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MESSAGE FROM THE DEAN

TO OUR BSIT Student Researchers, Technical Advisers and BSIT Program Head

As the Dean of the Institute of Business and Computing Education, it gives me an immense pleasure to congratulate each one of you for the job well done. As the academic year comes to a close, it is always important to reflect on achievements and what the future holds. I will start by stating that I am proud of our BSIT student Researchers, their technical advisers and the BSIT Program Head that comprise the Computing Education.

With your hard work, dedication and concerted effort, we are able to come up with different capstone projects that can be of help to our industry partners, our college and our community emphasizing how the technology can make a difference in the lives of every individual.

Furthermore, you have clearly shown your understanding of the Sustainable Development Goals (SDGs), in which our college inculcate to each in every one of us because you have successfully integrated the SDGs in your capstone projects.

Once again congratulations to all, I look forward to another exciting period of intellectual, technological and creative discovery and the robust integration of SDGs in every capstone projects of our student researchers. My hope and challenge for you is that you will take proactive steps to unite your personal curiosity, knowledge and skills with the noble purpose of making a new and lasting difference in the lives of others in the year ahead

MYRNA E. CUENTO-CALMA, CPA, FRIAcc, Ph.D.

Dean, Institute of Business and Computing Education

Mabalacat City College

MESSAGE FROM THE BSIT PROGRAM HEAD

Dear BSIT Student Researchers,

In my capacity as the program head of B.S. in Information Technology, I want to take this opportunity to express my deepest gratitude for your outstanding efforts of successfully infusing Sustainable Development Goals (SDGs) into your respective capstone projects. It is great to see young people like you dedicating their time and efforts to solving global problems through capstone project. You have shown an understanding of the significance of sustainable development by including SDGs in your capstone projects as well as emphasized how technology can drive change for the better. They are capable of addressing a wide range of social, economic, and environmental issues; therefore, I expect that your results will be beneficial in many ways.

I am extremely glad of the individuals who took up the challenge and had the possibility to present their research at the most prestigious IRCITE 2024. It is your diligence, originality, and critical thinking skills that are at the core of the issues loved by our IT society. Your participation in this esteemed conference not only showcases your expertise but also highlights the quality of IT education and capstone project in our program.

While on your educational and professional paths, I congratulate you on acquiring your goals and bringing full satisfaction to everything in the coming years. May you continue to embrace challenges, seek knowledge, and strive for excellence in all that you do. Remember that the skills and experiences you have gained throughout your time as BSIT student researchers will serve as a solid foundation for your future careers.

Once again, congratulations on your achievements and thank you for representing our program with distinction. Your dedication to incorporating the SDGs in your capstone projects is truly inspiring, and I have no doubt that you will continue to make a positive impact in the world.

Best wishes for a bright and successful future!

DENNIS L. TACADENA, DIT

BSIT Program Head, Institute of Business and Computing Education

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Note: *A – Application* *S – System* *Y – Video Presentation*

BSIT

ACM PAPER PRESENTATION

Anito-Boses ng Ninuno: Voice-Controlled 3D Boss Rush Action Game

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ABSTRACT

Voice activation for video games and applications is one example of the new world of technology and input devices created to match specific times and places. In contemporary smartphone games, automatic speech recognition technologies are not a new idea. Game designers anticipate that gesture-based and voice-activated technologies will spawn completely new genres of games. The general objective of the study is to develop a voice-controlled 3D boss rush action game entitled “Anito Boses ng Ninuno” that can be played on Android devices. The study aims to entertain and demonstrate Filipino mythology. The researchers used the modified waterfall model as the methodology for the process of developing the game. The beta tester and alpha testers have significantly improved the game's development, with the beta test rating 4.38 as "Excellent" and the alpha test rating 4.16 as "Very Good," demonstrating the mobile application's user satisfaction. Results from alpha and beta testing typically demonstrate that the mobile application satisfies user needs. Beta and alpha testers provided valuable feedback, enabling the developer to enhance the game's capabilities, ensure a pleasant and satisfactory experience. The researchers came to the conclusion that the study's overarching goal had been accomplished after considering all of the available data.

