTrack utilizes a centralized database that enables the secure storage, retrieval, and management of crime and incident records. The system supports the analysis of crime patterns and trends, assisting the PNP in making informed decisions for crime prevention and public safety strategies. Overall, the implementation of CrimeTrack enhances operational efficiency, improves information accessibility, and contributes to building a safer and more informed community in Mabalacat City through the effective use of web-based technology.

OBJECTIVES

1. To gather and analyze relevant literature, studies, and related systems concerning crime reporting, incident management, blotter records, and case tracking to support the development of CrimeTrack.
2. To identify the hardware and software requirements needed for system development, ensuring compatibility, security, and efficient performance across devices such as desktop, laptop, and smartphone.
3. To design the system architecture, database structure, and user interface (UI/UX) using appropriate tools such as storyboard, use case diagram, data flow diagram (DFD), entity relationship diagram (ERD), and Gantt chart.
4. To develop a web-based CrimeTrack system that allows authorized PNP personnel to manage crime reports, incident records, blotter entries, and case information in a centralized platform.
5. To implement secure authentication and user verification to ensure that only authorized users can access and submit sensitive reports such as blotter and incident reports, along with efficient search and case tracking features.
6. To test and evaluate the system using ISO/IEC 25010 standards and a research-made survey tool to assess its functionality, usability, reliability, security, and overall performance.
7. To deploy the system using a web hosting platform called Hostinger, allowing the system domain called "pnpmabalacat.online" accessibility anytime and anywhere with an internet connection.

METHODOLOGY

The researchers adopted the Modified Waterfall Model as the Software Development Life Cycle (SDLC) methodology in developing the system due to its structured and sequential approach, which ensures that each phase is completed before moving to the next. This SDLC framework guided the entire development process, including requirements gathering, system design, implementation, testing, deployment, and maintenance.



Results and Discussion

This chapter presents the results and findings of the study, including the detailed processes involved in the development, implementation, testing, and deployment of the project. It further explains how the researchers were able to achieve the objectives of the study through the application of appropriate methodologies, system design, and evaluation procedures. Additionally, this chapter discusses the outcomes gathered from the testing phases, the performance of the developed system, and the effectiveness of the CrimeTrack in addressing the identified problems and needs of the Philippine National Police (PNP) in Mabalacat City.

Sustainable Development Goal

This project also aligns with the United Nations Sustainable Development Goals (SDGs), particularly Goal 16: Peace, Justice, and Strong Institutions, aiming to promote just, peaceful, and inclusive societies by providing access to justice for all and building effective, accountable, and inclusive institutions at all levels.



Requirement Gathering

During the first stage, the project's vision and scope are established. The team works together with stakeholders to detail project objectives, recognize possible obstacles, and establish overall goals. Thorough planning is conducted at the start of each sprint, where the team divides the project into smaller, more manageable tasks and develops a prioritized backlog. Tasks are allocated according to their priority and complexity.

Implementation and Development

The system includes an admin dashboard that allows authorized personnel to manage crime and incident records, monitor case statuses, verify user accounts, and generate reports efficiently. The platform is also designed to be responsive and accessible on both desktop and mobile browsers to improve usability and accessibility for users. Furthermore, the system provides authorized PNP personnel with the capability to review submitted incident reports, monitor ongoing cases, and analyze crime-related data through graphical summaries and searchable records. During the development phase, the web-based application was built according to the planned design specifications. The developers implemented the core system features, including crime and incident reporting, blotter record management, user authentication, real-time case tracking, and data retrieval functionalities. Search and filtering features were also integrated to allow quick access to specific records such as case number, type of crime, 47 Institute of Business and Computing, Education CrimeTrack MABALACAT CITY COLLEGE persons involved, location, and case status. Additionally, graphical charts and statistical summaries were developed to support crime trend analysis and improve decision-making processes. The development phase followed industry-standard practices to ensure system maintainability, scalability, security, and performance optimization. Development tools such as XAMPP were utilized to provide a local server environment for PHP and MySQL development, while Visual Studio Code served as the primary code editor for coding and debugging. GitHub was used for version control and project collaboration, and Hostinger served as the web hosting platform for deployment and testing. These technologies contributed to the smooth development, testing, and implementation of the system.

Implementation and Development

During this phase, the researchers tested and refined the Web-Based Crime and Incident Information Management System based on the feedback and recommendations provided by the capstone panel, technical advisers, alpha testers, and beta testers. The primary objective of this phase was to ensure that the system functioned according to the defined specifications and to apply necessary improvements to enhance the system's functionality, usability, reliability, and overall performance. To ensure a comprehensive evaluation, the researchers conducted both alpha and beta testing using survey questionnaires aligned with the ISO/IEC 25010 Software Product Quality Standard. The system was evaluated based on the following quality characteristics: Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability. This standardized framework served as a guide in identifying system defects, evaluating performance, and measuring user satisfaction.

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EMURGENTRACK:

A Web and Mobile-Based Community Emergency System for the CDRRMO of Mabalacat City

ABSTRACT

This study presents EmurgenTrack, a web and mobile-based emergency reporting and response system developed for the City Disaster Risk Reduction and Management Office (CDRRMO) of Mabalacat City. The system addresses challenges caused by manual documentation and fragmented reporting channels by providing a centralized platform for incident reporting, real-time coordination, and information dissemination. Developed using the Modified Waterfall Model and implemented with React, React Native, Firebase, and Google Maps, the system underwent alpha and beta testing with residents, responders, and IT experts. Evaluation based on ISO 25010 standards yielded high ratings in functionality, usability, security, performance, and overall user experience, demonstrating EmurgenTrack's effectiveness in improving emergency response efficiency and community preparedness in Mabalacat City.

METHODOLOGY

The study employed the Software Development Life Cycle (SDLC) using the Modified Waterfall Model, which was suited for the structured development of EmurgenTrack. The model supported clear documentation, stakeholder collaboration, and phased deliverables through sequential stages including requirement gathering, design, implementation, testing, and operation and maintenance. This approach ensured a systematic development process while effectively meeting the operational needs of the Mabalacat City CDRRMO.

TESTING

The system underwent unit, integration, system, alpha, and beta testing to ensure functionality, reliability, and usability. Testing involved IT experts, residents, and emergency responders and evaluated system performance under real-world conditions, including varying devices, environments, and network connectivity.

DEPLOYMENT

Following deployment, EmurgenTrack entered the operational and maintenance phase. Continuous monitoring, user feedback, routine updates, and security measures were implemented to maintain system performance, reliability, and alignment with the evolving emergency response and disaster preparedness needs of Mabalacat City.

CONCLUSION

EmurgenTrack provides a reliable and centralized platform for managing community emergencies in Mabalacat City by integrating real-time incident reporting, responder coordination, and administrative monitoring, enabling faster and more organized disaster response through the City Disaster Risk Reduction and Management Office (CDRRMO). The system enhances community participation by empowering residents to report emergencies using GPS-based locations, photos, and videos, ensuring timely and accurate communication for rapid emergency response. It also improves coordination and operational efficiency among responders and administrators through real-time tracking, map-based navigation, resource monitoring, and a centralized dashboard that supports efficient incident management and informed decision-making. Built using secure and scalable technologies such as Firebase, React, and React Native, EmurgenTrack ensures secure authentication, real-time data synchronization, and adaptability for future system enhancements and integration with other government platforms. Overall, the system supports the development of sustainable and resilient communities by strengthening emergency preparedness, coordination, and public awareness in alignment with key Sustainable Development Goals in Mabalacat City.

OBJECTIVES

1. To conduct requirement gathering through interviews, document analysis, and review of related literature and systems with CDRRMO personnel and community representatives.
2. To identify and specify the software and hardware requirements necessary for the development and implementation of the EmurgenTrack system.
3. To design the EmurgenTrack system using storyboards, wireframes, use-case diagrams, and data flow diagrams to ensure usability, functionality, and accessibility.
4. To develop the system with core features for incident reporting, real-time alerts, incident management, responder coordination, and resource monitoring.
5. To test and evaluate the system using ISO 25010 standards to ensure compliance with international software quality requirements.
6. To deploy the EmurgenTrack system within the Mabalacat City CDRRMO and the local community.

REQUIREMENT GATHERING

Requirement gathering involved interviews, observations, and consultations with CDRRMO personnel and selected community members. This phase identified the functional and non-functional requirements of EmurgenTrack, including emergency reporting, real-time data synchronization, notifications, analytics, and supporting hardware and software needs, ensuring alignment with CDRRMO operations and user expectations.

DESIGN

The design phase utilized visual and analytical tools such as storyboards, wireframes, use case diagrams, entity relationship diagrams (ERD), data flow diagrams (DFD), flowcharts, and Gantt charts. These tools were used to define system architecture, functionality, and user interaction while ensuring usability and alignment with the needs of the CDRRMO and the community.

IMPLEMENTATION

EmurgenTrack was implemented using modern web and mobile technologies, including React, React Native, Firebase, and Google Maps. The system supported real-time incident reporting, location tracking, alerts, map-based visualization, analytics, and cross-platform accessibility. Deployment was carried out through Vercel, with the mobile application published on the Google Play Store.

RESULTS

The study focused on the development of EmurgenTrack, a web and mobile-based community emergency system for the City Disaster Risk Reduction and Management Office (CDRRMO) of Mabalacat City, aimed at improving communication, coordination, and response efficiency during emergencies. The findings identified existing emergency reporting and management practices used by residents and the CDRRMO, as well as the challenges associated with these methods, which informed the design of a centralized emergency system. Insights gathered from residents and CDRRMO personnel guided the identification of system features that support faster response times, real-time coordination, and improved accessibility for administrators, responders, and the community.

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Abstract: Online management systems with Biometric Scanner Lockdown Services for Roorpeth Fitness Gym addresses operational inefficiencies and security issues commonly encountered in fitness facilities, particularly problems related to lock misuse, lost keys, forgotten PINs, and unauthorised access. The system integrates an online gym management platform with an IoT-based biometric authentication system. The project aims to streamline gym operations, reduce administrative tasks, and enhance user experience. The system is designed to develop, design, and evaluate a prototype system capable of managing gym operations while providing secure locker access through fingerprint authentication. The Software Development Life Cycle (SDLC) using a modified waterfall model guides system development. Alpha and beta testing were conducted, and system performance was evaluated using ISO 25010 quality standards. Results indicated high levels of functional suitability, performance efficiency, and reliability. The system successfully streamlined administrative tasks, enhanced user experience, contributing to safer and more efficient gym operations while supporting Sustainable Development Goals related to health, innovation, and productivity.

Maintaining physical and mental well-being has become increasingly important in modern society, and gym plays a vital role in promoting healthy lifestyles. Regular physical activity reduces the risk of chronic illnesses and improves mental health by alleviating stress and anxiety. Gyms also serve as social centers that foster community and support. As the fitness industry continues to evolve, the integration of technology has become essential in improving operational efficiency and member satisfaction. Gym management systems automate processes such as membership tracking, scheduling, and billing, enabling gym owners to manage their operations more effectively. Additionally, these systems provide valuable insights into member behavior, allowing gym owners to tailor services and programs to better meet their needs. This paper explores the various applications of gym management systems, particularly regarding locker usage, which remains prevalent in many fitness facilities. Traditional locker systems, which rely on keys or PIN codes are prone to problems such as lost keys, forgotten combinations, and unauthorized access. These issues were observed at the Redtop Fitness Gym located along the Macao-Hong Kong Highway, where members frequently reported problems with lockers and improper locker usage. Ranging from simple lockers to smart lockers, this paper outlines the various types of locker systems and compares them with alternative biometric systems, only authorized users can access assigned lockers (Lockster, 2023). This study introduces FitSecure: Online Management System with Biometric Secure Locker Services for Redtop Fitness Gym. The project aims to integrate a web-based gym management system with a fingerprint-scanned locker solution to streamline locker management, enhance security, and improve member satisfaction. The system includes real-time monitoring, FitSecure seeks to enhance safety, efficiency, and overall user experience.

Requirements Gathering
Data were collected through interviews and observations involving gym members and staff of Roodlows Fitness Gym. The objective was to identify existing problems in locker usage, membership management, and administrative operations. Findings revealed frequent issues such as lost locker keys, forgotten PINs, manual record-keeping errors, and lack of centralized information dissemination.

System architecture and processes were illustrated using flowcharts, block diagrams, and circuit diagrams. The biometric locker component was designed using hardware components such as the ESP32 Dev Board, AS608 Fingerprint Sensor, LCD Display, Relay Module, jumper wires, and PCB. The online management system was structured into two interfaces: the admin panel and the user interface.

The system was developed using Visual Studio Code and Arduino IDE for programming, with MySQL as the database management system. The admin interface enables inventory and sales management, real-time activity monitoring, fingerprint registration, manual locker override, and announcement posting. The user interface provides features such as locker subscription, locker access, weight tracking, trainer information, and nutritional tips. Fingerprint authentication enables keyless locker access with a manual key backup for emergency use.

Alpha and beta testing were conducted to assess system functionality and reliability. Alpha testing involved IT experts evaluating system performance and security, while beta testing included selected gym users. The system was evaluated using ISO 25010 quality standards, focusing on functional suitability, usability, performance efficiency, compatibility, reliability, security, maintainability, and portability.

The thorough evaluation findings for the physical project and web@sis/Alpha and Beta tests, focusing on the relevant ISO 25010 standards, are displayed in the table and figure below. The table shows the results of the evaluation for each sample user and the Highest Rating from both alpha and beta test results, which actively demonstrate that the safeguard and compatibility in every type of device was absolutely great. L. Unifonted. Satisfaction (3.5) was the new because of its ease of use and the fact that it was the only one that was able to be used in the project (table 3.4.4), when it comes in interaction capability, user experience meets their expectation, having a wider and related project in their daily life they really help the user. On the other side, based on the test's findings, usability was the most important factor for the project, as it was the only one that was the project really liked it and very convenient in their lives. Nevertheless, the overall score indicated that this project could have the 5/5 itself with all the suggestions and feedback of every alpha and beta test. The vertical interpretation was also taken into account, the project's continuous 'improvements' and adherence to ISO 25010 standards.

To develop FitSecure: Online Management System with Biometric Secured Locker Services for a local fitness gym, enhancing accessibility, ensuring secure locker usage, streamlining staff management, providing real-time member monitoring to improve efficiency, security, and user convenience.

[illegible]

- The security: Data is Managed in a System with Network-Security: Local virus has been fixed. The system is protected by a virus scanner, a state-of-the-art, streamlined key operations, etc. enhanced user convenience through biometric authentication and automation. Measure demonstrated low total and variable costs.
- The business: The business has been able to address real-world challenges in "three facility management" (three enhancements may include: network application integration, support for full commercial deployment, and scalability for large "thin and fat" client base).
- The business: The business has been able to address real-world challenges in "three facility management" (three enhancements may include: network application integration, support for full commercial deployment, and scalability for large "thin and fat" client base).
- The business: The business has been able to address real-world challenges in "three facility management" (three enhancements may include: network application integration, support for full commercial deployment, and scalability for large "thin and fat" client base).

- **Admin** role: Manages users, their roles, activity logs, locker overviews, training registrations and, via email, sends out login hints and password resets
- **User** role: user can log in, edit profile, change password, select courses, view progress, manage info, and download tips

The prototype supports 20 to 40 sub-users with 10 to 15 sample users participating in a real-life use. Only four sub-users are real-life, leading to a limited use. First use case requires us to have three different roles, access to all data, and a few functions.

The study focuses on prototype development and assessment, not full commercial deployment. It was designed to be different or only used outdated technologies like HTML, static, recognition, or mobile apps, as well as a broader management toolset like .net, .joomla, or .php applications. Focuses focus emphasizes user access security, and locker management, as it is, finally, sample data does not reflect the entire user population.

- Society: encourages safer, organized, and healthier community fitness spaces.
- (Hebe: Context: Aiges with digital transformation and SDGs, demonstrating how smart, agile systems contribute to technological progress and sustainability.

The results demonstrate that integrating biometric security with an online gym management system effectively addresses common lock-related user and administrative issues. Fingerprint-based authentication eliminated problems associated with physical keys and PIN codes, while automated monitoring improved accessibility and fair lockout usage. The system aligns with Sustainable Development Goals, particularly SDG 3 (Good Health and Well-Being), by promoting a safe fitness environment, SDG 8 (Decent Work and Economic Growth) through operational efficiency, and SDG 9 (Industry, Innovation, and Infrastructure) via the adoption of modern digital technologies. Although the prototype was limited in scale, its performance confirms the feasibility of expanding the system for larger deployments.

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Green-Grain Hub
 A Microcontroller-Based Waste to Rice Dispenser







PROBLEM AND ITS SETTING

Intro

The Green-Grain Hub is a microcontroller-based Reverse Vending Machine (RVM) designed to promote recycling in Mabalacat City, Pampanga. Its unique feature is that it dispenses rice—a staple food—as an incentive for users who deposit empty plastic bottles and aluminum cans. Essentially, it operates as a "Waste to Rice Dispenser," directly linking environmental responsibility with food security.

Objectives of the Study

Design and Develop a microcontroller-based Reverse Vending Machine (RVM) that specifically processes plastic bottles and aluminum cans.	Implement a system that uses a rice dispenser as the unique incentive mechanism for deposited recyclable waste.	Evaluate the System's Functionality by testing the efficiency and effectiveness of the RVM's hardware and software components.
Determine the Acceptability of the Green-Grain Hub in terms of its usability, reliability, quality, and effectiveness as a community recycling tool.	Provide a sustainable solution to the problem of plastic and can waste disposal in Mabalacat City, Pampanga, while also contributing to food security (Zero Hunger).	Contribute to Sustainable Development Goals (SDGs 2 & 12). (This focuses on Zero Hunger and Responsible Consumption and Production).

METHODOLOGY AND DESIGN



The study followed a systematic approach, beginning with Requirement Gathering for components like the Arduino Uno, ESP32, and various sensors. The Design utilized a three-module architecture, while Development focused on physical fabrication and programming to dispense 100 grams of rice per 10 items. The system was then tested through Alpha and Beta phases to validate its functionality, efficiency, and usability based on ISO 25010 standards. Finally, the integrated prototype was deployed for real-world implementation.

SYSTEM FLOW AND LOGIC

The Green-Grain Hub system flow is a concise loop:

Item Drop: User inserts a plastic bottle or can.

Verification: Sensors check and validate the item's material type.

Count & Storage: The system registers the item and increments the counter.

Reward: At the threshold (10 items), rice (100g) is dispensed.

Monitoring (MIT App Inventor): The ESP32 sends real-time count and inventory data to the mobile application for administrator tracking.

SUMMARY OF FINDINGS

The study concludes that the Waste-to-Rice Dispenser (Green-Grain Hub) is an effective, functional, and user-friendly system. High ratings from Alpha and Beta testing (ISO 25010) confirm its reliability and successful achievement of objectives. It effectively promotes waste segregation and provides rice rewards, demonstrating a valuable dual impact by supporting both SDG 12 (Responsible Consumption) and SDG 2 (Zero Hunger). The system is deemed ready for wider implementation as a model for sustainable community development.