General Terms

Mobile Game, Boss Rush Action Genre

Keywords

Anito, Voice-Controlled, Filipino Mythological Creatures, Android Game

INTRODUCTION

Video games are a unique form of entertainment that allows players to take on the role of characters in the game. Today's complex mechanics of different genre of games need players to pay close attention to the screen at all times [1].A video game is an electronic game that may be played on a computer, gaming console, or mobile phone. Depending on the platform, video games are classed as computer games or console games. However, the recent introduction of social networks, smartphones, and tablets has given rise to new genres such as mobile and social games. Video games have come a long way since the first ones were introduced in the 1970s. In many cases, today's video games offer lifelike images and mirror reality to an astounding degree [2].

Voice activation for video games and applications is one example of the new world of technology and input devices created to match specific times and places. In contemporary smartphone games, automatic speech recognition technologies are not a new idea. Game designers anticipate that gesture-based and voice-activated technologies will spawn completely new genres of games. This study looks for a new pattern of in-app games that can be used to create games that are inclusive of all players. Voice-control smartphone games offer several gameplay options, making them more engaging and participatory [3]. Speech recognition initially appeared in the gaming industry in the 1980s, with the release of Halcyon, the first speech recognition-enabled game system. However, manufacturing ceased for around 20 years before returning in the early 2000s with the release of Hey You, Pikachu! by Nintendo. Natural language entered the gaming business a few years later with the release of North

Side's Bot Colony, a game that requires players to communicate with robot characters to progress. Today's gamers may use voice as a controller, interact with characters while playing, mobilize soldiers before sending them into war, communicate with other players in multiplayer and role-playing games, and much more [4].

Anito, often spelled anitu, refers to ancestor spirits, nature spirits, and deities in indigenous Philippine folk religions from pre- colonial times to the present, albeit the term can have different meanings and connections depending on the Filipino ethnic group. Anitos were depicted in their mythology as having existed since the birth of the earth, with each anito having its own unique job, such as providing rain, causing rice to grow, increasing the quantity of rice, and so on [5].

General Objective

The general objective of the study is to develop a voice- controlled 3D boss rush action game entitled "Anito - Boses ng Ninuno" that can be played on Android devices. The study aims to entertain and demonstrate Filipino mythology.

Specific Objectives

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

- To gather data through the use of survey, articles, books, and other related works that are found on the internet.
- To identify hardware and software specifications:
    - Hardware:
        - Desktop PC
        - Android Device
    - Software:
        - Godot Engine
        - GIMP
        - Audacity
        - Blender 3D
        - Android SDK
- To design a video game application using analysis and designing tools.
    - Storyboard
    - Game Menu Tree
    - Character Model
    - Gantt Chart
- To create and develop an action game that has the following feature:
    - Battle Mode
        - Tutorial
        - Campaign
    - Armory
        - Weapons
        - Armors
        - Items
    - Shop
    - Almanac
    - Settings
    - Sound
    - Language
        - Filipino
        - English
    - Controls
        - Touch Mode
        - Voice Mode
- To test the video game using MEEGA+ in terms of Player Experience and Usability.
    - Player Experience: User Error Protection, Confidence, Focused Attention, Fun, Challenge, Satisfaction
    - Usability: Aesthetic, Learnability, Operability, Accessibility
- To deploy the video game on Google Play Store.

Scope and Limitations of the Research

This section outlines the restrictions that are not addressed in the produced application and covers the scope of the investigation.

To develop and test the game, the researchers used a desktop PC powered by Microsoft Windows 10 operating system with a 3.20 GHz i5 processor, 8 GB RAM, 500 GB HDD, and 2 GB Video RAM. The Android device would be used to test the game. Godot Engine is the game engine the researchers used to create the game. GIMP would be used to create the images and icons of the game and Audacity for the game's sound effects and music. The game's 3D graphics would be made in Blender 3D. Android SDK would be used to export the game to Android devices.

The researchers created a boss rush action game about Filipino mythology. There would be four playable characters. These characters are Liyab, Diwata of Fire; Perlas, Diwata of Water; Ramil, Diwata of Earth; and lastly, Amihan, Diwata of Wind. Each character has different movement speed, the amount of health and defense they have, and the weapon they use. Liyab uses a kampilan which has moderate damage, attack speed, and range; Perlas

uses a bow which has low damage, moderate attack speed, and long range; Ramil uses a panabas which has high damage, slow attack speed, and moderate range; and Amihan uses two itak swords which have low damage, fast attack speed, and short range.

In Battle Mode, there would be a Tutorial Mode and fifteen (15) levels of Campaign Mode. The tutorial level would teach the player the controls and mechanics of the game. In Campaign Mode, all regular levels are boss fights. The bosses would either be deities or creatures from Filipino mythology. When beating certain levels the player will unlock the corresponding Almanac entry. Reading them will be important because to access certain levels the player will need to answer a short quiz. Each short quiz has five (5) items and the player needs to answer four (4) of them correctly to access the level.

The Shop is where the player can buy and equip new weapons, armors, and potions. The player buys things from the Shop using gold. Gold are earned by completing objectives, these are defeating the enemy, defeating the enemy without using potions, and defeating the enemy without getting hit. The more powerful the boss, the more gold earned for each objective the player completes. The player can also gain gold from gold drops which appear during battle but they only give a small amount of gold. Each weapon has a different attack damage, attack speed, and attack range. Armor helps with defending the player from attacks. Potions are useful tools that help the player (e.g. health potions that heal the player). The Almanac is where the player can see the health, attack damage, and some trivia for the bosses you see in the game. It is important for the player to read the entries here as to access certain levels the player needs to answer a short quiz.

The Settings menu is where the player can tweak different game settings. The player can access the: Sound settings which allows to tweak both the volume of the sound effects and background music; Language settings where the player can choose between Filipino and English; and Controls where the gamer can choose between touch controls and voice controls.

The researchers would create a real-time combat system. In combat, the player's character would be able to move left and right, jump, attack, block, dodge, and use potions. Blocking attacks decreases the guard meter. When it runs out, the character would be unable to block for a short while.

The game has two control schemes, touch and voice controls. Touch controls uses onscreen buttons to control the character while voice controls uses the player's voice. There are a total of ten words that the player can say to control the game. These are Left, Right, Pause, Attack, Jump, Block, Dodge, Item 1, Item 2, Item 3. The Left (Kaliwa) command will make the character move left. The Right (Kanan) command is similar to the Left command except it makes the character move right instead. Pause (Hinto) would make the game pause while in combat. Attack (Atake) would make the character attack. Jump (Talon) would make the character jump up. Block (Depensa) would make the character block attacks. Dodge (Iwas) will make the character move a short distance quickly for dodging attacks. Saying Item 1, 2, 3 (Aytem 1, 2, 3) would make the character use the corresponding item which are the health potion, attack boost potion, and shield potion. The mechanics for Filipino language is the same as the English language.

The app is only compatible with Android 5.0 (Lollipop) and higher versions. 13.0 (Tiramisu) has a camera that is more than 8 megapixels and more than 2GB of RAM. Low poly 3D hero models are available. Dim or dark locations make it impossible to detect the trackers. An internet connection would be necessary for the trackers to download.

METHODOLOGY

This chapter presents methods used in developing the Android game application and illustrates the functions of the game. It contains methods, designs, and data that were used in the game's development. It also shows the methodologies and research instruments used by the researchers to collect data. There are also different kinds of diagrams to further explain the flow and design of the study.

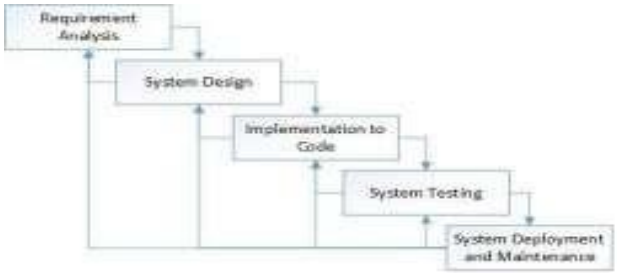

Figure 1: Agile Methodology

Figure 1 is the Waterfall Model as the methodology for the process of developing the game. The software

goes through various phases in this model. The steps are as follows: requirement analysis, design, implementation, testing, and maintenance. Unlike the classic waterfall model, the modified waterfall model permits a return to a previous phase.

Requirements

The researchers cooperated to collect ideas and suggestions for an entertaining boss rush action game. This would entail idea-sharing exercises, group discussions, and brainstorming sessions. The team browsed for articles to learn more about how familiar people are with Filipino mythology. The researchers also obtained data by reading and examining a variety of books, journals, articles, and other related online works and topics.

Design

The researchers would use design tools to create the game. The design tools that would be used include a storyboard, game menu tree, character model, and Gantt chart. The storyboard (see Figure 2) serves as a visual roadmap for displaying the gameplay and flow of the game. The researchers would use the game's menu tree (see Figure 3) as a guide while constructing the game's menus. A character model would be used to display the 3D models that the researchers used to develop the game (see Figure 4). Last but not least, the researchers would use a Gantt chart to display the tasks completed by each researcher (see Figure 5).