CONCLUSION





INTELLICODE: LEARNING TOOL & PERSONALIZED CODING ASSESSMENT

A Web-Based Learning Management System for Programming Education



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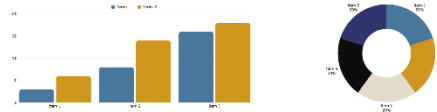
Iver Allen N. Vargas

Abstract

This study developed Intellicode, a web-based LMS designed to address fragmented learning experiences in programming education. Tailored for BSIT at Mabalacat City College, it integrates course delivery, coding practice, automated assessment, and digital credentialing. Features include a multi-language code editor, AI-powered code checker, secure exam environment, and automated certificates. Evaluated using ISO/IEC 25010, it achieved "Excellent" ratings in Alpha (M=4.82) and Beta (M=4.87) testing. Aligned with UN SDG 4 and SDG 9.

Objectives

- Gather requirements through literature review and interviews
- Identify hardware/software technologies for core features
- Design using VTOC, Storyboards, System Flow Charts, Use Case Diagrams
- Develop multi-user system for administrators, instructors, students
- Test functionality, security, and usability through unit and user trials
- Evaluate against ISO/IEC 25010 quality standards
- Deploy in pilot environment with training and support



Methodology



1

Intellicode was developed using the Prototyping Model of software development with iterative refinement until acceptable final product.



2

Requirements gathered through literature review and structured interviews with BSIT Dean, instructors, and IT students.



3

Development phases: requirements gathering, quick design, prototype building, user evaluation, prototype refinement, implementation and maintenance.



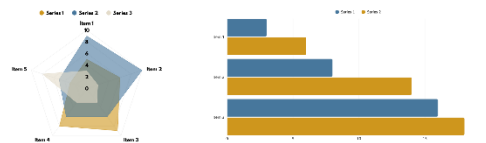
4

Implementation: TypeScript, Next.js, NestJS, Prisma, PostgreSQL via Supabase, Monaco Editor, Gemini AI.



5

Quality assurance through ISO/IEC 25010 evaluation with validation questionnaires and comprehensive testing protocols.



Results

Alpha Testing (M=4.82 Excellent):

- Functional Suitability: 4.88
- Interaction Capability: 4.81
- Security: 4.78
- Flexibility: 4.81

Beta Testing (M=4.87 Excellent):

- Functional Suitability: 4.89
- Interaction Capability: 4.84
- Security: 4.88
- Flexibility: 4.86

Improved scores reflect OTP verification and enhanced authentication.

System Features

- Multi-user system with role-based portals
- Embedded coding sandbox for hands-on practice
- AI-powered code checker for automated evaluation
- Secure browser mechanism for examinations
- Manual yet traceable certificate issuance
- Course management with modules and lessons
- OTP-secured authentication
- Real-time progress tracking
- Digital certificate generation

Conclusion

Intellicode effectively addresses gaps in programming education at Mabalacat City College by providing a unified, secure, and user-centered LMS. The system delivers strong functional performance, intuitive navigation, and reliable interaction quality. It aligns with UN SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure), advancing institutional innovation. The study confirms Intellicode as an effective, innovative, and reliable solution for enhancing IT education.



iPROTECH

Microcontroller-Based Location Tracking with Temperature Alarm And Monitoring User Interface For Construction Workers



MABALACAT CITY COLLEGE


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ABSTRACT

iProTech is an IoT-based smart hardhat and web monitoring dashboard designed to enhance construction-site safety through RFID time-in/out, SOS signaling, fall and impact detection, heat monitoring, and GPS tracking. Developed using a modified Waterfall SDLC, the system integrated ESP32-based sensors with a Firebase-backed Next.js dashboard, guided by design artifacts such as architecture diagrams, ERD, flowcharts, and storyboards.

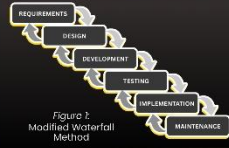
Evaluation included alpha testing with four IT experts and beta testing with thirty site participants, using ISO/IEC 25010-aligned criteria. Both phases achieved Excellent ratings (alpha mean 4.92; beta mean 4.80), with users noting rapid alerts, clear dashboard visibility, and stable device-cloud performance. Minor recommended refinements involved battery capacity, fall-threshold tuning, heat-status indicators, logging, and helmet weight.

Overall, iProTech provides a robust, user-centered, and field-ready safety solution that supports real-time monitoring and effective supervisory oversight on construction sites.

OBJECTIVES

- To gather information from existing users, related research articles, and previous capstone projects to evaluate how similar hardhat systems have performed.
- To identify the specific hardware components and software tools necessary for developing the system.
- To design the overall system, including diagrams that represent its structure and workflow.
- To construct and configure the ESP32 microcontroller for application development.
- To develop the system with the planned safety features such as GPS tracking, alerts, and monitoring functions.
- To test the system through developer testing followed by alpha and beta testing phases.
- To assess the performance of the system using the ISO 25010 quality standards.
- To deploy the finalized system in an actual or simulated construction site environment for pilot implementation, user orientation, and refinement based on real-world feedback.

METHODOLOGY



The researchers made use of the modified waterfall model as the Software Development Life Cycle (SDLC) methodology to develop iProTech: Microcontroller-Based Location Tracking with Temperature Alarm And Monitoring User Interface For Construction Workers. This section described the SDLC phases and analytical diagrams that were used for this project. SDLC phases include requirements gathering, system design, software and hardware implementation, system testing, deployment, and maintenance.

RESULTS & DISCUSSION

This chapter presents the findings from the implementation and evaluation of the iProTech system. The results show how the smart hardhat and monitoring dashboard addressed the project's aims of improving worker safety through real-time tracking, hazard alerts, and responsive site oversight. Data from system testing, participant feedback, and feature validation are analyzed against the research questions. The discussion connects these findings to related work on IoT safety wearables and construction-site risk management, underscoring iProTech's contributions to incident prevention, safety visibility, and practical digital innovation in construction settings.

TESTING RESULTS

The Alpha and Beta testing phases were conducted to evaluate the iProTech system using ISO/IEC 25010-aligned criteria, focusing on functional suitability, compatibility, performance efficiency, and reliability. Alpha testing with IT professionals under controlled conditions yielded very high ratings, confirming the system's architectural soundness and implementation quality.

Beta testing with laborers and engineers in real construction site environments produced consistent excellent results, including an overall laborer rating of 4.79. The system demonstrated dependable safety functions, responsive dashboards, stable device-cloud synchronization, and effective recovery from temporary disruptions. Engineers also rated the system highly, noting strong compatibility, timely alerts, and reliable performance. Only minor non-critical refinements were identified, confirming that iProTech meets its safety and monitoring objectives and is ready for broader field deployment.

CONCLUSION

Based on the findings, the researchers conclude that iProTech successfully met all its specific objectives. The system demonstrated reliable performance across core safety and monitoring functions, achieving excellent ratings in functional suitability, performance efficiency, compatibility, and reliability during both alpha and beta testing. Real-time alerts, responsive dashboard updates, and stable multi-device operation confirmed its effectiveness in real construction-site conditions.

The system's robustness, efficient recovery from temporary interruptions, and flexible architecture further validated its design and implementation. With only minor, feasible refinements identified, iProTech is considered ready for continued field use. Overall, the results establish iProTech as a reliable, user-centered, and scalable construction-site safety solution with strong potential for future enhancement.

Requirements

To understand construction site safety needs, the researchers conducted interviews with construction workers, supervisors, and safety officers in Angeles City, Pampanga. These discussions provided insights into safety challenges, daily workflows, and system requirements. Additional research from credible sources and consultations with technical advisors and related studies supported requirement validation and system improvements. Responsibilities were distributed among the researchers based on technical expertise, contributing to the successful development of the iProTech system.

Design

The researchers used various design tools to clearly present the functionality and workflow of the iProTech system. Storyboards visualized user interactions, while architecture, block, and flowchart diagrams illustrated system structure, logic, and data flow. An ERD defined database relationships, and a Visual Table of Contents (VTOC) ensured requirement traceability. A Gantt chart guided the project timeline from design through deployment.

Development

The development phase of iProTech focused on integrating hardware and software components in compliance with ISO/IEC 25010 quality standards. The researchers assembled the smart hardhat using key components such as the ESP32, sensors, RFID, and alert modules, and developed firmware and a Next.js-Firebase monitoring interface to support real-time tracking, alerts, and attendance. System integration was validated through bench and field testing, with issues addressed through collaboration and firmware optimization. Proper documentation was prepared to support maintenance and future development.

Testing

After the development of the iProTech system was completed, it underwent both alpha and beta testing. This stage evaluated the system's overall functionality, accuracy, and performance. During the testing phase, the validity of the questionnaires was also assessed to ensure reliable data collection. The methods for gathering, evaluating, and processing the data, along with the sampling techniques and devices used, were clearly described. To verify that the results of the study were unbiased and unaffected by the researchers, the respondents, or the evaluation setting, the ISO 25010 questionnaire underwent validity testing.

Implementation

The deployment phase involved implementing the fully developed iProTech system at an actual construction site in Pampanga to evaluate its functionality, usability, reliability, and compliance with ISO/IEC 25010 standards. The system provided real-time location tracking, heat and fall monitoring, RFID-based attendance, and centralized monitoring through a responsive web dashboard, along with on-helmet alerts and safety features. Real-world use by construction workers and site personnel enabled performance evaluation and user feedback, helping identify necessary refinements before broader implementation.

Maintenance

Following system implementation, a maintenance phase was conducted to ensure the continued reliability and performance of the iProTech system. The maintenance strategy included scheduled hardware and software inspections, routine diagnostics, and firmware updates to prevent system failures. Critical components such as sensors, GPS, and dashboard notifications were regularly monitored through an administrative interface, supporting timely issue resolution. The inclusion of maintenance planning in the project design demonstrated the researchers' commitment to long-term system sustainability and reliability.

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I-TUNGKOD

A SMART ASSISTIVE CANE WITH ULTRASONIC PROXIMITY SENSING, GPS TRACKING, AND EMERGENCY COMMUNICATION

FEATURES

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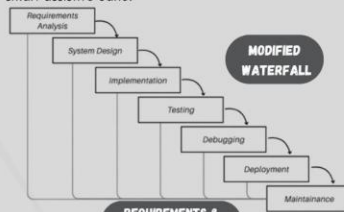
ABSTRACT

This study developed I-TUNGKOD, a smart assistive cane designed to enhance mobility, safety, and independence for visually impaired, mobility-impaired, and elderly individuals by addressing challenges in navigation and emergency response. The system was created using the Modified Waterfall Model and integrates ultrasonic sensors, a water detection sensor, AI-based object recognition, GPS tracking, and GSM-based emergency communication, all powered by an ESP8266 microcontroller. It provides real-time alerts through audio and vibration while enabling mobile monitoring for caregivers. Evaluation using ISO/IEC 25010 during alpha testing showed high performance in functionality, compatibility, and portability, while beta testing confirmed reliable operation and improved user confidence. Overall, I-TUNGKOD offers a practical and innovative assistive technology solution that promotes independence and supports Sustainable Development Goals (SDGs) 3, 9, and 10.

GENERAL OBJECTIVE

- 1 To gather information through internet and library research, interviews, academic journals, government sites, and publish news articles.
- 2 To identify hardware and software developmental requirements
- 3 To design the system using diagrams and analysis tools.
- 4 To create a microcontroller-based IoT Smart Cane prototype
- 5 To connect to a mobile phone
- 6 To develop and interconnect hardware prototype and mobile application
- 7 To test the developed Smart Cane Prototype and System
- 8 To develop and interconnect hardware prototype and mobile application
- 9 To deploy the developed IoT Smart Cane System

The researchers used the Modified Waterfall Model, a structured and sequential approach with feedback between phases. This model was chosen to ensure clear planning, organized development, and reliable integration of hardware and software components in the I-TUNGKOD smart assistive cane.



The researchers gathered data from academic journals, websites, and consultations to ensure the system meets user needs. The requirements focused on obstacle detection, location tracking, emergency communication, and identifying the necessary hardware and software components for I-TUNGKOD.

DESIGN

Based on the identified requirements, the I-TUNGKOD system was designed using system architecture diagrams, flowcharts, and storyboards. These tools were used to visualize how the hardware components such as sensors, microcontroller, GPS, and GSM modules interact with each other. The flow of data from obstacle detection to alert generation and mobile communication was clearly defined. The design also focused on creating a simple, user-friendly interface to ensure accessibility for visually impaired users.

DEVELOPMENT

The system was developed by integrating both hardware and software components into a single assistive device. It utilizes an ESP8266 microcontroller, ultrasonic sensors, a water sensor, AI camera, GPS, and GSM modules. The software was programmed using Arduino IDE and connected to a mobile application for real-time monitoring. Each component was assembled, configured, and tested individually before full system integration to ensure proper communication and functionality.

MAINTENANCE

The system requires continuous maintenance to ensure long-term reliability and efficiency. This includes updating the software, monitoring system performance, and checking hardware components such as sensors and battery. User feedback is also considered for further improvements, allowing the system to adapt and enhance its features over time.

TESTING

The system underwent multiple testing phases, including unit testing, integration testing, and system testing, to ensure reliability and performance. Alpha testing was conducted with IT experts to evaluate functionality and system accuracy, while beta testing involved actual users such as visually impaired individuals and caregivers. Feedback from these tests was used to identify issues and improve system performance.

DEPLOYMENT

After successful testing and validation, the I-TUNGKOD system was deployed as a working prototype. The device, along with its mobile application, was introduced for real-world use to demonstrate its capabilities. Users were able to experience features such as obstacle detection, GPS tracking, and emergency communication, while caregivers could monitor the user's location and receive alerts.

RESULT & OUTCOMES

DATA GATHERING & SYSTEM REQUIREMENTS

A comprehensive analysis was conducted by the researchers through internet and library research, academic journals, government websites, and consultations with their technical adviser to identify the needs of visually impaired, mobility-impaired, and elderly users. The findings highlighted challenges in mobility, obstacle detection, and emergency communication. These insights guided the system requirements, focusing on integrating sensors, GPS tracking, and GSM communication to ensure safety, accessibility, and ease of use of the I-TUNGKOD system.

TEST RESULT

Alpha Test:
The system achieved high evaluation results based on ISO/IEC 25010 standards, particularly in functional suitability, compatibility, and portability. The findings indicate that the system performs its intended functions accurately and reliably during initial testing.

Beta Test:
The beta testing results showed positive feedback from users, confirming reliable system performance and improved user confidence in navigation. The system demonstrated effective obstacle detection, communication features, and overall usability in real-world conditions.

CONCLUSION

I-TUNGKOD effectively provides an innovative and practical assistive solution that enhances mobility, safety, and independence for visually impaired, mobility-impaired, and elderly individuals. The results from alpha and beta testing confirm high system performance and reliability based on ISO/IEC 25010 standards. Through features such as obstacle detection, GPS tracking, and emergency communication, the system improves user confidence and supports daily navigation. It also contributes to inclusive development aligned with SDGs 3, 9, and 10, while providing a strong foundation for future improvements in assistive technology.

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KANDADO

An IoT-Based Public Locker System with Randomized QR Codes



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ABSTRACT

KANDADO is an IoT-based public locker system developed for Mabalacat City College to address unsecured lockers, lost keys, prolonged occupancy, weak monitoring, and complaint-handling issues. The system uses an ESP32-based controller, shared QR scanner, sensors, electronic locks, and a LAN-hosted web application. Randomized, time-bound QR/PIN codes, presence sensing, and detailed audit logs ensure secure, traceable, and fair locker usage. Using the Modified Waterfall Model and evaluated under ISO/IEC 25010, KANDADO obtained Excellent overall mean scores: 4.95 (Alpha IT experts), 4.91 (Beta-MIS), and 4.86 (Beta-Students), showing it is a viable and robust solution for MCC.

OBJECTIVES

To develop and deploy KANDADO, a secure, LAN-based locker system with randomized time-bound QR/PIN access and an admin dashboard for real-time monitoring and control at Mabalacat City College.

Specific goals:

- Gather requirements from literature, students, and administrators.
- Identify needed hardware (ESP32, QR scanner, locks, sensors, indicators) and software (web app, server, database).
- Design the system using storyboards, diagrams, and ERD.
- Build and integrate the ESP32 controller, peripherals, and LAN server.
- Develop user and admin web interfaces with QR/PIN, notifications, and audit logs.
- Test via developer, alpha, and beta testing.
- Evaluate quality using ISO/IEC 25010.
- Deploy the system on the MCC LAN with a secured /api/extend endpoint via ngrok.

METHODOLOGY

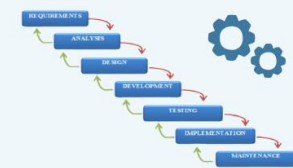


Figure 1: Modified Waterfall Model

Requirements were collected through surveys and informal interviews with students and administrators, direct observation of existing locker practices, and a review of related literature and MCC policies. These inputs identified key issues, unsecured compartments, lost keys, prolonged occupancy, and weak monitoring and guided the functional and non-functional requirements for KANDADO.

Design

Using the Modified Waterfall Model, the team designed KANDADO with storyboards for student and admin flows, block and system architecture diagrams, flowcharts, use case diagrams, and an Entity Relationship Diagram. These tools mapped how the ESP32 hardware, web server, and database interact over the MCC LAN and ensured that features such as time-bound QR/PIN access, presence sensing, penalties, and On-Hold logic were planned clearly before implementation.

Development

Hardware development focused on an ESP32 main controller with slave units driving electronic locks, RGB indicators, ultrasonic and tilt/vibration sensors, and interior lighting in a four-compartment wooden cabinet. Software development used PHP, JavaScript, Node.js, MySQL (XAMPP), Arduino IDE, and Visual Studio Code, with Git/GitHub for version control. The student portal handled registration, locker availing, QR/PIN generation, and session management, while the admin dashboard provided real-time states, overrides, and logs.

Testing

Developer tests removed initial bugs and integration issues, followed by alpha and beta testing using ISO/IEC 25010-based questionnaires. Four IT experts (alpha) stressed functional correctness, reliability, and security under edge cases like power loss and network interruptions. Three MIS administrators and thirty students (beta) executed realistic scenarios—avail, unlock, extend/end, keypad fallback, and overdue flows—while providing feedback on usability, clarity, and perceived security.

Implementation

The final prototype was deployed at MCC Main Campus in a supervised, high-traffic area. The locker cabinet was powered via UPS and buck converters and connected to an on-premise server on the MCC LAN. All services remained LAN-restricted except a single /api/extend endpoint published through ngrok, allowing off-campus time extensions and penalty compliance without exposing the full system to the internet.