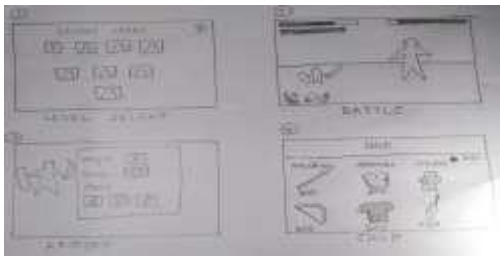

Figure 2: Storyboard

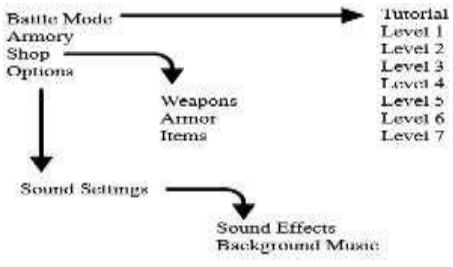

Figure 3: Game Menu Tree

Implementation

In this phase, the researchers translated the designed diagrams into a working application. The game's 3D models and animations would be made in Blender 3D. The music and sound effects would be made and edited using Audacity, same with GIMP for the images. The created assets would then be used in Godot Engine to program and create the game using the storyboard and game menu tree as guides. The game would be exported to Android devices using Android SDK. All our progress would be tracked by using a Gantt chart.

Figure 4: Character Model

Figure 5: Gantt chart

Testing

To determine if the gaming application has achieved the necessary goals, the researchers used an instrument that was based on the MEEGA+ assessment. On the researchers' mobile device, the game was installed. The researchers conducted an alpha testing by contacting three (3) IT experts to evaluate the game and for the beta testing phase, researchers go door-to-door in Mabalacat City, visiting the homes of thirty (30) students each.

The statistical procedures listed below were applied to reduce the amount of data:

Frequency Distribution

A frequency distribution was used in the research to display the proportion of instances that classified into each score range. Each group in the process of interval-defined character traits of the individuals who participated comprised an array of contiguous possible scores. A variable with

data that indicate the cases' order can be of several forms. The entire number of instances for each category was used to calculate the probability.

Mean Score

The research study utilizes the mean score to ascertain whether the mean value, or standard rating, of the information provided by the participants set is equal that of the total of every factor in the data set reduced by the entire amount of values. The mean, often known as the average, is calculated using the following equation:

$$A = N/S$$

Where:

A = average (or mean),

N = number of terms (the quantity of objects or figures being averaged, and

S = total of the variables within the interest set(e.g., the sum of the numbers being averaged).

Likert scale

A method of assessing information used in questionnaires, the Likert scale is intended to gauge participants' mindsets, opinions, or views. The researcher utilized the Likert scale to translate the average rating of every questionnaire tool sub-criteria and criterion into a verbal interpretation that corresponded to the outcome.

Deployment and Maintenance

The game would be released after testing is complete and is made available for free download on the Google Play Store or in (https://l1nk.dev/anitoboses). Here, users would be able to send in bug reports and suggest improvements to the application. Potential users would be able to download the game by visiting the repository hosting site. The repository hosting site would be used to promote and distribute the game application. A summary statistic on the repository hosting site can help researchers determine the exact statistics for application installations, uninstalls, and ratings.

RESULTS

This part offered the findings and conclusions derived from the study's aims. The goals of the study, the finished analysis, and the testing of the created application prototype serve as the foundation for these discussions and findings. It also includes the researchers' analysis and assessment of the alpha and beta testing. The researchers have meticulously calculated the results and outcomes. The research findings must be offered in an orderly, cohesive, and comprehensible.

Alpha Test

The online survey was sent over Facebook Messenger. Three (3) IT specialists named Mr. Joceleon Sanguyu, Mr. Ralph Cadalzo, and Mr. Frederic Santos. The researchers sent them a mail inviting them to join an online survey between December 12 and December 13, 2023. During the alpha testing phase, the researchers asked them to evaluate and test the game. A brief synopsis of the procedure, which requires each expert to meet the requirements based on their level of gaming experience, will be provided at the time the form is released and presented. The researchers conducted, disseminated, and collected the surveys (see Figure 15). The experts finished answering the survey after spending fifteen (25) minutes utilizing and interacting with the created gaming application.