Maintenance

During testing, the researchers performed regular maintenance by checking locks, sensors, indicators, QR/PIN flows, and web performance. Issues found in logs or reported by testers were fixed through firmware and web app updates, then retested to ensure stable and reliable operation before handing the system over to MCC.

TEST RESULTS

ISO/IEC Criteria	Alpha	Beta-MIS	Beta-Students
Functional Usability	4.91	4.89	4.81
Performance Efficiency	4.91	4.87	4.71
Compatibility	4.90	4.88	4.82
Interaction Capability - Usability	4.97	4.91	4.84
Reliability	4.97	4.96	4.96
Security	4.96	4.92	4.86
Flexibility	4.81	4.72	—
Safety	5.00	5.00	4.79
Testability (under specific)	5.00	—	4.87
Portability & Access (under specific)	5.00	—	4.97
Security Test (dependent scenarios)	5.00	—	—
Overall Mean Score	4.97	4.91	4.86

KANDADO was evaluated under ISO/IEC 25010 during alpha and beta tests.

- Alpha (4 IT experts): Overall mean 4.95 – Excellent (all criteria 4.83–5.00; Security Test = 5.00).
- Beta-Admin (3 MIS staff): Overall mean 4.91 – Excellent (all criteria 4.72–5.00).
- Beta-Students (30 students): Overall mean 4.86 – Excellent, with high scores for Security (4.96), Usability (4.94), Fairness & Access (4.95), and Notifications (4.87).

These results confirm that KANDADO is functionally complete, efficient, usable, reliable, secure, and safe in its intended campus environment.

DISCUSSION

The development of KANDADO sought to replace MCC's unsecured, key-based lockers with a secure, organized IoT locker system using QR/PIN access, time-limited sessions, presence sensing, status indicators, and an admin dashboard aligned with campus practices. Testing under ISO/IEC 25010 showed Excellent overall ratings from IT experts (4.95), MIS administrators (4.91), and students (4.86), confirming strong functionality, performance, usability, reliability, security, and safety, while notifications and clear locker states helped users manage sessions responsibly and gave administrators better oversight with less manual work. Future enhancements—such as optional two-factor authentication, a more durable cabinet, richer analytics, finer-grained admin roles, and expanded reporting and notifications—can further strengthen KANDADO as a robust, adaptable smart locker solution for MCC.

CONCLUSION

The study concludes that KANDADO effectively addresses the long-standing issues of unsecured, key-based lockers at MCC. By combining IoT hardware with a LAN-hosted web application and time-bound QR/PIN access, the system improves security, fairness, and administrative oversight. High ISO/IEC 25010 ratings from IT experts, MIS administrators, and students demonstrate readiness for continued use and expansion. Future enhancements may include optional two-factor authentication, cabinet hardening, and richer analytics, further strengthening KANDADO as a campus-ready smart locker solution.

ACKNOWLEDGEMENT

The researchers express their gratitude to Almighty God for providing strength and wisdom, and to their advisers, Ritchell Z. Escoto and Frederic D. Santos, for their essential guidance and technical expertise. The researchers also thank Engr. Dennis L. Tacadena for the project's approval and acknowledge the Alpha and Beta testers for their role in optimizing the system. Finally, the researchers extend their heartfelt appreciation to their families, friends, and teammates for their unwavering support throughout the journey.

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KAPANIMPLA: A WEB-BASED ORDERING AND CUSTOMIZATION SYSTEM FOR SILUNG COFFEE



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ABSTRACT

Coffee plays an important role in daily well-being, supporting alertness, focus, and motivation while also fostering social connection. Silung Coffee, located in Brgy. Poblacion, Mabalacat City, was established to blend Kapampangan cultural heritage with modern coffee culture and to promote community engagement aligned with Sustainable Development Goals (SDGs) 4, 9, 11, and 12. This study developed a system intended to enhance the café's operational efficiency and service delivery. Using a structured development approach, the researchers conducted alpha and beta testing to assess the system's functional suitability, interaction capability, security, and flexibility. The alpha test produced an overall rating of 3.96, while improvements implemented afterward resulted in a higher beta test rating of 4.41. These results indicate that the system effectively met its performance criteria, demonstrating strong functionality, usability, security, and adaptability. Following comprehensive evaluation, the system was found to support Silung Coffee's goals of improving operational processes while advancing its cultural, educational, and sustainability-driven mission.

METHODOLOGY

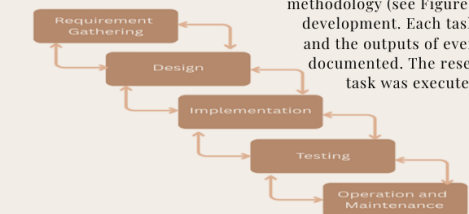


Figure 2. The Modified Waterfall Model

The researchers used the Modified Waterfall methodology (see Figure 12) to monitor the system's development. Each task was thoroughly discussed and the outputs of every development phase were documented. The researchers ensured that every task was executed to meet its specific goals, and that the final system accomplished the expected results.

DEVELOPMENT

The Kapanimpla system for Silung Coffee will be developed through a structured workflow assigning specific roles to researchers. The front-end developer is tasked with creating a user-friendly UI, focusing on key elements like product customization and the admin dashboard, while ensuring compatibility and good user experience across devices. The back-end developer will handle server-side logic and database management, covering product, order, customer, and inventory tables, along with features for status updates and customer feedback. Close collaboration between front-end and back-end developers aims to meet the expectations of business owners and customers, resulting in a reliable solution for online ordering and coffee customization.

RESULT

The results of the alpha testing using ISO 25010 software quality standards, the evaluation of the system revealed that it is highly appropriate for its intended use, meeting key criteria such as functional suitability (4.29), interaction capability (3.98), security (4.16), and flexibility (3.96). Overall, it received a total rating of 3.96, indicating good performance across various platforms and environments, user-friendliness, and strong security. The system is thus highly recommended for its designated purpose.

The results of the alpha testing after evaluation. The feedback from thirty respondents indicated strong agreement with the ISO 25010 standards, scoring the system as 'Excellent' in key areas: Functional Suitability (4.56), Interaction Capability (4.42), Security (4.44), and Flexibility (4.22). Overall, the system met all required standards with an average score of 4.41, demonstrating high performance and reliability.

DISCUSSION

The study aims to create a website Kapanimpla: A Web-Based Ordering and Customization System for Silung Coffee to make ordering easier by allowing customers to explore the coffee menu, customize their cups with preferences like milk type, and flavor add-ons, and submit orders online. Customers will also be able to see the status of their orders in real time.

General:

The general objective of the study is to develop a system entitled "Kapanimpla: A Web Based Ordering and Customization System" for Silung Coffee Shop.

Specific:

- To gather information about the requirements for the ordering and customization system of Silung Coffee through interviews with the owner and brainstorming sessions.
- To identify the specific hardware and software components used to develop the website.
- To design the website using the following analysis, diagrams, and design tools throughout the development process:
- To create and develop Kapanimpla with the main feature ordering and customization of coffee.
- To evaluate the system using ISO 25010's Software Product Quality Standards for alpha and beta testing.
- To deploy and implement the system in Silung Coffee.

OBJECTIVES

REQUIREMENTS

The requirements gathering phase identified key hardware (desktop, laptop, cellphone) for the project development. Software included Angular (Framework), VsCode(IDE), PostgreSQL(database), Javascript (backend) and Nodejs (dependencies), giving Kapanimpla with an effective and cooperative development environment.

DESIGN

In this phase, researchers utilized several analysis tools to design the Kapanimpla system, including Storyboard, Use Case Diagram, Visual Table of Contents, Gantt Chart, and Entity-Relationship Diagram (ERD). The Storyboard facilitated user interface planning, ensuring a smooth application flow. The Use Case Diagram defined system features and user interactions. A Visual Table of Contents provided an overview of the system's components, while the Gantt Chart outlined the project timeline for task management and resource allocation. Finally, the ERD illustrated the database structure, organizing data relationships for efficient design and accurate data flow.

ACKNOWLEDGEMENTS

To begin with, the researchers are grateful to God for directing and bringing them on this educational journey. If it were not for his favor, this research would not have been possible.

The researchers would like to thank Mr. Khyle Alegre, researchers technical adviser, for her unwavering patience, support, and guidance as they worked to complete this study.

Additionally, the Committee who were present during the oral examination phase of the research process. Their combined efforts, suggestions, and thoughts influenced the researcher's choice and the study.

Finally, the researchers express their gratitude to their families and friends for providing unwavering support, particularly in the form of financial aid, throughout their time as students.

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KHRIA: AI ECOMMERCE WEBSITE BUILDER



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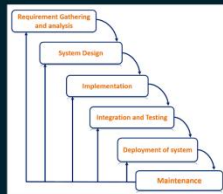
DENNIS L. TACADENA

ABSTRACT

KHRIA is an AI-powered website builder designed to help individuals and local businesses create their online platforms efficiently. Built using the Modified Waterfall Model, the system automates website generation, supports content and theme customization, integrates e-commerce tools, and provides AI-assisted features such as automated deployment and digital asset management. Alpha and beta testing, guided by ISO 25010, showed excellent results in functionality, usability, compatibility, and flexibility. KHRIA contributes to SDGs by promoting innovation, economic growth, and digital accessibility for small enterprises.

METHODOLOGY

The study followed the Modified Waterfall Model of the Software Development Life Cycle (SDLC), ensuring a structured and systematic development process. Each phase contributed to the creation, refinement, and evaluation of the KHRIA: AI Ecommerce Website Builder.



REQUIREMENTS GATHERING

During the Requirement Gathering and Analysis phase, the researchers collected accurate and reliable data through interviews and online research. They conducted library and internet studies using articles, government websites, and academic journals to generate ideas for the capstone project. The team maintained regular communication with their technical and capstone advisers to monitor progress, while collaboratively planning activities, creating timelines, and assigning tasks. Interviews were also conducted to identify the challenges small businesses face in establishing an online presence, including their digital marketing strategies, e-commerce needs, mobile compatibility, user interface preferences, and technological and financial constraints.

SYSTEM DESIGN

In the System Design phase, the researchers used a variety of analytical and visual modeling tools to ensure clarity and efficiency in developing KHRIA. The storyboard outlined the website's flow, illustrating the user experience and system operations. A Use Case Diagram identified the system's actors, administrators, and users, detailing their interactions with the platform. Flowcharts depicted the logical sequence of processes, while the Visual Table of Contents organized website components and navigation paths for improved usability. The Entity Relationship Diagram defined the database structure and relationships among entities, and the Data Flow Diagram mapped the movement of information from user input to AI processing, database storage, and website deployment. Collectively, these tools provided a comprehensive understanding of the system's functionality, data flow, and design, promoting collaboration and transparency among team members.

INTEGRATION AND TESTING

The integration phase of KHRIA focused on combining all modules into a unified system, including AI content generation, user interfaces, databases, and external APIs. Verification ensured smooth interaction between components, while validation confirmed that user requirements were met. Comprehensive testing covered functional and non-functional aspects such as e-commerce features, responsiveness, and security, using AI-based tools for automated regression testing across devices and browsers. Testing progressed through unit, integration, system, developer, alpha, and beta stages. Feedback from panels, clients, and advisers was incorporated, and alpha and beta testing used an ISO 25010-based survey to evaluate quality attributes, with results analyzed using validated statistical methods.

MAINTENANCE

After deployment, KHRIA undergoes maintenance to ensure functionality, security, and performance. AI-driven tools monitor and predict issues, while automated debugging and updates address code problems and system improvements. Periodic enhancements, user feedback integration, and security patches maintain optimal system performance, with AI enabling autonomous updates for continuous improvement.

RESULT

The study successfully developed the KHRIA AI E-Commerce Website Builder using the Modified Waterfall Model, employing React.js and Google Gemini AI to enable automated content generation and e-commerce integration. Structured design tools, including flowcharts and storyboards, guided the development process to ensure a logical user journey from template selection to deployment. The system underwent rigorous evaluation based on ISO 25010 standards, achieving an "Excellent" rating in both testing phases. Alpha testing by IT experts yielded a mean score of 4.88, while beta testing with students and business owners resulted in an improved score of 4.99, confirming the platform's high stability, security, and usability for non-technical users.

DISCUSSION

The discussion emphasizes KHRIA's role in addressing the digital challenges faced by local entrepreneurs and students at Mabala City College. By streamlining website creation through AI, the platform lowers the barriers to entry for establishing an online presence, directly supporting the study's objective to foster digital accessibility and business growth. The project fulfills its goal of empowering small enterprises to compete in the evolving digital economy while contributing to innovation and economic development goals.

GENERAL OBJECTIVE

The main purpose of this study is to develop a web-system entitled "KHRIA: AI Ecommerce Website Builder", a platform that uses AI to help individuals and businesses create and grow their online presence. Due to the complexity and costs of conventional website development, most companies and local businesses encounter difficulties in creating their own websites. This platform is designed to address these challenges by allowing users to generate a fully functional website within 30 seconds and easily customize, edit and manage their site without the need for technical skills.

SPECIFIC OBJECTIVES

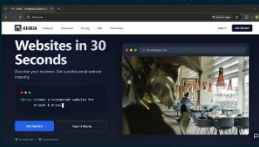
1. To gather information through interviews, surveys, journals, government portals, and articles.
2. To identify the required hardware and software development tools such as laptop, Computer, Visual Studio Code, Canva and Figma.
3. To design the system using a diagrams and analysis tools such as Storyboard, Use Case Diagram, VTC, Flow Chart and ERD.
4. To create a Web Application with the following features: such as Website Generator, Website Management, Content Editing, AI Powered Content Generation, Theme Editor, Management, Location using google map, E-commerce Support, Chatbot, QR Code, Automatic Deployment to Vercel, Website Export.
5. To test and evaluate the system using the Software Quality Product model of ISO 25010 in terms of Functional Suitability, Interaction Capability, Security, and Flexibility.
6. To deploy the system using Render.

IMPLEMENTATION

The implementation of KHRIA followed a structured process starting with requirement gathering to ensure the system met user and research needs, including AI-generated templates and e-commerce features. Using a modified waterfall model, design and development overlapped, allowing early feedback through wireframes and prototypes. Developers implemented AI-driven layout and content generation along with third-party API integrations, followed by rigorous testing to ensure performance, responsiveness, and reliability. The system was deployed via the Vercel API for efficient cloud deployment and continuous updates, while the Google Maps API added location-based features to enhance usability.

DEPLOYMENT OF SYSTEM

The deployment phase of KHRIA involves placing the system in a live environment and ensuring it functions as intended. Pre-deployment preparations include finalizing configurations, setting up hosting environments, and verifying hardware and software compatibility. Users are trained on AI-powered features, such as automated content generation, and provided with documentation for operational guidance. Final acceptance tests are conducted to confirm system stability and performance under real-world conditions. Post-deployment, monitoring and feedback mechanisms are implemented to track system performance, user interactions, and engagement using analytics tools. Feedback loops allow the researchers to identify and address any issues, while the modified waterfall approach facilitates incremental adjustments, ensuring smooth integration without disrupting operations.



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MaCisanmetungCa

A Centralized Student Election Management System for Mabalacat City College - COMSELECA

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ABSTRACT

The MaCisanmetungCa is a web-based Candidate Management System designed to streamline the student council candidacy process at Mabalacat City College. It replaces the previous manual submission method, which involved paper documents and in-person verification, leading to delays and errors. This centralized digital platform allows candidates to submit applications, upload necessary requirements, schedule appointments for screening, and receive real-time updates. Administrators benefit from enhanced management capabilities, enabling them to review documents, verify candidates, and oversee voting procedures using secure logins facilitated by Firebase Authentication and data management through Firebase Realtime Database. Utilizing the Modified Waterfall Model for development, the researchers ensured a structured approach with room for adjustments. The system was assessed against ISO 25010 quality standards, emphasizing criteria like functionality, performance efficiency, interaction capability, reliability, and security. User testing indicated that the MaCisanmetungCa significantly decreases manual tasks, minimizes document checking errors, and enhances transparency and accessibility in the electoral process. Ultimately, it shows strong promise for modernizing student elections, fostering efficient governance while supporting student leaders, election officers, and the broader academic community through a contemporary, technology-driven approach.

OBJECTIVES

To develop MaCisanmetungCa, a web-based centralized student election management system for Mabalacat City College - Commission on Student Elections and Appointments, enabling secure, transparent, and automated campus-wide elections using modern web technologies.

1. To review scholarly literature related to web-based election management systems, online voting technologies, and electronic authentication mechanisms.
2. To identify and utilize the appropriate hardware and software resources required for the development, testing, and deployment of the system.
3. To design the system using standard development and documentation tools including diagrams, charts, and visual models.
4. To develop a centralized, web-based election management system with secure authentication, role-based access, real-time vote tallying, and automated result generation.
5. To implement system features tailored for Super Admins, COMSELECA administrators, candidates, and voters to support efficient election processes.
6. To test the functionality and performance of the system through Alpha and Beta testing.
7. To evaluate the system based on the ISO/IEC 25010 software quality model in terms of functionality, usability, performance, reliability, security, and maintainability.
8. To deploy and implement the MaCisanmetungCa system for actual student election use at Mabalacat City College.

METHODOLOGY

The Modified Waterfall Model was employed by the researcher for the Software Development Life Cycle (SDLC), characterized by a linear approach with limited feedback. It is well-suited for academic projects, focusing on detailed documentation and distinct phase transitions. The model's key stages are Planning and Requirements Gathering, Design, Development, Testing, Deployment, and Maintenance. Its structured yet flexible nature makes it ideal for developing MaCisanmetungCa, a system aimed at optimizing the student election process at Mabalacat City College.



Figure 1: The Modified Waterfall Model

Planning & Requirements Gathering

In this phase, researchers utilized various analysis and design tools to conceptualize and structure the Centralized Student Election Management System for Mabalacat City College. This phase highlights the limitations of current election processes, which are manual and semi-digital, causing delays, lack of transparency, and human error. Consultations with COMSELECA officials and students provided insights into workflows, challenges, and system expectations.

Design

The Design phase of MaCisanmetungCa took place as it transitioned from development to actual use by COMSELECA, candidates, and student voters. Deployed on a secure online platform, it ensured accessibility and reliability during elections. Accounts were set up, election schedules established, and core modules like COC filing, candidate screening, campaign material management, and online voting were activated. Key features included role-based authentication, digital submissions, automated approvals, voter verification, online voting, real-time vote tallying, result generation, and activity logging were validated for use.

Development

The development of MaCisanmetungCa focused on creating a web-based application for efficient, secure, and transparent management of student elections. It features modules for submitting and screening Certificates of Candidacy, managing campaigns, and facilitating online voting. The system supports digital COC submissions, real-time status tracking, media uploads, and secure voting for verified students, while allowing administrative oversight and real-time vote tallying. Built with React 19, Tailwind CSS, and Firebase, it emphasizes performance, usability, security, and accountability in the election process.

Maintenance

After deployment, maintenance activities were conducted to ensure the system's continuous reliability, security, and sustainability. These included ongoing performance monitoring, bug fixing, system optimization, and feature updates as necessary. User feedback from COMSELECA officials, candidates, and student voters was utilized to improve usability, navigation, security, and election workflows. Through regular maintenance, the system remained stable, efficient, and adaptable for future student elections at Mabalacat City College.

Testing

The MaCisanmetungCa system underwent comprehensive testing phases, including unit, integration, system, and acceptance testing, to ensure module functionality and compliance with design specifications. The QA team conducted system testing on various devices to assess responsiveness and reliability. User feedback was collected via a validated survey instrument based on the ISO 25010 Software Quality Model while adhering to ethical standards and data privacy regulations. Respondents included COMSELECA officials and MCC students, with feedback analyzed using descriptive statistics, specifically weighted means, to evaluate system quality. The evaluation confirmed that the system satisfied functional requirements and is ready for deployment in managing student elections at Mabalacat City College.

Deployment

The Deployment phase of MaCisanmetungCa took place as it transitioned from development to actual use by COMSELECA, candidates, and student voters. Deployed on a secure online platform, it ensured accessibility and reliability during elections. Accounts were set up, election schedules established, and core modules like COC filing, candidate screening, campaign material management, and online voting were activated. Key features included role-based authentication, digital submissions, automated approvals, voter verification, online voting, real-time vote tallying, result generation, and activity logging were validated for use.

TEST RESULTS

The evaluation of MaCisanmetungCa during Alpha and Beta testing phases shows substantial enhancement from development to user deployment. Alpha testing, executed by IT experts, yielded a mean score of 4.15, noted strengths in Interaction Capability (4.36) and functional suitability (4.3), while performance efficiency (3.9) signaled optimization needs. Post adjustments, Beta testing with real users delivered a mean score of 4.86, categorized as Excellent. Individual criteria-functional suitability (4.93), Interaction Capability (4.91), reliability (4.92), performance efficiency (4.87), security (4.90), and maintainability (4.6) — demonstrated significant improvements. This transition emphasizes the success of iterative development, user feedback integration, and system readiness for managing elections at Mabalacat City College.

ACKNOWLEDGEMENTS

The researchers sincerely thank the Almighty God for the wisdom, strength, and perseverance that made the completion of this capstone project possible. We gratefully acknowledge the Bachelor of Science in Information Technology program of Mabalacat City College for providing the academic support and resources necessary for this study. Our deepest appreciation goes to Mr. Kyle L. Alegre, Capstone Adviser, for his guidance, expertise, and continuous support throughout the development of MaCisanmetungCa. Special thanks are also given to the panel members led by Engr. Dennis L. Tacadena, PDPc, DIT, with Ms. Danna Jay De Castro and Ms. Rithell Z. Escoto, MIT, for their valuable insights and constructive recommendations. We also thank the Commission on Student Elections and Appointments of Mabalacat City College, especially Mr. Darvin Dave C. Campos, for their cooperation and shared insights. Lastly, we acknowledge the students, candidates, election officers, and the research team whose participation and dedication contributed to the successful completion of this project.

CONCLUSIONS

The development of MaCisanmetungCa: A Centralized Student Election Management System successfully addressed the challenges of Mabalacat City College's traditional student election process. Using the Modified Waterfall SDLC, the system was systematically designed, developed, and deployed based on user needs and technical requirements. Analysis of existing election processes revealed issues in accuracy, transparency, security, and efficiency, which guided the creation of a centralized, role-based platform. The system features candidate registration, election configuration, secure online voting, automated results, and real-time data processing using Firebase Authentication and Realtime Database. Built with React 19 and Tailwind CSS, the platform provides a responsive and user-friendly interface that improves operational efficiency and minimizes human error. Testing results confirmed the system's effectiveness. Alpha Testing by IT experts rated the system "Good" across all ISO 25010 criteria, while Beta Testing by students yielded "Excellent" ratings in key quality areas. Live deployment via Hosting and the domain www.macsanmetungca.com demonstrated reliable real-world performance, secure voting, and transparent election management. Overall, MaCisanmetungCa modernized the student election process, enhanced participation and transparency, and is ready for continued use and future scalability.

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MCCARE : A WEB-BASED GUIDANCE COUNSELING SYSTEM FOR MABALACAT CITY COLLEGE

ABSTRACT

The MCCARE Web-Based Guidance Counseling System underwent a comprehensive development process, encompassing research, data collection, design, development, testing, and deployment. Using the Modified Waterfall Model ensured system quality and consistency. Quality assurance testing was conducted to identify and fix issues, following the ISO 25010 standards, which measured functionality, performance, compatibility, usability, reliability, security, maintainability, and flexibility. Alpha testing with three IT professionals provided initial feedback, followed by beta testing with twenty-five IBCE students, four Guidance Associates, and one professor. The alpha test achieved an overall mean score of 4.59, while the beta test improved to 4.76. Both results are verbally interpreted as "excellent," confirming that the system met ISO 25010 standards.

METHODOLOGY



REQUIREMENTS GATHERING

The researchers gathered necessary information and ideas on how to create an effective mental health system for the students of Mabalacat City College. This process included interviews, surveys, web browsing, and group discussions. An initial survey was conducted to understand the system's requirements. The researchers conducted a series of interviews with the Guidance Services Unit of Mabalacat City College to enhance the system's functionality.

Design

The researchers employ the following analysis tools and diagrams, including the Storyboard, Visual Table of Contents (VTOC), Menu Tree, Use Case Diagram, Entity Relationship Diagram (ERD), to design and develop the web-based system and database management system.



IMPLEMENTATION

This web-based system utilizes system development resources and tools, contributing to the cohesiveness, responsiveness, and functionality of the system. Visual Studio Code is the primary code editor and debugging environment. React JS is used as the implementation for front-end development, Laravel for the back-end operations, and MySQL for database design and management. The MCCARE system supports student wellness through key features such as flexible appointment scheduling, allowing students to choose either face-to-face or chat-based sessions. An integrated chat enables administrators to monitor student engagement, while an organized database helps manage records by year level, section, institute, and case intensity. The Message of the Day (MOTD) provides daily motivational updates, and the Online Freedom Wall offers a moderated space for students to express their thoughts safely.



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OBJECTIVES

- To identify hardware and software requirements for the development of the system.
- To gather needed information through surveys, interviews, and internet research.
- To identify hardware and software requirements for the development of the system.
- To integrate the following user-level:
- To design a web-based system using the following diagrams:
- To evaluate the performance of the system based on ISO25010
- To build the system with the following features:
- To implement the system in the Guidance Council at Mabalacat City College
- To test the system through alpha and beta testing.

TESTING

The system underwent two essential testing stages: Alpha and Beta testing. During the alpha phase, the researchers extensively assessed the web system ISO 25010 standards, which include Functional Suitability, Compatibility, Interaction Capability, Reliability, Security, Maintainability, Flexibility, and Safety. Three (3) IT professionals acted as the alpha testers, participating in a guided evaluation session. The beta testing aspect consisted of thirty (30) participants from Mabalacat City College, with twenty-five (25) students, four (4) Guidance Associates, and one (1) professor. Together, these assessments provide a thorough understanding of the system's performance and user experience, serving as the basis for the detailed discussions in the next sections.

DEVELOPMENT SYSTEM

The MCCARE system was developed using the Modified Waterfall methodology. This organized structure produced quality results for every user group interacting with the system. To meet the needs of students, guidance associates, and administration, the team used surveys and consulted with guidance associates. System diagrams and interface designs were created in Figma before coding. The back end was built using Laravel, the front end with ReactJS, and the database with MySQL. This architecture makes the system highly secure, scalable, and efficient. After the first version was created, the developers performed ongoing debugging and revisions to refine it. They also conducted alpha testing with IT personnel and beta testing with students and guidance personnel. Feedback from both testing phases finalized enhancements, ensuring the system met both functional and usability requirements.

MAINTENANCE

The operation and maintenance phase ensures the continuous functionality, reliability, and effectiveness of the system after it has been implemented. It includes the actual use of the system in the Guidance Council of Mabalacat City College and ongoing support for updates, issue resolution, and improvements.

RESULTS

Table 7 summarizes the ISO 25010 evaluation of the MCCARE web application from Alpha to Beta testing. Results show consistent improvement across all criteria. Functional Suitability increased from 4.59 to 4.75, and Compatibility rose from 4.50 to 4.72, indicating better performance and device support. Interaction Capability in alpha is already rated high at 4.81. Reliability and Maintainability improved from 4.71 and 4.61 to 4.77 and 4.81, showing stable operation and easier updates. Security increased from 4.61 to 4.80, reflecting stronger data protection. Flexibility and Safety also improved from 4.50 and 4.58 to 4.78 and 4.79. Overall, the mean score increased from 4.59 to 4.76, both rated "Excellent," demonstrating continuous enhancement and strong compliance with ISO 25010 standards.

CONCLUSIONS

The MCCARE Web-based Guidance Counseling System underwent a comprehensive development journey, encompassing stages such as brainstorming, investigation, research, data gathering, surveying, development, testing, and deployment. The MCCARE A Web-based Guidance Counseling System for Mabalacat City College successfully achieved its technical objectives and demonstrated significant potential for positive impacts on the academic community. By integrating innovative technology with student-centered services, MCCARE provides a reliable platform for promoting well-being, improving educational outcomes, and supporting the professional readiness of students within the institution.

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MediCall: An IoT-Based Enhancing Emergency Response System in Mabalacat City College – Dapdap Campus



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ABSTRACT

MediCall: An IoT-Based Enhancing Emergency Response System was developed to address delays in medical response, communication gaps, and heat-related health risks at Mabalacat City College (MCC) Dapdap Campus. The system integrates Internet of Things (IoT) technology with real-time two-way communication, a tiered alert mechanism, environmental monitoring, and automated heat-mitigation features such as exhaust ventilation and retractable roofing. The study aimed to design, develop, and evaluate a prototype system capable of improving emergency reporting, response coordination, and environmental safety within the campus. The Software Development Life Cycle (SDLC) using a modified waterfall model guided the system development. Alpha and beta testing were conducted, and system performance was evaluated using ISO 25010 quality standards. Results showed high levels of functionality, usability, interaction capability, security, and flexibility. MediCall significantly reduced response delays, improved emergency location accuracy, and minimized heat exposure risks, contributing to a safer and more responsive campus environment while supporting Sustainable Development Goals related to health, education, innovation, and resilient infrastructure.

Keywords: IoT Emergency System, Campus Safety, Real-Time Communication, Heat Index Monitoring, Smart School Infrastructure.

INTRODUCTION

Educational institutions require efficient emergency response systems to ensure the safety and well-being of students and staff. Advances in technology, particularly Internet of Things (IoT)-based systems, have enabled faster communication, automated alerts, and real-time monitoring, reducing response delays during emergencies. In the Philippines, schools are increasingly affected by medical emergencies and heat-related illnesses caused by high temperature and humidity levels, especially in crowded or poorly ventilated areas. At Mabalacat City College (MCC) Dapdap Campus, emergency response relies primarily on manual reporting through phone calls or physical notification, resulting in delayed medical assistance. According to campus clinic records, there is a recurring increase in heat-related symptoms such as headaches, dizziness, fatigue, and allergic reactions, particularly during warmer months. These conditions highlight the need for a more responsive and integrated emergency communication and environmental monitoring system. This study introduces MediCall, an IoT-based emergency response system designed to provide real-time two-way communication between classrooms and the clinic, automated alert prioritization, room location mapping, and heat mitigation through environmental controls. By integrating emergency communication with preventive environmental features, MediCall aims to enhance campus safety, reduce medical response time, and improve overall preparedness at MCC Dapdap Campus.

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General Objective

You can also show studies of existing literature that were used as references.

Specific Objectives:

- Gather information and best practices from clinic staff, web references, academic journals, and related systems.
- Identify hardware (e.g., ESP32, Arduino boards, sensors, motors, speakers, TFT screens) and software (Arduino IDE, MIT App, Google Sheets) requirements.
- Design the system using storyboards, flowcharts, block diagrams, circuit diagrams, and wire diagrams.
- Develop features including:
 - Emergency Communication: Two-way intercom between classrooms and clinic.
 - Alerts & Notifications: Tiered alert system with warning indicators for fast location identification.
 - Monitoring & Mapping: Visual panel mapping emergency locations.
 - Prevention: Automated exhaust fans and retractable roof systems to mitigate heat-related risks.
- Conduct Alpha and Beta testing for reliability.
- Evaluate performance based on ISO 25010 standards (Functionality, Compatibility, Interaction Capability, Security, Flexibility).
- Deploy the final system campus-wide, integrating it into MCC Dapdap's emergency communication infrastructure.

Limitations of the Study

The MediCall system is limited to MCC Dapdap Campus and cannot replace existing medical procedures. It does not provide live video or telemedicine, and its effectiveness depends on available medical staff. Technical issues like weak signals may affect performance, and delays can occur if responders are busy. Despite these limitations, it enhances emergency reporting, communication, and coordination on campus.

DISCUSSION

The findings indicate that integrating IoT-based communication and environmental monitoring systems can substantially improve emergency preparedness in educational institutions. MediCall addressed key issues at MCC Dapdap Campus by providing real-time alerts, precise location identification, and preventive measures against heat-related health risks. Unlike traditional emergency response methods, the system reduced dependence on manual reporting and improved coordination among responders. The inclusion of automated environmental controls further enhanced safety by minimizing exposure to high heat index conditions. MediCall supports Sustainable Development Goals, particularly SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 11 (Sustainable Cities and Communities).

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Significance of the Study

Global Context: MediCall supports the adoption of secure, flexible, and scalable emergency systems in educational institutions, improving real-time crisis management and readiness.

Environmental Context: The digital system streamlines emergency responses, reduces disturbances in classrooms, and fosters a safer, more organized campus environment.

Societal Context: MediCall enhances communication among students, instructors, and clinic staff, enabling quicker, more effective responses and promoting a culture of preparedness and shared responsibility.

CONCLUSIONS

The study successfully developed and evaluated MediCall: An IoT-Based Enhancing Emergency Response System for MCC Dapdap Campus. The system improved emergency response efficiency, enhanced communication between classrooms and clinic staff, and reduced heat-related health risks through automated monitoring and mitigation features. MediCall demonstrates the effective application of IoT technology in campus safety and emergency management. Future enhancements may include mobile application integration, expanded sensor coverage, and scalability for deployment across other educational institutions.

METHODOLOGY

Requirements Gathering
Data were collected through interviews with MCC clinic personnel and faculty members, as well as analysis of campus health statistics and existing emergency response procedures. Key issues identified included delayed emergency reporting, lack of direct communication between classrooms and the clinic, and increased heat-related medical cases.

System Design
The system architecture was designed using flowcharts, block diagrams, circuit diagrams, and wire diagrams. MediCall consists of classroom-based emergency buttons, environmental sensors, a clinic monitoring dashboard, and automated response indicators such as sirens and warning lights.

Implementation
The system was implemented using Arduino-based microcontrollers (ESP32, Arduino Mega, Arduino Uno), sensors for temperature and humidity monitoring, TFT touchscreen displays, speakers, LEDs, and motorized retractable roofing mechanisms. Software development utilized Arduino IDE, MIT App Inventor, and Google Sheets as a cloud-based database.

Testing and Evaluation
Alpha testing was conducted by technical evaluators to assess system functionality and security, while beta testing involved selected faculty and students. System performance was evaluated using ISO 25010 standards, focusing on functionality, compatibility, interaction capability, security, and flexibility.

RESULTS
The MediCall System's alpha testing phase provided a thorough evaluation of its interface and functionalities, grounded in ISO 25010 standards, focusing on Functional Suitability, Compatibility, Interaction Capability, Security, and Flexibility. The feedback session allowed their observations, leading to valuable suggestions for refinement. Results from the questionnaires, with an overall mean score of 4.83, classified the system as "Excellent" confirming its effectiveness.

ISO25010 Criteria	Mean Score	Verbal Interpretation
Functionality	4.88	Excellent
Compatibility	4.90	Excellent
Interaction Capability	4.93	Excellent
Security	4.70	Very Good
Flexibility	4.75	Excellent
Overall Mean Score	4.83	Excellent



MEDITRACK+



A Smart Solution for Medical Services and Records

Abstract

MediTrack+ is a web-based healthcare information system developed to improve medical record management, workflow efficiency, and patient care. It addresses issues of fragmented records and manual documentation through features such as secure patient data handling, inventory and sales monitoring, patient progress tracking, and laboratory result management. The system was developed using the Modified Waterfall SDLC and evaluated based on ISO/IEC 25010 quality standards through alpha and beta testing by IT experts and medical professionals. Results showed high overall system quality, with mean scores of 4.92 (Strongly Agree) in alpha testing and 4.47 (Agree) in beta testing. Security received the highest rating in both phases, confirming MediTrack+ as a reliable and secure digital solution for healthcare management.

Methodology

Modified Waterfall Model

The study employed a descriptive-developmental research design. Descriptive methods were used to identify user needs, pain points, and existing workflows of staff and patients at Medlife Diagnostic Center. MediTrack+ was then designed, developed, and evaluated using the Modified Waterfall Model (requirements, design, implementation, testing, and deployment), incorporating iterative feedback during design review, alpha testing, and beta testing.

Requirement Gathering

System requirements were identified through a collaborative process involving brainstorming, interviews, and informal discussions with Medlife Diagnostic Center staff, including the clinic owner, medical representatives, and administrative personnel. Patient feedback was also considered to identify common issues such as long waiting times, delayed laboratory results, and limited access to medical records. Additionally, related literature and industry best practices in digital health were reviewed, and consultations with IT and healthcare professionals were conducted to validate the feasibility and usability of the proposed features.

Design

The system design employed standard development tools, including Storyboard, Use Case Diagram, Data Flow Diagram (DFD), Visual Table of Contents, Entity Relationship Diagram (ERD), and Gantt Chart. These tools defined user interactions, system processes, data movement, navigation structure, database relationships, and project timelines, ensuring a well-organized system aligned with user requirements.

Implementation

MediTrack+ was developed using Visual Studio Code as the primary development environment. The system implements two user roles: Admin (clinic staff) for managing patient records, laboratory results, inventory, and system content, and Patient for accessing medical records and laboratory results through an online portal. The backend was developed using PHP with MySQL as the database management system, while CSS was used for front-end styling. Continuous testing and debugging were conducted throughout development to ensure system functionality, usability, and reliability prior to deployment.

Conclusion

MediTrack+ is a dependable, user-centered digital healthcare solution that addresses key challenges in small to medium private health facilities, including fragmented record-keeping, manual documentation, and inefficient workflows. The high evaluation scores confirm its functionality, usability, reliability, and security, with particular strength in protecting sensitive patient data. The development of MediTrack+ demonstrates that digital solutions can significantly improve healthcare management in private clinics by enhancing operational efficiency, patient satisfaction, and data accuracy through an integrated platform. It provides a secure, convenient, and interactive experience for both patients and staff, aligning with national eHealth strategies and serving as a model for future digital adoption in similar healthcare facilities. By facilitating streamlined operations, efficient record management, and timely laboratory result access, MediTrack+ supports the modernization of healthcare services and provides a sustainable framework for long-term operation and management after the research team's involvement.