Table 1: Interval range for results' verbal interpretation

Response	**Value**	**Range**	**Verbal Interpretation**
Strongly Agree	5	4.21-5.00	Excellent
Agree	4	3.41-4.21	Very Good
Neutral	3	2.41-3.41	Good
Disagree	2	1.41-2.41	Fair
Very Disagree	1	1.00-1.40	Poor

The game's alpha evaluation findings are summarized in Table 2 for the MEEGA+ Player Experience assessment. The most favorable sub-criteria result is Focused Attention, with a mean score of 4.50 and a verbal assessment of "Excellent,"

indicating that the IT experts finds the game entertaining and exciting as well as that it helps them develop their sense of humor and abilities to think critically. Another individual criteria result is User Error Protection, with a mean score of 4.33 and a verbal application of "Excellent," demonstrating the player's initial assumption that the game would be simple to use and intuitive. It prevented the player from making mistakes, which made it simple for them to recover in the game. Despite the fact that every verbal interpretation is outstanding, the Confidence and Satisfaction has the lowest mean score 4, having a verbal interpretation of "Very Good" among the sub-criteria results. This indicates that the game's level of difficulty is somewhat easy and requires something more to make them feel satisfied.

Table 2. Summary of MEEGA+ in terms of Player Experience criteria of Alpha test

Player Experience Sub-criteria	**Mean**	**Verbal Interpretation**
User Error Protection	4.33	Excellent
Confidence	4.00	Very Good
Challenge	4.11	Very Good
Satisfaction	4.00	Very Good
Fun	4.17	Very Good
Focused Attention	4.50	Excellent
Total Mean	**4.19**	**Very Good**

Table 3.Summary of MEEGA+ in terms of Usability criteria of Alpha test

Usability Sub-criteria	**Mean**	**Verbal Interpretation**
Aesthetic	4.00	Very Good
Learnability	4.33	Excellent
Operability	4.17	Very Good
Accessibility	4.00	Very Good
Total Mean	**4.19**	**Very Good**

Table 3 presents an overview of the game's beta test findings based on the MEEGA+ Usability test. Considering a mean score of 4.33 and a verbal interpretation of "Excellent," Learnability obtains the greatest result among the sub-criteria. As a result, participants are able to master the mechanics of the game more easily and with more clarity. The commands in voice control are better suited for the participants. The criterion that yields the lowest mean among the sub-criteria results is Aesthetic and Accessibility. With a mean score of 4 which is “Very Good”, Gamers have a slight need for better text fonts and graphics.

Table 4.Summary of MEEGA+ of Alpha test

MEEGA+ criteria	**Mean**	**Verbal Interpretation**
Player Experience	4.19	Very Good
Usability	4.13	Very Good
Total Mean	**4.16**	**Very Good**

Table 4 demonstrates that, considering the alpha test rating's entire mean score of 4.16 and verbal interpretation of "Very Good," the researchers ruled that the game possessed exceedingly well met the set objectives for the assessment.

Beta Test

The survey was disseminated throughout Mabalacat City. The researchers visit the homes of every student within January 1 and January 2, 2024. Thirty (30) students were asked to test and assess the game during the beta testing phase by the researchers. A short overview of the process by which the respondent must fulfill the criteria depending on their gaming experience would be given during the form's release and presentation. The beta surveys were distributed, gathered, and conducted by the researchers (see Figure 14). After using and engaging with the developed gaming application for fifteen (16) minutes, the respondents completed the survey.

Table 5.Summary of MEEGA+ in terms of Player Experience criteria of Beta test

Player Experience Sub-criteria	**Mean**	**Verbal Interpretation**
User Error Protection	4.23	Excellent
Confidence	4.47	Excellent
Challenge	4.23	Excellent
Satisfaction	4.40	Excellent
Fun	4.52	Excellent
Focused Attention	4.55	Excellent
Total Mean	**4.35**	**Excellent**

The game's beta evaluation findings are summarized in Table 5 for the MEEGA+ Player Experience assessment. The most favorable sub-criteria result is Fun, with a mean score of 4.52 and a verbal assessment of "Excellent," indicating that the player finds the game entertaining and not dull as well as that it helps them develop their sense of humor and abilities to think critically. Another individual criteria result is Confidence, with a mean score of 4.47 and a verbal application of "Excellent," indicating which the participant initially assumed the game would be effortless to grasp and that the

design and content gave them the belief that they required to complete the game. Despite the fact that every verbal interpretation is outstanding, the Satisfaction has the lowest mean score 4.4, having a verbal interpretation of "Excellent," among the sub-criteria results. This indicates that the game's level of difficulty satisfied the participants' need for enjoyment.