Objectives

To design and develop MediTrack+, an integrated digital platform for small to medium private healthcare facilities that improves operational efficiency, digitizes medical workflows, and enables timely access to clinical information.



To gather relevant data for the study and development of the system.



To identify the hardware and software specifications for the development of the system.



To design the web-based system using different diagrams and tools.



To develop a system with the medical related features.



To test the system using both alpha and beta testing to validate system performance and identify errors before deployment.



To evaluate the system using ISO/IEC 25010 standards.



To deploy and implement the system using a reliable web hosting service with Hostinger to ensure accessibility and sustainability.

Testing

MediTrack+ underwent system, alpha, and beta testing to ensure functionality, reliability, and usability. Purposive sampling was used to select participants directly involved in Medlife Diagnostic Center operations. Alpha testing involved 4 IT experts who assessed technical performance, functionality, and security, providing recommendations for improvement. Beta testing included 30 participants (7 clinic staff, 23 patients) who evaluated usability, reliability, and overall effectiveness. Feedback was collected through surveys and observations, allowing fine-tuning of the system to ensure it met operational and patient needs.

Operation and Maintenance

MediTrack+ is hosted on Hostinger, providing reliable web access, domain registration, and SSL security to protect user data. After project completion, the clinic's designated personnel will manage system operations, including routine database checks, validation of patient and laboratory records, and software or security updates. The Memorandum of Agreement (MOA) defines the duration of collaboration and termination procedures, guiding the clinic's long-term management to ensure system stability, reliability, and continued protection of sensitive medical information.

Results

MediTrack+ was evaluated through alpha and beta testing to assess its functionality, usability, reliability, and security. Alpha testing, conducted with 4 IT experts, focused on technical performance and system security, resulting in an overall mean score of 4.92 (Strongly Agree). Beta testing, involving 30 participants (7 clinic staff and 23 patients), assessed usability, workflow efficiency, and effectiveness in managing patient records and laboratory results, achieving an overall mean of 4.47 (Agree). Across both testing phases, security received the highest rating, reflecting strong confidence in data protection. Feedback from both staff and patients indicated that the system is reliable, user-friendly, and effective in streamlining clinic operations and providing timely access to clinical information. Overall, the capstone project successfully addressed the challenges identified during the research, including fragmented record-keeping, manual documentation, and delays in accessing patient information, demonstrating that MediTrack+ provides a practical and efficient solution for small to medium private healthcare facilities.

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MORAL MATRIX: A ROLE-BASED SYSTEM FOR VIOLATION AND SANCTION TRACKING FOR THE CENTER FOR CHARACTER DEVELOPMENT UNIT OF MABALACAT CITY COLLEGE

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ABSTRACT

Moral Matrix is a QR code-enabled, web-based system developed for the Center for Character Development Unit (CCDU) of Mabalacat City College to improve the recording and monitoring of student violations and corresponding sanctions. The project addresses issues commonly found in manual, paper-based documentation such as inconsistent records, slow retrieval, human error, and the risk of falsification. The system uses role-based access so that students, faculty, security personnel, CCDU staff, administrators, and validators can perform only the tasks assigned to them (e.g., encoding violations, verifying identity, monitoring community service, processing good moral requests, and generating reports). Moral Matrix supports faster processing, centralized record management, and more secure handling of student data. To validate quality and acceptability, the system underwent alpha and beta testing and was evaluated using ISO 25010 software quality standards, focusing on functional suitability, performance efficiency, interaction capability, and security. Findings showed "Excellent" overall results, indicating that the system is effective, usable, and reliable for CCDU operations.

OBJECTIVE

- Develop and implement Moral Matrix, a role-based web system for the Center for Character Development Unit (CCDU) of Mabalacat City College, to improve violation and sanction tracking.
- Replace paper-based/manual documentation with a centralized digital record system to reduce errors, delays, and possible record falsification.
- Support QR-based identity verification to ensure accurate student identification during encoding and monitoring of violations and sanctions.
- Test and validate the system's performance and reliability through alpha and beta testing.
- Evaluate acceptability using ISO 25010 quality criteria, focusing on functional suitability, performance efficiency, interaction capability/usability, and security.

REQUIREMENT GATHERING

The researchers studied CCDU's current disciplinary process and identified problems in manual documentation. They gathered user needs and required features through consultation, discussions, and review of how violations, sanctions, and related requests are handled. This step ensured the system would match real CCDU workflow, user roles, and reporting needs.

DESIGN

Based on gathered requirements, the system was planned with role-based access and clear modules for violation logging, sanction tracking, validation, and reporting. The design included database structure and user interface plans to ensure easy navigation for different users. QR scanning was included in the workflow to support accurate identity verification and better control of records.

IMPLEMENTATION

The proponents developed the web-based application using front-end and back-end technologies and built the database for storing violations, sanctions, and service records. Core functions were created such as user login by role, QR code verification, logging and updating of violations, tracking of community service, and generating reports. Notifications and document processing features were also integrated to support CCDU operations.

TESTING

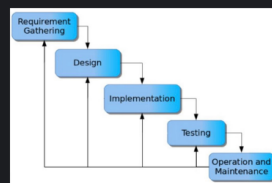
The system was tested in two stages: alpha testing by IT experts and beta testing by target users. Testing checked if features worked correctly and if the system was reliable, secure, and easy to use. ISO 25010 quality standards were used as evaluation basis, focusing on functional suitability, performance efficiency, interaction capability/usability, and security. Feedback was used to fix issues and improve the system before deployment.

MAINTENANCE

After verification and deployment, maintenance focuses on keeping the system stable and updated. This includes bug fixes, feature improvements, monitoring data integrity, and maintaining security and privacy compliance. Continuous support ensures the system remains effective for CCDU and adapts to future needs.

METHODOLOGY

The study used a modified Waterfall approach to develop Moral Matrix through requirement gathering, design, implementation, testing, and maintenance. The system was evaluated through alpha and beta testing using ISO 25010 criteria (functionality, performance, interaction/usability, and security).



RESULTS

The system was evaluated through both alpha testing (IT experts) and beta testing (end users) using ISO 25010 criteria: functional suitability, performance efficiency, interaction capability/usability, and security. The evaluation results showed an overall "Excellent" rating in both testing stages, indicating that Moral Matrix met the required quality standards and performed well in actual use.

CONCLUSION

The study concludes that Moral Matrix is an effective solution for CCDU because it improves how student violations and sanctions are recorded, monitored, and reported. By using QR-based verification and role-based access, the system supports more accurate, efficient, and secure record management compared to manual documentation, strengthening transparency and accountability in disciplinary tracking.

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“PetalPicks: An Interactive Web-Based Application for Personalized Bouquet Arrangement”

Abstract

PetalPicks is an interactive, web-based application developed for Blooms and Petals in Mabalacat City to enhance the bouquet ordering experience through real-time customization, transparent pricing, secure digital payments, and an automated appointment booking system. The system addresses common issues in traditional ordering, such as miscommunication, manual quotations, and scheduling conflicts. Using the Modified Waterfall Model, PetalPicks was designed, developed, and tested through Alpha and Beta evaluations based on ISO 25010 standards. Results show excellent performance in usability, functionality, reliability, and security. The system increases customer satisfaction and operational efficiency while promoting digital transformation among local florists.

Objectives

1. To gather and analyze academic literature on bouquet customization, e-commerce, secure payment processing, and appointment booking module.
2. To identify the hardware and software requirements required for system development application, ensuring system compatibility, scalability, and efficiency.
3. To design the system's interactive user interface (UI) and user experience (UX), database, and functionalities using appropriate analysis and design tools.
4. To create and develop a web application that offers real-time pricing, secure payments through e-wallets, bouquet customization, and appointment scheduling.
5. To test the system using a researcher-made survey tool and ISO 25010 quality standards in terms of functional suitability, performance efficiency, compatibility, maintainability, security, usability, reliability, and portability.
6. To deploy and implement the system at Blooms and Petals and evaluate its impact on customer satisfaction and business operations.

Requirements Gathering

The researchers reviewed literature, conducted interviews, and researched technology to identify system needs. They explored scholarly articles and online resources on e-commerce, flower arrangement systems for customization, and payment security. Additionally, they carried out more studies on online appointment booking systems. The goal was to integrate a scheduling module that allows customers to book consultations or orders for events through the system. They also interviewed the staff and customers of Blooms and Petals to find common issues in manual ordering, scheduling, and payment processing. The information gathered helped outline the overall scope, workflow, and features of the system.

Design

In this phase, the team carefully examined the system's requirements and turned them into technical solutions that guided development. The wireframes that depicted the layout and design of every interface component were made by the researchers in order to depict the system's structure and user interactions in a clear manner. They also prepared a Visual Table of Contents (VTOC) to map the navigation flow and organization of content within the application. This helped both developers and stakeholders understand the system's setup. Additionally, use case diagrams were created to show the functional interactions between users and the system, highlighting how different modules respond to user actions. These planning tools helped create a structured development process, reducing potential errors and improving usability.

Maintenance

Ongoing maintenance was done to keep the system working well. The maintenance phase included regular monitoring, fixing bugs, and updates based on real-world usage and user feedback. Improvements were made to speed up page loading, make the interface easier to use, and enhance the overall user experience. Additional maintenance tasks included updating the event calendar, improving appointment handling features, boosting system security, and conducting regular backups to protect transactional and customer data. These efforts kept the system reliable, secure, and in line with the needs of Blooms and Petals.

Result

The results and outcomes of the system called “PetalPicks: An Interactive Web-Based Application for Personalized Bouquet Arrangement.” It discusses the findings from the system evaluation using ISO 25010 standards, including Alpha and Beta Testing, along with user feedback and performance validation. The study assessed the system's ability to offer personalized bouquet customization, real-time pricing, payment processing, and appointment booking for Blooms and Petals in Mabalacat City, Pampanga.

Methodology

The development of the “PetalPicks: An Interactive Web-Based Application for Personalized Bouquet Arrangement” followed the Waterfall Model of the Software Development Life Cycle (SDLC). This model provided a well-defined structure, sequential process, and allowed for detailed documentation and evaluation at each stage. The figure illustrates the Waterfall Model phases that will be applied in this study.



Implementation

The implementation phase integrated key features such as bouquet customization, interactive controls, real-time pricing, e-wallet payments, and delivery/pick-up scheduling. An appointment system was added, allowing users to choose available dates and receive automated email updates. An admin dashboard was created for managing inventory, pricing, orders, and appointment verification. Development followed the system design using tools like XAMPP, Notepad++, and Hostinger, ensuring a user-friendly interface, synchronized bookings, and optimized performance.

Conclusion

The study confirms that all research objectives were fully achieved, demonstrating that the PetalPicks system successfully addressed the limitations of the shop's traditional bouquet-ordering process by introducing organized digital features such as appointment scheduling, streamlined order processing, and secure online payments, which significantly reduced communication errors and improved service efficiency. The system met the ISO 25010 software quality standards with Excellent ratings across all evaluated areas, proving its reliability, security, and overall performance. Customer experience was also enhanced through real-time pricing, organized scheduling, email verification, and secure payment features, enabling users to manage budgets, service times, and personal data with confidence. Hosted through Hostinger, the system maintained stable and consistent performance. Overall, PetalPicks improved workflow, customer satisfaction, and the online presence of Blooms and Petals, offering a sustainable digital solution that supports local florists in adopting to the growing demands of online commerce.

Acknowledgement

The successful completion of the capstone project PetalPicks: An Interactive Web-Based Application for Personalized Bouquet Arrangement was made possible through the collective support, guidance, and dedication of many individuals. The team extends profound gratitude to Almighty God for providing wisdom and strength throughout the process, as well as to their Technical Adviser, Mrs. Ritchelle Z. Escoto, MIT, for her expert guidance and continuous encouragement. Appreciation is also given to Dr. Myrna E. Cueto-Calma and Engr. Dennis L. Tacadena of Mabalacat City College for permitting and supporting the conduct of the study. The contributions of Alpha testers—IT professionals who helped refine the system—and Beta testers from Mabalacat City who evaluated it based on ISO 25010 standards were invaluable in improving its quality. Special thanks are offered to the management and staff of Blooms and Petals for their cooperation and for allowing the system to be developed for their shop. Lastly, the dedication and teamwork of all researchers were essential to the project's success, and the team expresses heartfelt gratitude to everyone who contributed along the way.

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A WEB-BASED APPOINTMENT SYSTEM WITH PET DISEASES VERIFICATION AND QR - CODE PET LOCATOR FOR MABALACAT PET CLINIC

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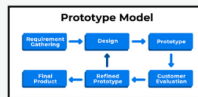
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ABSTRACT

The platform PetKlinika is a web-based appointment and pet management system developed to enhance veterinary services and pet healthcare at Mabalacat Pet Clinic. It integrates appointment scheduling, pet disease verification, medical inquiries, and a QR-Code Pet Locator for lost pet recovery. With a centralized database, it streamlines record management, improves communication, and minimizes clerical errors. Developed using the Prototyping Model and evaluated under ISO 25010 standards, the system demonstrated high functional suitability, usability, and security. PetKlinika also supports SDGs 3 and 9 by advancing animal healthcare and promoting technological innovation. Overall, it provides a modern, efficient, and community-focused solution for veterinary operations.

METHODOLOGY

The developers followed the guidelines at each stage of the prototype model and developed the system in a series of procedural stages. To create an incomplete model with an early prototype that covers the fundamental functionality the client requires, the model's development process begins with customer interviews. The team keeps working on the prototype after receiving suggestions and comments from the client. Until the prototype is approved by the client, the process is repeated.



REQUIREMENT GATHERING

In this phase, the developers promoted professional growth, delegated tasks effectively, and strengthened team collaboration. They gathered essential research on Mabalacat Pet Clinic through literature reviews, credible online sources, and staff interviews to establish a solid study foundation. The team also explored reference websites to guide feature development. For hardware, they utilized a desktop computer for building the system and a laptop for monitoring progress. The software requirements included HTML, PHP, JavaScript, CSS, MySQL, XAMPP, a hosting platform, a domain, and Visual Studio Code. All system features and interface designs were developed based on the team's prepared design references.

DESIGN

The developers defined and identified each user's roles and functions within the system using Use-Case Diagrams. By illustrating how data moves between different modules, Data Flow Diagrams (DFDs) improve comprehension of system operations. Gantt Chart was used in the system development to manage timelines and resources, ensuring the PetKlinika system is delivered on schedule. Storyboard was used to visualize user interactions during the system development. The logical system flow, development execution, and real-user interactions were all in harmony due to these graphics.

PROTOTYPE

The developers identified system features based on the challenges faced by Mabalacat Pet Clinic, particularly in managing appointments, medical records, and lost pet recovery. The appointment scheduling module provides a calendar-based interface for booking consultations, while veterinarians can manage requests to improve time efficiency and reduce errors. The Pet Disease Verification module gives veterinarians secure access to pet profiles and medical histories for accurate updates and diagnoses. The system includes four user interfaces—Admin, Veterinarian, Pet Owner, and Pet Finder—each with specific access levels. Admins manage system content and user accounts, veterinarians handle appointments and medical records, pet owners manage pet profiles and QR codes, and pet finders can scan QR codes to contact owners. Dedicated dashboards ensure secure, organized, and efficient operations for every role.

CUSTOMER EVALUATION

The ISO 25010 Software Product Quality Model, which evaluates eight quality attributes such as functionality suitability, interaction capability, and security, is used by the advocates. Respondents for the system testing were chosen from among the employees and pet owners of Mabalacat Pet Clinic using the self-selection sampling and purposive sampling technique. After being allowed to test the system, these users were requested to fill out a questionnaire created by the researcher. To ascertain satisfaction levels and evaluate the quality of the system, the feedback is subjected to a weighted mean analysis. The analysis's findings directed the process of improvement and guaranteed that the finished system met user requirements.

REFINED PROTOTYPE

The developers refined the system based on recommendations from the panel, technical adviser, and capstone adviser. During testing, the system was evaluated to ensure it met all requirements, incorporating agreed-upon feedback from panels and clients. Alpha and beta testing were conducted using a survey tool aligned with the ISO 25010 Software Product Quality Standard to identify and resolve system issues. A survey questionnaire assessing functional suitability, usability, and security was developed based on ISO 25010 criteria. The questionnaire underwent validity testing to ensure neutral and reliable results. Pretesting was conducted under the guidance of Technical Adviser Dennis L. Tacadena, DIT, to verify test alignment with ISO 25010 sub-criteria, ensure proper correlation of results, and confirm that the instrument accurately measured the intended factors through evaluation of research methods, sampling, frequency distribution, mean scores, and the Likert scale.

FINAL PRODUCT

The system was made accessible on a range of internet-connected devices by means of a scalable and secure web hosting platform. To ensure easy integration into the system, veterinary personnel have training sessions, and pet owners received user manuals and verbal instructions to help them navigate the system's features. Since the QR-Code Pet Locator is presently limited to Mabalacat City, its design would eventually enable regional or national extension.

OBJECTIVES

The general objective of this study is to design, develop, implement, and innovate business processes for a functional web-based system for verifying pet diseases, appointment scheduling, and a QR-code pet locator in Mabalacat Pet Clinic. This system aims to enhance pet healthcare management by providing an efficient platform for pet owners, veterinary staff, and administrators.

To gather related literature, related systems' features, and development procedures through published articles, academic journals, government portals, and conduct interviews with local business personnel.

To Identify Hardware and Software Requirements.

To design the Web System using Diagrams and Analysis Tools

To develop a Web System with an Integration of the Pet Management System, Appointment System, Scheduling System, and QR Code Pet Locator.

To test the develop system and evaluate using the Criteria of the Software Quality Product model of ISO 25010 in terms of Functional Suitability, Interaction Capability, and Security.

To determine the results of alpha and beta tests.

To deploy the Develop Web System in a Reliable Domain Repository site.

RESULTS & OUTCOMES

SUMMARY OF FINDINGS

The study aimed to develop, evaluate, and deploy PetKlinika, a web-based appointment and pet management system for Mabalacat Pet Clinic. The integration of modules—Pet Management, Appointment, Health Assessment, and QR Code Pet Locator—resulted in a comprehensive and user-friendly platform. Pet owners could register pets, book appointments, and send medical inquiries, while clinic staff efficiently managed records and disease verification through dedicated interfaces.

System evaluation using the ISO 25010 Software Quality Model showed strong performance. Alpha Testing by IT experts yielded a mean of 4.08 ("Very Great Extent"), and Beta Testing with pet owners and clinic staff produced a mean of 36.01 ("Very Great Extent"). Both confirmed high functionality, usability, and security, with only minor issues noted.

The system was successfully deployed on a secure Hostinger domain, ensuring stability, accessibility, and data protection. Overall, the findings confirm that PetKlinika met its objectives, adhered to ISO 25010 standards, and proved ready for real-world use in enhancing the clinic's digital operations.

CONCLUSION

The development of PetKlinika successfully addressed Mabalacat Pet Clinic's challenges in managing pet records, appointments, and client interactions by integrating streamlined modules into a user-friendly web-based system. Evaluation results showed that the system met ISO 25010 standards for Functional Suitability, Interaction Capability, and Security, with both alpha and beta testers rating it to a "Very Great Extent." Minor issues were noted but did not affect overall performance. The system's deployment through Hostinger confirmed its stability, accessibility, and readiness for real-world use. Overall, PetKlinika proved to be an efficient and secure digital solution that modernizes veterinary services, enhances clinic operations, and provides a strong foundation for future enhancements aligned with the Sustainable Development Goals (SDGs).

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Mabalacat City College
 Institute of Business and Computing Education


PSITE
 CENTRAL LUCON REGION

SIGNIFY: An Interactive E-Learning Application for Deaf and Educators


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This study developed Signify, an Android-based interactive e-learning application designed to support American Sign Language (ASL) learning for Deaf individuals and educators under the Christian Society for the Deaf (CSD) in Barangay Village, Pampanga North. Addressing communication gaps between Deaf and over 600 hearing members, the project used the Modified Waterfall Model across requirements gathering, design, development, implementation, and testing. Signify integrates ASL videos, interactive modules, real-time search, speech-to-text, assessments, gamified tasks, and progress tracking. The system was built using Flutter, Dart, Firebase, and multimedia assets to ensure accessibility and performance. Alpha Testing (IT experts) using ISO/IEC 25010 showed high scores in functional suitability, usability, and performance. Beta Testing (30 Deaf members) indicated excellent user satisfaction and improved app performance. Overall, Signify enhances ASL learning, strengthens accessibility, and promotes inclusive communication. It supports SDGs 4, 9, and 10 and provides a sustainable, community-centered digital learning tool.

Objectives

General Objective:
To develop Signify, an interactive and user-friendly ASL E-learning Android application tailored for Deaf individuals and educators.

- To gather pertinent data from interviews, academic journals, technical websites, and organizational sources relevant to Deaf education and ASL pedagogy.
- To identify the necessary hardware and software requirements for developing the Android application, including device specifications and development tools.
- To design the system using storyboards, flowcharts, UI mockups, Gantt charts, and Visual Table of Contents.
- To develop the mobile application with the following features:
 - ASL video lessons (offline & online)
 - Real-time search and voice search
 - Learning progress tracking
 - Gamified activities
 - Favorites management
- To assess the application using ISO/IEC 25010 criteria (functional suitability, usability, reliability, performance efficiency, compatibility, maintainability).
- To deploy the application for real-world use via APKPure.

Abstract

Methodology

The researchers used the Modified Waterfall Model, which follows a structured, sequential process while allowing limited feedback loops between phases. This model was selected because it supports clarity in planning, documentation, and development—important for educational systems requiring validated content for learners with disabilities.



Requirements Gathering

During requirement gathering, the researchers conducted interviews and consultations with Deaf individuals, educators, and sign language specialists to understand user needs and functional requirements. The system specifications focused on accessibility, visual clarity, intuitive navigation, and accurate representation of Filipino Sign Language. Content requirements included lessons, sign demonstrations, quizzes, user progress tracking, and an interface sensitive to the learning patterns of Deaf users.

Design

Based on the identified requirements, the system design was conceptualized using storyboards, which visually mapped user interactions and screen transitions. A flowchart detailed the operational logic of navigating lessons, accessing sign demonstrations, and completing assessments. The Visual Table of Contents (VTOC) structured the lesson flow and coherent module organization. These design tools ensured that all educational and accessibility objectives were systematically integrated into the application.

Development

SIGNIFY was developed using Flutter and the Dart programming language through Android Studio, ensuring compatibility across Android devices. The interface was prototyped using Figma for consistency in color, typography, and layout. The backend data storage utilized Firebase, allowing real-time data access, cloud storage, and seamless integration of user information. Additionally, Google's ML Kit was incorporated for sign recognition components where applicable. This phase included module creation, multimedia content integration, quiz development, and UI refinement.

Testing

Testing was conducted in two stages. Alpha Testing involved educators, IT experts, and sign language specialists who assessed the system's functionality, usability, security, and content accuracy. Their feedback informed revisions before public release.

Deployment

Upon completing development and internal testing, the researchers compiled SIGNIFY into an Android Package (APK) and uploaded it to APKPure, providing an accessible platform for installation by participants during beta testing. This distribution method allowed wider reach, device compatibility testing, and real-world usage interaction by the intended users.

Maintenance

Testing was conducted in two stages. Alpha Testing involved educators, IT experts, and sign language specialists who assessed the system's functionality, usability, security, and content accuracy. Their feedback informed revisions before public release.

Result & Outcomes

Data Gathering & System Requirements

A comprehensive needs analysis revealed the instructional challenges encountered by Deaf learners, notably limited access to sign-language-based learning materials and insufficient digital tools that support visual comprehension. Consultations with educators highlighted the need for structured modules, clear sign demonstrations, and adaptive assessments. These insights guided the final system features, ensuring pedagogical appropriateness, accessibility, and ease of use.

Test Result

Alpha Test:
SIGNIFY achieved an overall mean of 4.39, reflecting very high acceptability across ISO 25010 criteria. The system received strong ratings in usability, reliability, performance efficiency, and compatibility, showing that its features are accurate, stable, and easy to use. These results confirm that SIGNIFY delivers excellent quality and dependable performance during its initial evaluation.

Beta Test:
The Beta test produced an overall mean of 4.36, demonstrating that SIGNIFY performs effectively in real classroom environments. Deaf learners and educators rated the system highly in usability, reliability, and compatibility, highlighting its accessibility, stability, and smooth operation. These findings confirm that SIGNIFY is highly functional and beneficial for Deaf education.

Conclusion

Signify effectively delivers an accessible and inclusive ASL learning experience for Deaf individuals and educators. Both Alpha and Beta tests confirm high system quality based on ISO 25010 standards. Through interactive lessons, assessments, offline/online content, and gamified activities, the app supports continuous learning, enhances communication within the community, and advances digital inclusivity aligned with global SDGs. It provides a strong foundation for future expansion into advanced ASL content and broader accessibility features.

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TECHNOLOGY

SHAPING A BETTER FUTURE

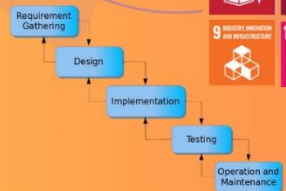
SignSAYA: A Mobile Application for Filipino Sign Language Interpretation Using Real-Time Gesture Recognition to Aid in Deaf Communication

ABSTRACT

This study introduces SignSAYA, a mobile-based Filipino Sign Language (FSL) learning and interpretation application designed for Deaf individuals, learners, and teachers. It features real-time FSL-to-Text, Text-to-FSL, a categorized dictionary with video demonstrations, customizable interface, and game-based quizzes. The system also includes login, Google authentication, and guest access. Developed using the Modified Waterfall Model, the application underwent alpha testing with IT experts and beta testing with Deaf and hearing users. Based on ISO 25010 standards, results showed mean scores of 4.33 and 4.31, both rated Excellent, indicating strong usability, performance, and support for inclusive communication and learning.

METHODOLOGY

This study employed the Modified Waterfall Model as the software development approach for the design and implementation of the SignSAYA application. This model was chosen for its structured yet flexible framework, allowing the researchers to follow a systematic process while incorporating necessary improvements at each stage. The methodology consisted of five main phases: requirements gathering, system design, development, testing, and deployment.



4

QUALITY EDUCATION

8

DECENT WORK AND ECONOMIC GROWTH

9

INDUSTRIAL INNOVATION AND INFRASTRUCTURE

10

REDUCED INEQUALITIES

INTRODUCTION

This study introduces SignSAYA, a mobile-based Filipino Sign Language (FSL) learning and interpretation application developed to support both Deaf and hearing individuals. The application aims to enhance communication, promote accessibility, and improve learning experiences through the use of modern technology. It features real-time FSL translation, interactive quizzes, categorized learning modules, and video demonstrations to help users better understand sign language. Designed with a user-friendly interface, SignSAYA encourages active engagement and continuous learning. By integrating educational and assistive tools in one platform, the application contributes to inclusive education and supports effective communication across different social and academic environments.

KEY FINDINGS

1. Requirement Gathering

The requirement gathering process involved brainstorming, school visits, surveys, and interviews with Deaf and hearing students and teachers from Mabuhay City Elementary School and Mausaque Resettlement High School. Insights were also gathered from signing teachers, related studies, capstone projects, and online sources to understand communication challenges and guide the development of SignSAYA.

2. Design

The design phase involved creating storyboards, flowcharts, and interface layouts to visualize the structure and functionality of SignSAYA. The researchers focused on developing a user-friendly and accessible design, ensuring smooth navigation and clear interaction. This phase provided a detailed blueprint that guided the development of the application's features and overall system flow.

3. Implementation

The implementation phase involved developing the SignSAYA application using Android Studio and integrating key technologies such as OpenCV, MediaPipe, and TensorFlow for gesture recognition. Firebase was used for database and authentication. The system's core features, including translation, learning modules, and quizzes, were built, tested, and refined to ensure functionality and performance.

OBJECTIVE OF THE STUDY

1. Develop and implement SignSAYA, a mobile-based Filipino Sign Language (FSL) learning and interpretation application designed to improve communication between Deaf and hearing individuals.
2. Replace traditional and limited learning resources with a centralized digital platform that provides accessible FSL learning tools.
3. Test and validate the system's performance and reliability through alpha and beta testing.
4. Evaluate acceptability using ISO 25010 quality criteria, focusing on functional suitability, performance efficiency, usability, compatibility, reliability, and portability.

4. Testing

The testing phase involved alpha testing with IT experts and beta testing with Deaf, hearing users, and SPED teachers. The system was evaluated using ISO 25010 standards focusing on functionality, usability, performance, and reliability. Feedback was gathered to identify issues and improve the overall performance, accuracy, and user experience of SignSAYA.

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RESULTS

The evaluation results of the SignSAYA application, based on the ISO 25010 Software Quality Model, demonstrated consistently high performance across both alpha and beta testing phases. The alpha testing conducted with IT experts yielded an overall mean score of 4.33, while the beta testing involving Deaf and hearing participants, including SPED teachers, resulted in a slightly lower but still Excellent rating of 4.31. The system performed well in terms of functional suitability, usability, reliability, performance efficiency, compatibility, and portability. Overall, the results indicate that SignSAYA is effective, user-friendly, and reliable, providing a strong foundation for inclusive communication and FSL learning.

CONCLUSION

SignSAYA successfully provides a mobile-based Filipino Sign Language learning and interpretation platform that enhances communication between Deaf and hearing individuals. The system demonstrates strong performance in usability, functionality, and reliability based on ISO 25010 evaluation. Overall, it supports inclusive education, improves accessibility, and promotes better understanding of Filipino Sign Language.



**TECHNOLOGY TODAY,
A BETTER TOMORROW.**

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StenoCoach:

Stenography Learning Management System for Mabalacat City College





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ABSTRACT

StenoCoach is a web-based learning management system designed to enhance stenography learning among Bachelor of Science in Office Administration (BSOA) students of Mabalacat City College. The platform offers interactive lessons, real-time practice drills, a virtual stenotype keyboard, quizzes, progress tracking, and digital certificates to support effective skill development. StenoCoach was developed using the Modified Waterfall Model of the Software Development Life Cycle (SDLC) and evaluated based on ISO/IEC 25010 standards, including Functional Suitability, Compatibility, Interaction Capability, Security, Performance Efficiency, and Flexibility. Alpha testing achieved an overall mean score of 4.93, while beta testing obtained a mean score of 4.78, both interpreted as "Excellent." The system aligns with Sustainable Development Goals (SDGs), particularly Quality Education (SDG 4), Decent Work and Economic Growth (SDG 8), Industry, Innovation, and Infrastructure (SDG 9), and Reduced Inequalities (SDG 10), by promoting accessible and technology-driven stenography education.

OBJECTIVES OF THE STUDY

The general objective of this study was to develop a web-based platform entitled "StenoCoach: Stenography Learning Management System for Mabalacat City College", which is designed to enhance stenography learning through interactive lessons and tutorials.

In line with this, the study aims to achieve the following specific objectives:

1 To gather relevant information and best practices for system development through literature and studies on e-learning and educational technology.

2 To identify the required hardware and software specifications necessary for system implementation and compatibility.

3 To design the StenoCoach system using appropriate system analysis and design tools such as flowcharts, storyboards, use case diagrams, visual tables of contents, and Gantt charts.

4 To develop the system with integrated lessons, interactive practice sessions, and progress tracking for stenography and machine shorthand learning.

5 To test and evaluate the system through alpha and beta testing based on ISO/IEC 25010 quality standards.

6 To deploy and implement the StenoCoach system using Vercel as the hosting platform and stenocoach.xyz as the domain name.

METHODOLOGY

The research employed the Modified Waterfall Model, allowing a structured and systematic development process.



Figure 1. Modified Waterfall Model

1. REQUIREMENTS GATHERING

The requirements-gathering phase identified the functional, hardware, and software needs of the StenoCoach system through a review of related studies, existing e-learning platforms, and stenography learning practices. Emphasis was placed on accessibility, usability, interactivity, and secure data handling for BSOA students, instructors, and administrators, establishing a solid foundation for a reliable and scalable learning management system.

2. DESIGN

During the design phase, the gathered requirements were converted into a structured system plan. Tools such as flowcharts, use case diagrams, storyboards, visual tables of contents, and Gantt charts were used to define system workflows, user interactions, and development timelines. This phase ensured a user-friendly interface and clearly defined system roles.

3. DEVELOPMENT

The development phase focused on constructing the StenoCoach system based on the approved design. The platform integrated structured lessons, interactive practice drills, quizzes, progress tracking, and digital certification features. Development followed the Modified Waterfall Model to maintain an organized and systematic implementation process using modern web technologies.

4. TESTING

StenoCoach underwent developer, alpha, and beta testing to assess functionality, usability, and compatibility. The system was evaluated using ISO/IEC 25010 quality standards, covering functional suitability, compatibility, interaction capability, security, performance efficiency, and flexibility. Feedback from users guided system improvements.

5. DEPLOYMENT

After successful testing, StenoCoach was deployed as a web-based application using Vercel as the hosting platform, with stenocoach.xyz as its official domain. Deployment ensured secure access, system stability, and ease of use while supporting efficient updates.

6. MAINTENANCE

The maintenance phase ensured continuous system reliability through regular monitoring, bug fixes, feature enhancements, content updates, and security checks. Ongoing user feedback was used to support improvements, ensuring long-term academic use at Mabalacat City College.



4. QUALITY EDUCATION



8. DECENT WORK AND ECONOMIC GROWTH

RESULTS AND OUTCOME



9. INDUSTRY, INNOVATION, AND INFRASTRUCTURE



10. REDUCED INEQUALITIES

This results present the key findings of StenoCoach, demonstrating its effectiveness in supporting stenography learning for BSOA students at Mabalacat City College. Alpha and beta testing showed high performance in terms of functional suitability, compatibility, interaction capability, security, performance efficiency, and flexibility. Key features such as interactive learning modules, real-time practice exercises, and progress tracking enhanced student engagement, skill development, and overall learning efficiency.

DATA AND GATHERING REQUIREMENTS

The development of StenoCoach was informed by a systematic data-gathering process involving a review of related literature, existing e-learning platforms, stenography instructional methods, and current educational technologies. System requirements were derived from the needs of BSOA students and faculty of Mabalacat City College to ensure compatibility with standard desktop and laptop devices. System analysis and design tools, including flowcharts, storyboards, use case diagrams, a visual table of contents, and a Gantt chart, were employed to define system workflows, user interactions, and development schedules, ensuring an organized and user-centered learning platform.

TEST RESULTS

Alpha and Beta testing results of StenoCoach, based on ISO/IEC 25010, show consistently excellent performance across all criteria. Functional Suitability (4.95–4.83), Compatibility (4.88–4.68), Interaction Capability (4.91–4.81), Security (4.96–4.81), Performance Efficiency (4.94–4.73), and Flexibility (4.94–4.85) all remained in the Excellent range. Overall, the mean score shifted from 4.93 in Alpha to 4.78 in Beta, confirming that the system maintained high quality and reliability under real-user conditions.

CONCLUSION

The researchers conclude that StenoCoach was successfully developed and implemented as a comprehensive stenography learning management system. With structured modules, interactive exercises, machine shorthand drills, and progress tracking, the platform effectively supports both beginner and advanced learners. Hosted on Vercel with the domain stenocoach.xyz, it ensures stable accessibility. Despite limitations such as the lack of real-time shorthand recognition, StenoCoach demonstrates strong educational value, usability, and performance, fulfilling the study's objectives as an innovative digital learning resource.

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ING TRIKE CUAYAN NA

A TRICYCLE NAVIGATION AND BOOKING SYSTEM FOR CUAYAN TODA

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ABSTRACT

In Cuayan, Angeles City, tricycles continue to serve as a primary mode of transportation and are operated under the supervision of the Cuayan Tricycle Operators and Drivers' Association (TODA). Despite their importance, passengers often encounter difficulties due to the absence of a modern booking and navigation platform, resulting in fare disagreements and inconsistent pricing, particularly for tourists, new residents, and commuters unfamiliar with local routes. To address these concerns, this study developed **TrikeCuayan: A Tricycle Navigation and Booking System for Cuayan TODA**, a digital platform designed to facilitate ride booking, provide route navigation, and offer accurate fare estimates. The system was developed through a comprehensive assessment of the needs and preferences of both TODA drivers and passengers, aiming to enhance commuting convenience, improve transparency in fare calculation, and promote a more efficient and reliable tricycle transportation service.

OBJECTIVE**General Objective**

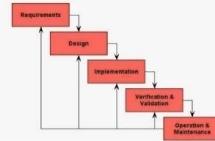
to develop a smart and user-friendly fare estimation system for tricycle commuters under Cuayan TODA in Angeles City. This system was designed to help passengers know the estimated fare before their trip, making pricing more transparent and fairer for both riders and drivers.

Specific Objectives

1. To identify the required hardware and software for system development.
2. To design the system using appropriate diagrams and UI mockups.
3. To create and develop GPS-based fare estimation aligned with local fare matrices.
4. To evaluate the system using ISO 25010 quality standards.

METHODOLOGY

The study employed a Modified Waterfall Model, consisting of requirements gathering, system design, development, testing, and deployment. Data were collected through interviews, surveys, and literature review. Alpha testing involved IT experts, while Beta testing included selected Cuayan TODA drivers and passengers. System quality was assessed using ISO 25010 criteria.

**REQUIREMENTS GATHERING**

The requirements gathering phase identified the hardware and software needed for developing TrikeCuayan. Requirements were gathered through related studies, brainstorming, and consultations with Cuayan TODA drivers and residents. The system was developed using a mid-range computer and Android devices, with Flutter, Dart, Firebase, Google Maps API, Visual Studio Code, and Vercel as the main technologies. Design tools such as use case diagrams, wireframes, storyboards, and Gantt charts were also utilized to ensure efficient development and to address the transportation needs of the Cuayan TODA community.

DESIGN

In this phase, the researchers transformed the gathered requirements into a detailed system design for TrikeCuayan. Design tools such as Use Case Diagrams, system flowcharts, wireframes, and UI mockups were utilized to illustrate system functionalities, user interactions, and workflow processes. The design focused on creating a user-friendly, accessible, and efficient platform for passengers, drivers, and administrators while ensuring reliable system architecture, secure data management, and a seamless user experience.

IMPLEMENTATION

During the implementation phase, the researchers implemented the TrikeCuayan using Flutter and Dart, with Firebase serving as the backend database and Google Maps API providing navigation and distance calculation functionalities. The system included key features such as ride booking, fare estimation, route navigation, driver queue management, and driver-passenger interaction. A web-based administrative portal was also implemented to manage user records, driver registrations, and system operations. Continuous testing and debugging were conducted throughout the process to ensure the system's functionality, reliability, security, and overall performance.

TESTING

Following the implementation phase, the TrikeCuayan: A Tricycle Navigation and Booking System for Cuayan TODA underwent Alpha and Beta Testing to evaluate its functionality, usability, reliability, efficiency, portability, and security based on the ISO 25010 Software Quality Model. IT experts conducted Alpha Testing to identify and resolve system issues, while selected Cuayan TODA drivers and passengers participated in Beta Testing to assess the system's real-world performance. The results confirmed that the application effectively supports ride booking, GPS navigation, fare estimation, and driver management, demonstrating its readiness for deployment and its ability to provide a reliable and user-friendly transportation service.

MAINTENANCE

After the verification phase, the researchers will proceed to the maintenance phase of TrikeCuayan. This phase involves monitoring system performance, fixing bugs, enhancing security, managing the database, and providing user support. Regular updates will be implemented to ensure that TrikeCuayan remains a secure, reliable, and user-friendly transportation solution that meets the evolving needs of the Cuayan TODA community.

RESULT

The combined beta test results from Cuayan TODA drivers and passengers demonstrate the excellent performance of TrikeCuayan, achieving mean scores of 4.74 and 4.71, respectively. The system received high ratings in Functional Suitability, Usability, Compatibility, Security, and Flexibility, indicating its effectiveness, reliability, and ease of use. The findings also show that TrikeCuayan successfully improved fare transparency, enhanced booking efficiency, and reduced fare-related disputes, validating its capability as a dependable and user-friendly transportation solution for the Cuayan TODA community.

CONCLUSIONS

In this study, the researchers successfully developed TrikeCuayan: A Tricycle Navigation and Booking System for Cuayan TODA, which effectively addressed the objectives of improving tricycle transportation services through a digital platform. The system enhanced fare transparency, streamlined ride booking, improved navigation through GPS integration, and strengthened communication between drivers and passengers. These features contributed to a more efficient, reliable, and user-friendly transportation experience within the Cuayan community. The implementation of the system demonstrated positive results in terms of usability and operational efficiency, supporting the goal of modernizing local tricycle operations.

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Visondyna Job Board

Web-Based Hiring System for Manpower Solutions · Mabalacat City College

ABSTRACT

This study developed the **Visondyna Job Board**, a web-based job application and listing management system for Visondyna Manpower General Services. The platform addresses limited online job visibility, manual applicant tracking, fragmented records, and slow communication. Built with **Next.js**, **Prisma**, **PostgreSQL**, and **shadcn/ui**, it integrates authentication, applicant profiling, skill-based recommendations, digital forms, data export, HR messaging, and in-app/email notifications.

Next.js Prisma ORM PostgreSQL shadcn/ui OAuth 2.0 Docker
Node.js JWT jsPDF Nodemailer

EVALUATION RESULTS (ISO/IEC 25010)

Alpha: 3 IT experts · Beta: 10 Admin/HR users + 20 Job-seeker users

Alpha — IT Experts	3.73
Beta — Admin/HR Users	4.32
Beta — Job Seekers	4.49

JOB SEEKER BETA — ISO DIMENSIONS

FUNCTIONAL 4.55 Excellent	INTERACTION 4.47 Excellent	FLEXIBILITY 4.42 Excellent	SECURITY 4.54 Excellent
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✓ All 4 dimensions rated Excellent after post-alpha revisions.

OBJECTIVES

01
Analyze existing recruitment processes at Visondyna via stakeholder interviews

02
Design using flowcharts, ERD, FDD, use case diagrams & Gantt charts

03
Develop Applicant, Admin & HR modules using Agile Scrum sprints

04
Conduct Alpha & Beta testing to identify issues and refine the system

05
Evaluate via ISO/IEC 25010: Functional, Interaction, Flexibility, Security

SDG
Industry, Innovation & Infrastructure alignment (Goal 9)

KEY SYSTEM FEATURES

- User Auth & OAuth 2.0
- Job Posting & Listing
- Skill-Based Matching
- Admin Dashboard
- HR Direct Messaging
- Email & In-App Notifications
- Data Export (jsPDF)
- Account Moderation
- Applicant Status Tracking
- Data Visualization

SYSTEM SCOPE

✓ Web Platform ✓ Mobile View ✓ 3 User Roles ✓ PDF Export

✓ Email Alerts ✗ Mobile App ✗ Payroll ✗ Offline Mode

METHODOLOGY

Developed using **Agile Scrum** — iterative sprints for structured, incremental delivery. Design utilized multiple modeling tools to blueprint all system processes before implementation.

Backlog → Sprint → Develop → Test → Release

System Flowchart Storyboard Use Case Diagram
ER Diagram (ERD) FD Diagram Gantt Chart

CONCLUSION

The Visondyna Job Board successfully digitalizes core recruitment processes while complementing the agency's semi-digital workflow. It reduces administrative workload, enhances communication, improves applicant engagement, and provides a replicable model for small-to-medium manpower agencies. The system strengthens labor matching efficiency and supports Sustainable Development Goal 9.


SDG 9 — Industry, Innovation & Infrastructure
Introduces technology-driven recruitment to improve manpower services in Mabalacat City, Pampanga.

TESTING PHASES

PHASE	PARTICIPANTS	FOCUS	RESULT
Alpha	3 IT Experts	Technical validation, core feature coverage	3.73 Very Good
Beta	10 Admin/HR	Recruitment workflow, job & applicant mgmt	4.32 Excellent
Beta	20 Job Seekers	Usability, job matching, application flow	4.49 Excellent

IMPACT & RECOMMENDATIONS

- Centralizes recruitment data, replacing fragmented Facebook posts, walk-ins, and tarpaulin-based sourcing
- Reduces manual applicant tracking and administrative paperwork for HR personnel
- Future work: mobile app version, AI-enhanced matching, integration with DOLE PhilJobNet
- Scalable model applicable to other manpower and placement agencies in the Philippines

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KEY FINDINGS

- 797+ workers hired via Facebook & walk-ins — system scales this significantly
- Alpha (WM 3.73 / Very Good) flagged UI & recommendation areas for improvement
- Post-alpha revisions elevated all scores to **Excellent** in beta testing
- Job seekers rated Functional Suitability at **4.55** and Security at **4.54**
- Compatible with Visondyna's semi-digital operations and existing offline processes

CERTIFICATION OF PLAGIARISM
SCAN VERIFICATION
AND
CERTIFICATION OF ENGLISH
CRITIC

(Full Paper - Oral Presentation)



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Basilio, Alejandro G. Maglalang, Keryll D., Magsino, Jemima Grace B., Victoria, Jomari G. of Bachelor of Science in Information and Technology entitled **“AloHOA: A Web-Based Homeowners Association Management System for Xevera Subdivision, Mabalacat City”** is valid and has 8% similarity relative to internet databases.

This CERTIFICATION is issued this 10th day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025258

December 11, 2025

CERTIFICATION

This is to certify that the manuscript of the undergraduate thesis titled: **ALOHOA: A WEB-BASED HOMEOWNERS ASSOCIATION MANAGEMENT SYSTEM FOR XEVERA SUBDIVISION, MABALACAT CITY** by **Alejandro G. Basilio, Keryll D. Maglalang, Jemima Grace B. Magsino, and Jomari G. Victoria**, of the **Bachelor of Science in Information Technology (BSIT)** program at **Mabalacat City College**, has been checked, proofread, and edited/corrected for grammatical and mechanical consistency.

This certification is issued upon the request of the authors for whatever academic purpose it may serve.

Signed:



EDWARD Q. INONG, LPT, MAELLT
Proofreader



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Bulaun, Angelito C., Delatina, Maruel D., Flores, Kristine Joy M., and Quiambao, Isaiah C. of Bachelor of Science in Information and Technology entitled "**ArborWatch: A Web-Based Mapping and Monitoring System for Conservation of Trees in Mabalacat City**" is valid and has 8% similarity relative to internet databases.

This CERTIFICATION is issued this 3rd day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025264



Mabalacat City College

Mabalacat City, Pampanga

CERTIFICATION OF LANGUAGE EDITING

This is to certify that the undergraduate thesis entitled:

ArborWatch: A Web-Based Mapping and Monitoring System for Conservation of Trees in Mabalacat City

Authored by:

**Bulaun, Angelito C.
Delatina, Maruel D.
Flores, Kristine Joy M.
Quiambao, Isaiah C.**

in partial fulfillment of the requirements for the degree Bachelor of Science in Information Technology, has undergone a thorough review and language editing.

The manuscript was evaluated by an English Language Editor, whose name and signature appear below, to ensure that the text is grammatically correct, clear, and coherent. The editing process did not alter the content, structure, or authorial intent of the study in any way.

Certified this 8th Day of December 2025 by:

A handwritten signature in black ink, appearing to read "Michael A. Mesa".

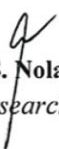
Michael A. Mesa, LPT, PhD
English Language Editor



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Gamboa, Erain F., Lansangan, Don Marco S., Delos Santos, Kail Christian L., and Calma, Louis Miguel B. of Bachelor of Science in Information and Technology entitled "**CrimeTrack: A Web-Based Case Information Management System for Mabalacat City Police Station**" is valid and has 3% similarity relative to internet databases.

This CERTIFICATION is issued this 16th day of June 2026 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-OVPRES2026100

CERTIFICATE OF PROOFREADING

This is to certify that the research paper entitled "*CrimeTrack: A Web-Based Case Information Management System for Mabalacat City Police Station*," by Gamboa, Erain F., Lansangan, Don Marco S., Delos Santos, Kail Christian L., and Calma, Louis Miguel B., has undergone a comprehensive process of editing and proofreading.

The review process ensured that the manuscript adheres to established grammatical standards, maintains stylistic coherence, and complies with the technical conventions expected of an academic research paper.

This certificate is issued at the request of the authors for academic purposes.

Issued and signed this 9th day of June 2026.


ANGELO JEAN R. MERCADER, LPT
Instructor, Mabalacat City College
Proofreader
PRC Lic. No. 2350495

MABALACAT CITY COLLEGE



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Atkinson, Kate Ashley F., Carcellar, Melvin G., Flores, Samantha R., and Manalo, Veronica E. of Bachelor of Science in Information Technology entitled **“EmurgenTrack: A Web and Mobile-Based Community Emergency System for the CDRRMO of Mabalacat City”** is valid and has 9% similarity relative to internet databases.

This CERTIFICATION is issued this 12th day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.

Glen S. Nojasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025275



MABALACAT CITY COLLEGE
Mabalacat City, Pampanga

December 16, 2025

CERTIFICATION

This is to certify that the manuscript of the undergraduate thesis titled: **"EmurgenTrack: A Web and Mobile-Based Community Emergency System for the CDRRMO of Mabalacat City"** prepared and submitted by Atkinson, Kate Ashley F., Carcellar, Melvin G., Flores, Samantha R., and Manalo, Veronica E. who are fourth-year, Bachelor of Science in Information Technology students at Mabalacat City College, has been checked, proofread, and edited/corrected for grammatical and mechanical consistency.

Signed:


CARL REYDEL I GUANLAO, LPT
English Proofreader



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Frias, Elaiza, Gonzales, Gellaine Eunize M., Libo, Liam L., and Libo, Tricia of Bachelor of Science in Information Technology entitled **"FitSecure: Online Management System with Biometric Secured Locker Services for Rooftop Fitness Gym"** is valid and has 8% similarity relative to internet databases.

This CERTIFICATION is issued this 15th day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025288

CERTIFICATE OF PROOFREADING

This is to certify that the research paper entitled ***"FitSecure: Online Management System with Biometric Secured Locker Services for Rooftop Fitness Gym"*** by **Frias, Elaiza, Gonzales, Gellaine Eunize M., Libo, Liam L., Libo, Tricia L.,** has undergone a comprehensive process of editing and proofreading.

The review process ensured that the manuscript adheres to established grammatical standards, maintains stylistic coherence, and complies with the technical conventions expected of an academic research paper.

This certificate is issued at the request of the authors for academic purposes.

Issued and signed this 13th day of December 2025.


ANGELO JEAN R. MERCADER, LPT
Instructor/Mabalacat City College
Proofreader
PRC Lic. No. 2350495



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Garbo, Chezly S. Muldong, Izan J., Pacia, Prince Kenneth P., and Orcena, Charles Kyle G. of Bachelor of Science in Information Technology entitled **“GRADWAY: A CAPSTONE MANAGEMENT SYSTEM FOR COMPUTING STUDIES OF MCC”** is valid and has 1% similarity relative to internet databases.

This CERTIFICATION is issued this 25th day of May 2026 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-OVPRES2026054



Mabalacat City College
Mabalacat City, Pampanga
Institute of Hospitality and Tourism Management

CERTIFICATION

The present document serves as an official certification for the thesis titled **"GradWay: A Capstone Management System for Computing Studies of MCC"** authored by **Garbo, Chezly S., Muldong, Izan J., Pacia, Prince Kenneth P., Orcena, Charles Kyle G.**

The previously mentioned study has been reviewed and edited by an English proofreader, whose name and signature appear below, to ensure that the language used is clear, concise, and free of grammatical errors. Moreover, it should be noted that the authors' objectives were not altered in any way during the editing process.

A handwritten signature in black ink, appearing to read "Michael A. Mesa".

Michael A. Mesa, LPT, PhD

English Proofreader

June 01, 2026



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Manguerra, Kyle Owen A., Delos Reyes, Cesar Emanuelle P., Herrera, Allaine Paul M., and Mirasol, Marc Andre J of Bachelor of Science in Information Technology entitled **"Green-Grain Hub: A Microcontroller-Based Waste to Rice Dispense"** is valid and has 9% similarity relative to internet databases.

This CERTIFICATION is issued this 15th day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025279



Mabalacat City College

Mabalacat City, Pampanga

CERTIFICATION OF LANGUAGE EDITING

This is to certify that the undergraduate thesis entitled:

Green-Grain Hub: A Microcontroller-Based Waste to Rice Dispenser

Authored by

Manguerra, Kyle Owen A.

Delos Reyes, Cesar Emanuelle P.

Herrera, Allaine Paul M.

Mirasol, Marc Andre J.

in partial fulfillment of the requirements for the degree **Bachelor of Science in Information Technology**, has undergone thorough review and language editing.

The manuscript was evaluated by an English Language Editor, whose name and signature appear below, to ensure that the text is grammatically correct, clear, and coherent. The editing process did not alter the content, structure, or authorial intent of the study in any way.

Certified this 19th of December 2025 by:

A handwritten signature in black ink, appearing to read "Michael A. Mesa", written over a horizontal line.

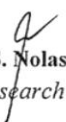
Michael A. Mesa, LPT, Ph.D.
English Language Editor



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Cabillo, Abegail, Hipolito, Jamila Joy, Espinoza, James Mark, and Duldulao, Kurt Elija of Bachelor of Science in Information and Technology entitled **“Ing Trike CuAyan na: A Tricycle Navigation and Booking System for Cuayan TODA”** is valid and has 2% similarity relative to internet databases.

This CERTIFICATION is issued this 16th day of June 2026 at Office of the Vice President for Research and Extension Services, Mabala City College, Rizal St., Dolores, Mabala City, Pampanga.


Glen S. Nolasco, M.Sc
Vice President for Research and Extension Services



CRN-OVPRES2026097

GRAMMARIAN'S CERTIFICATE

This is to certify that the undersigned has reviewed and went through all the pages of the capstone project entitled **“Ing Trike CuAyan Na: A Tricycle Navigation and Booking System for Cuayan TODA”** by Abegail Cabillo, Jamila Joy Hipolito, James Mark Espinoza, and Kurt Elijah Duldulao of Mabalacat City College, aligned with the set of structural rules that govern the composition of sentences, phrases, and words in the English language.

This certification is issued to the aforementioned author/s for English Critic/Grammarian requirements. Issued this 13th day of June 2026.


GIRLIE S. GANADO, LPT
English Critic/Grammarian
PRC#: 2212660



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Aguilar, Alexander L., Ballesteros, Gwen T., Penino, Jericho C. and Vargas, Iver Allen N. of Bachelor of Science in Information and Technology entitled **"Intellicode: Learning Tool & Personalized Coding Assessment"** is valid and has 8% similarity relative to internet databases.

This CERTIFICATION is issued this 10th day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025269



Mabalacat City College

Mabalacat City, Pampanga

CERTIFICATION OF LANGUAGE EDITING

This is to certify that the undergraduate thesis entitled:

Intellicode: Learning Tool & Personalized Coding Assessment

Authored by:

**Aguilar, Alexander L.
Ballesteros, Gwen T.
Penino, Jericho C.
Vargas, Iver Allen N.**

In partial fulfillment of the requirements for the degree of Bachelor of Science in
Information Technology.

The manuscript was evaluated by an English Language Editor, whose name and
signature appear below, to ensure that the text is grammatically correct, clear, and
coherent. The editing process did not alter the content, structure, or authorial intent of
the study in any way.

Certified this 9th Day of December 2025 by:

A handwritten signature in black ink, appearing to read "Michael A. Mesa".

Michael A. Mesa, LPT, PhD
English Language Editor



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Bautista, Emmanuelle P., Esguerra, Reign C., Gamboa, Jan Michael C., and Manaloto, Aaron Ken T. of Bachelor of Science in Information and Technology entitled **“IproTech: Microcontroller-Based Location Tracking with Temperature Alarm and Monitoring User Interface For Construction Workers”** is valid and has 5% similarity relative to internet databases.

This CERTIFICATION is issued this 3rd day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.

Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025265



Mabalacat City College

Mabalacat City, Pampanga

CERTIFICATION OF LANGUAGE EDITING

This is to certify that the undergraduate thesis entitled:

IproTech: Microcontroller-Based Location Tracking with Temperature Alarm And Monitoring User Interface For Construction Workers

Authored by:

**Bautista, Emmanuelle P.
Esguerra, Reign C.
Gamboa, Jan Michael C.
Manaloto, Aaron Ken T.**

In partial fulfillment of the requirements for the degree of Bachelor of Science in Information Technology.

The manuscript was evaluated by an English Language Editor, whose name and signature appear below, to ensure that the text is grammatically correct, clear, and coherent. The editing process did not alter the content, structure, or authorial intent of the study in any way.

Certified this 9th Day of December 2025 by:

A handwritten signature in black ink, appearing to read "Michael A. Mesa".

Michael A. Mesa, LPT, PhD
English Language Editor



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Candelaria, Ielmar Carlo, Gamboa, Filip Carlos G., Santos, Karl D. and Tapang, Carlvon Ayzel P. of Bachelor of Science in Information and Technology entitled **"I-TUNGKOD": A Smart Assistive Cane with Ultrasonic Proximity Sensing, GPS Tracking, and Emergency Communication Features** is valid and has 3% similarity relative to internet databases.

This CERTIFICATION is issued this 5th day of May 2026 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-OVPRES2026048

CERTIFICATION OF GRAMMARIAN

This is to certify that the study titled, **“I-TUNGKOD”: A Smart Assistive Cane with Ultrasonic Proximity Sensing, GPS Tracking, and Emergency Communication Features**”, proposed by **Candelaria, Ielmar Carlo Gamboa, Filip Carlos G., Santos, Karl D., Tapang, Carlvon Ayzel P.**, under the course of **Bachelor of Science in Information Technology** at the Mabalacat City College, has been checked and verified by the undersigned.

Signed:


Carl Remiel I. Guanlao, LPT
PRC Reg. No: 2129469
Grammarian

Date Signed:

May 12, 2026



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Angeles, Algernon C., Enobio, Maria Angelica, and Sanchez, Allen S. of Bachelor of Science in Information and Technology entitled **"KANDADO: An IoT-Based Public Locker System with Randomized QR Codes"** is valid and has 5% similarity relative to internet databases.

This CERTIFICATION is issued this 28th day of November 2025 at Office of the Vice President for Research and Extension Services, Mabalaat City College, Rizal St., Dolores, Mabalaat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025259



MABALACAT CITY COLLEGE
Mabalacat City, Pampanga

December 11, 2025

CERTIFICATION

This is to certify that the manuscript of the undergraduate thesis titled: **"KANDADO: An IoT-Based Public Locker System with Randomized QR Codes"** prepared and submitted by **Angeles, Algernon C. Enobio, Maria Angelica Sanchez, Allen S.** who are fourth-year, Bachelor of Science in Information Technology students at Mabalacat City College, has been checked, proofread, and edited/corrected for grammatical and mechanical consistency.

Signed:


CARL REMEDIOS I. GUANLAO, LPT
English Proofreader



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Bautista, Raymond D., De Leon, Andrew M., Payad, Angelo Justin F., and Udiong, Mark Andrei L. of Bachelor of Science in Information and Technology entitled "**Kapanimpla: A Web-Based Ordering and Customization System for Silung Coffee**" is valid and has 6% similarity relative to internet databases.

This CERTIFICATION is issued this 4th day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025268

December 11, 2025

CERTIFICATION

This is to certify that the manuscript of the undergraduate thesis titled: **KAPANIMPLA: A WEB-BASED ORDERING AND CUSTOMIZATION SYSTEM FOR SILUNG COFFEE** by **Raymond D. Bautista, Andrew M. De Leon, Angelo Justin F. Payad, and Mark Andrei L. Udiong**, of the **Bachelor of Science in Information Technology (BSIT)** program at **Mabalacat City College**, has been checked, proofread, and edited/corrected for grammatical and mechanical consistency.

This certification is issued upon the request of the authors for whatever academic purpose it may serve.

Signed:


EDWARD Q. INONG, LPT, MAELLT
Proofreader



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Lopez, Arianne C., Mendoza, Mc Khyle Dean Y., and Quiambao, Angela Kyla A. of Bachelor of Science in Information and Technology entitled **"KHRIA: AI Ecommerce Website Builder"** is valid and has 5% similarity relative to internet databases.

This CERTIFICATION is issued this 4th day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalarat City College, Rizal St., Dolores, Mabalarat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025267

December 09, 2025

CERTIFICATION

This is to certify that the manuscript of the undergraduate thesis titled: **KHRIA: AI ECOMMERCE WEBSITE BUILDER** by **Arianne C. Lopez, Mc Khyle Dean Y. Mendoza,** and **Angela Kyla A. Quiambao**, of the **Bachelor of Science in Information Technology (BSIT)** program at **Mabalacat City College**, has been checked, proofread, and edited/corrected for grammatical and mechanical consistency.

This certification is issued upon the request of the authors for whatever academic purpose it may serve.

Signed:


EDWARD Q. INONG, LPT, MAELLT
Proofreader



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Abril, Cris Anne N., De Leon, Chynna D., Galvan, Jasper G., and Lazundin, Jonathan U. of Bachelor of Science in Information Technology entitled **“MaCisanmetungCa: A Centralized Student Election Management System for Mabalacat City College - COMSELECA”** is valid and has 7% similarity relative to internet databases.

This CERTIFICATION is issued this 7th day of January 2026 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-OVPRES2026002



MABALACAT CITY COLLEGE
Mabalacat City, Pampanga

January 12, 2025

CERTIFICATION

This is to certify that the manuscript of the undergraduate thesis titled: **MaCisanmetungCa: A Centralized Student Election Management System for Mabalacat City College - COMSELECA** prepared and submitted by **Abril, Cris Anne N., De Leon, Chynna D., Galvan, Jasper G., Lazundin, Jonathan U.** who are third-year, Bachelor of Science in Information Technology students at Mabalacat City College, has been checked, proofread, and edited/corrected for grammatical and mechanical consistency.

Signed:

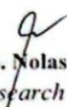

CARL REMDEL I. GUANLAO, LPT
English Proofreader



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Cabrera, Omnio B., Dolosa, Jan Vincent, Pagaduan, Sharly Haze Angel D., and Sangil, Mica M. of Bachelor of Science in Information and Technology entitled **"MCCARE: A WEB-BASED GUIDANCE COUNSELING SYSTEM FOR MABALACAT CITY COLLEGE"** is valid and has 4% similarity relative to internet databases.

This CERTIFICATION is issued this 17th day of March 2026 at Office of the Vice President for Research and Extension Services, Mabala City College, Rizal St., Dolores, Mabala City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-OVPRES2026046



Republic of the Philippines
Department of Education
REGION III – CENTRAL LUZON
SCHOOLS DIVISION OF ANGELES CITY
SAPANG BATO NATIONAL HIGH SCHOOL - SHS
CAMILLA STREET, SAPANG BATO
ANGELES CITY

December 15, 2024

GRAMMARIAN'S CERTIFICATE

This is to certify that the undersigned has reviewed and gone through all the pages of the capstone research entitled **“MCCare: A Web-based Guidance Counseling System for Mabalacat City College,”** by **Cabrera, Omnio B., Dolosa, Jan Vincent, Pagaduan, Sharly Haze Angel D., and Sangil, Mica M.**, as against the set of structural rules that govern the composition of *sentences, phrases, and words* in the English language.

Signed this 15th day of December in the year of our Lord, 2025, at Sapang Bato National High School, Senior High School, Sapang Bato, Angeles City.

Signed:

A handwritten signature in black ink, appearing to read "Leonita M. Jaca", is positioned above the printed name of the Grammarian.

MS. LEONITA M. JACA, LPT, PAFR
Grammarian



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Baculi, Amarie M., Cabrera, Ashlee D., Dela Cruz, David Josh D., and Sunga, Jayson Kim D of Bachelor of Science in Information Technology entitled **"MediCall: An IoT - based Enhancing Emergency Response System in Mabalacat City College Dapdap"** is valid and has 7% similarity relative to internet databases.

This CERTIFICATION is issued this 19th day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025291

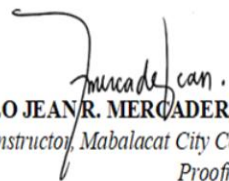
CERTIFICATE OF PROOFREADING

This is to certify that the research paper entitled "MediCall: An IoT-Based Enhancing Emergency Response System in Mabalacat City College Dapdap," by Baculi, Amarie M., Cabrera, Ashlee D., Dela Cruz, David Josh D., Sunga, Jayson Kim D., has undergone a comprehensive process of editing and proofreading.

The review process ensured that the manuscript adheres to established grammatical standards, maintains stylistic coherence, and complies with the technical conventions expected of an academic research paper.

This certificate is issued at the request of the authors for academic purposes.

Issued and signed this 17th day of December 2025.


ANGELO JEAN R. MERCADER, LPT
Instructor, Mabalacat City College
Proofreader
PRC Lic. No. 2350495



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Fanugon, Arthur Louise C., Flores, Michael Louie A., Tuazon, Ricky Ros Janver G., and Yabut, Rafaela Mae M. of Bachelor of Science in Information and Technology entitled **"MediTrack+: A Smart Solution for Medical Services and Records"** is valid and has 6% similarity relative to internet databases.

This CERTIFICATION is issued this 10th day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025270



Mabalacat City College

Mabalacat City, Pampanga

CERTIFICATION OF LANGUAGE EDITING

This is to certify that the undergraduate thesis entitled:

MediTrack+: A Smart Solution for Medical Services and Records

Authored by:

Fanugon, Arthur Louise C.
Flores, Michael Louie A.
Tuazon, Ricky Ros Janver G.
Yabut, Rafaela Mae M.

In partial fulfillment of the requirements for the degree of Bachelor of Science in Information and Technology.

The manuscript was evaluated by an English Language Editor, whose name and signature appear below, to ensure that the text is grammatically correct, clear, and coherent. The editing process did not alter the content, structure, or authorial intent of the study in any way.

Certified this 10th Day of December 2025 by:

A handwritten signature in black ink, appearing to read "Michael A. Mesa".

Michael A. Mesa, LPT, PhD
English Language Editor



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Deñola, Geonna Lyzzet B., Manatiga, Jimboy L., Mariano, James C., and Ylan, Marc Christian Paul D. of Bachelor of Science in Information and Technology entitled **“Moral Matrix: A Role-Based System for Violation and Sanction Tracking for the Center for Character Development Unit of Mabalacat City College”** is valid and has 7% similarity relative to internet databases.

This CERTIFICATION is issued this 3rd day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.

Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025263



MABALACAT CITY COLLEGE
Mabalacat City, Pampanga

December 11, 2025

CERTIFICATION

This is to certify that the manuscript of the undergraduate thesis titled: **Moral Matrix: A Role Based System for Violation and Sanction Tracking for the Center for Character Development Unit of Mabalacat City College** prepared and submitted by **Deñola, Geonna Lyzzet B., Manatiga, Jimboy L., Mariano, James C., Ylan, Marc Christian Paul D.** who are fourth-year, Bachelor of Science in Information Technology students at Mabalacat City College, has been checked, proofread, and edited/corrected for grammatical and mechanical consistency

Signed:


CARL REMIEL GUANLAO, LPT
English Proofreader



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Antibero, Cristine Joy E., Limio, Lemuel M., Pineda Melvie Joy B., and Sombillo, Angeline S of Bachelor of Science in Information and Technology entitled **“PetalPicks: An Interactive Web-Based Application for Personalized Bouquet Arrangement”** is valid and has 5% similarity relative to internet databases.

This CERTIFICATION is issued this 3rd day of December 2025 at Office of the Vice President for Research and Extension Services, Mabala City College, Rizal St., Dolores, Mabala City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025261

CERTIFICATE OF PROOFREADING

This is to certify that the research paper entitled *"PetalPicks: An Interactive Web-Based Application for Personalized Bouquet Arrangement"* by Antibero, Cristine Joy E., Limio, Lemuel M., Pineda Melvie Joy B., Sombillo, Angeline S., has undergone a comprehensive process of editing and proofreading.

The review process ensured that the manuscript adheres to established grammatical standards, maintains stylistic coherence, and complies with the technical conventions expected of an academic research paper.

This certificate is issued at the request of the authors for academic purposes.

Issued and signed this 9th day of December 2025.


ANGELO JEAN R. MERCADER, LPT
Instructor, Mabalacat City College
Proofreader
PRC Lic. No. 2350495



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Lacanlale, Arvin B., Matchado, Danica C., Muñoz, Angelo M., and Quiambao, Arian R. of Bachelor of Science in Information and Technology entitled **"PETKLINIKA: A Web-based Appointment System with Pet Diseases Verification and QR –Code Pet Locator for Mabalacat Pet Clinic"** is valid and has 5% similarity relative to internet databases.

This CERTIFICATION is issued this 4th day of December 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025266

December 09, 2025

CERTIFICATION

This is to certify that the manuscript of the undergraduate thesis titled: **PETKLINIKA: A WEB-BASED APPOINTMENT SYSTEM WITH PET DISEASES VERIFICATION AND QR – CODE PET LOCATOR FOR MABALACAT PET CLINIC** by **Angelo M. Muñoz, Arian R. Quiambao, Danica C. Matchado, and Arvin B. Lacanlale**, of the **Bachelor of Science in Information Technology (BSIT)** program at **Mabalacat City College**, has been checked, proofread, and edited/corrected for grammatical and mechanical consistency.

This certification is issued upon the request of the authors for whatever academic purpose it may serve.

Signed:



EDWARD Q. INONG, LPT, MAELLT
Proofreader



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Morales, Reuben F., Pineda, Jay Ivan B., Sombillo, Edison D., and Tanglao, Kathleen L. of Bachelor of Science in Information and Technology entitled “**Signify: An Interactive E-Learning Application for Deaf and Educators**” is valid and has 6% similarity relative to internet databases.

This CERTIFICATION is issued this 28th day of November 2025 at Office of the Vice President for Research and Extension Services, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga.


Glen S. Nojasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRI2025260



Mabalacat City College

Mabalacat City, Pampanga

CERTIFICATION OF LANGUAGE EDITING

This is to certify that the undergraduate thesis entitled:

Signify: An Interactive E-Learning Application for Deaf and Educators

Authored by

Morales, Reuben F.
Pineda, Jay Ivan B.
Sombillo, Edison D.
Tanglao, Kathleen L.

in partial fulfillment of the requirements for the degree **Bachelor of Science in Information and Technology**, has undergone a thorough review and language editing.

The manuscript was evaluated by an English Language Editor, whose name and signature appear below, to ensure that the text is grammatically correct, clear, and coherent. The editing process did not alter the content, structure, or authorial intent of the study in any way.

Certified this 2nd Day of December 2025 by:

A handwritten signature in black ink, appearing to read "Michael A. Mesa".

Michael A. Mesa, LPT, Ph.D.
English Language Editor



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Cunanan, Kenji Martell M., Manalang, Steven Allen P., Salangsang, Kim Vincent G., and Tuazon, Khaz Leewen C. of Bachelor of Science in Management Accounting entitled **"SIGNSAYA: A MOBILE APPLICATION FOR FILIPINO SIGN LANGUAGE INTERPRETATION USING REAL-TIME GESTURE RECOGNITION TO AID IN DEAF COMMUNICATION"** is valid and has 1% similarity relative to internet databases.

This CERTIFICATION is issued this 14th day of May 2026 at Office of the Vice President for Research and Extension Services, Mabala City College, Rizal St., Dolores, Mabala City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-OVPRES2026052



MABALACAT CITY COLLEGE
Mabalacat City, Pampanga

May 28, 2026

CERTIFICATION

This is to certify that the manuscript of the undergraduate capstone project entitled "***SignSaya: A Mobile Application for Filipino Sign Language Interpretation Using Real-Time Gesture Recognition to Aid in Deaf Communication***" prepared and submitted by **Cunanan, Kenji Martell M. Manalang, Steven Allen P. Salangsang, Kim Vincent G. and Tuazon, Khaz Leewen C.**, who are Bachelor of Science in Information Technology students at Mabalacat City College, has been checked, proofread, and edited/corrected for grammatical and mechanical consistency.

Signed:


CARL REIDEL I. GUANLAO, LPT
English Proofreader



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Baratilla, Giecel Ira D., Calaguas, Fiona Mae T., Cruz, Franceska Nicole B., and David, Erika M. of Bachelor of Science in Information and Technology entitled **"StenoCoach: Stenography Learning Management System for Mabulacat City College"** is valid and has 8% similarity relative to internet databases.

This CERTIFICATION is issued this 3rd day of December 2025 at Office of the Vice President for Research and Extension Services, Mabulacat City College, Rizal St., Dolores, Mabulacat City, Pampanga.

Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



CRN-CCRJ2025262



Mabalacat City College

Mabalacat City, Pampanga

CERTIFICATION OF LANGUAGE EDITING

This is to certify that the undergraduate thesis entitled:

StenoCoach: Stenography Learning Management System for Mabalacat City College

Authored by:

**Baratilla, Giecel Ira D.
Calaguas, Fiona Mae T.
Cruz, Franceska Nicole B.
David, Erika M.**

In partial fulfillment of the requirements for the degree **Bachelor of Science in Information and Technology**, has undergone a thorough review and language editing.

The manuscript was evaluated by an English Language Editor, whose name and signature appear below, to ensure that the text is grammatically correct, clear, and coherent. The editing process did not alter the content, structure, or authorial intent of the study in any way.

Certified this 4th Day of December 2025 by:

A handwritten signature in black ink, appearing to read "Michael A. Mesa".

Michael A. Mesa, LPT, Ph.D.
English Language Editor



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Alvarez, Cedric John Z., Dela Cruz, Charls John S., and Hernandez, Shanelle Anne R. of Bachelor of Science in Information and Technology entitled **"VISONDYNA JOB BOARD: WEB-BASED HIRING SYSTEM FOR MANPOWER SOLUTION"** is valid and has 1% similarity relative to internet databases.

This CERTIFICATION is issued this 21th day of April 2026 at Office of the Vice President for Research and Extension Services, Mabala City College, Rizal St., Dolores, Mabala City, Pampanga.


Glen S. Nolasco, M.Sc

Vice President for Research and Extension Services



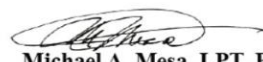
CRN-OVPRES2026047



Mabalacat City College
Mabalacat City, Pampanga
Institute of Business and Computing Education

CERTIFICATION

The present document serves as an official certification for the thesis titled " *Visondyna Job Board: Web-Based Hiring System for Manpower Solutions* " authored by Alvarez, Cedric John Z. Dela Cruz, Charls John S. Hernandez, Shanelle Anne R. The previously mentioned study has been reviewed and edited by an English proofreader, whose name and signature appear below, to guarantee that the language used is clear, concise, and devoid of inaccuracies. More so, it ought to be noted that the authors' objectives were not altered in any way during the editing process.


Michael A. Mesa, LPT, PhD
English Proofreader
April 23, 2026