Table 6.Summary of MEEGA+ in terms of Usability criteria of Beta test

Usability Sub-criteria	**Mean**	**Verbal Interpretation**
Aesthetic	4.37	Excellent
Learnability	4.31	Excellent
Operability	4.43	Excellent
Accessibility	4.52	Excellent
Total Mean	**4.41**	**Excellent**

Table 6 presents an overview of the game's beta test findings based on the MEEGA+ Usability test. Considering a mean score of 4.52 and a verbal interpretation of "Excellent," Accessibility obtains the greatest result among the sub-criteria. As a result, participants are able to read the text and fonts more easily and with more clarity. The colors utilized in the game are better suited for the participants. The criterion that yields the lowest mean among the sub-criteria results is Learnability. With a mean score of 4.31 which is “Excellent” and still high, players can quickly and readily pick up the game's mechanics and regulations.

Table 7.Summary of MEEGA+ Beta Test

MEEGA+ criteria	**Mean**	**Verbal Interpretation**
Player Experience	4.35	Excellent
Usability	4.41	Excellent
Total Mean	**4.38**	**Excellent**

Table 7 demonstrates that, considering the beta test rating's entire mean score of 4.38 and verbal interpretation of "Excellent," the researchers ruled that the game possessed exceedingly well met the set objectives for the assessment.

Comparison of Alpha and Beta Testing

The development of the game has much improved, as seen by the results from the alpha and beta tests. Overall, the beta test is rated 4.38 and is understood as "Excellent," and the alpha test's overall mean is 4.16, which is considered "Very Good." Results from alpha and beta testing typically demonstrate that the mobile application satisfies user needs. The developer was able to further improve the game's capabilities which enable the beta tester to engage using the game application in a pleasant and satisfactory way thanks to the feedback provided by the alpha testers. However, the study does not apply or cover security features.

DISCUSSION

The targets of the research, the finished analysis, and the testing and assessment of the created game serve as the foundation for this discussion and its findings. It also includes the developers' suggestions on how to make the game even better for upcoming researchers. These results and discussion are predicated on the goals of the research, the finished analysis, and the testing and assessment of the produced game. It also includes the developers' suggestions for how to make the game even better for upcoming researchers.

The researcher’s information was verified for accuracy and dependability through online research methods. The researchers collaborated to create ideas for capstone projects through planning, generating ideas, and internet and library research. To characterize the problems and ascertain the fundamental requirements for the application development, the researchers first used the internet to gather information from academic publications, journals, official sites, as well as application store websites. The researchers kept in regular contact with their technical and capstone advisers to inquire about the progress of the application and documentation development. Based on the parameters of the study, the researchers distributed individual tasks, shared ideas, and made activity schedules.

The researchers used the Waterfall methodology to develop a mobile application for Capstone Project 2, which involved several steps such as requirement analysis, system design, implementation to code, system testing, deployment, and maintenance. They utilized software development technologies like Android SDK, Blender 3D, GIMP, Godot game engine, and Audacity. The game was created using Blender 3D and an online survey was conducted for IT specialists between December 12 and 13, 2023. The game met the software quality criteria and underwent a beta test using MEEGA+ survey instruments. The researchers conducted the beta test by visiting random students in Mabalacat City between January 1 and 2, 2024. The game's alpha evaluation showed that it met the set objectives for the assessment. The most favorable sub- criteria result was Focused Attention, with a mean score of 4.50 and a verbal assessment of "Excellent." User

Error Protection had a mean score of 4.33 and a verbal assessment of "Excellent," indicating that the game was entertaining and helping players develop their sense of humor and critical thinking abilities. The game's usability test yielded a mean score of 4.33 and a verbal interpretation of "Excellent," with Learnability receiving the highest rating among the sub-criteria. Aesthetics and accessibility received the lowest ratings, with Learnability receiving the highest rating.The beta test yielded a mean overall rating of 4.35, indicating that the gaming application met its assessment criterion with great satisfaction and quality. The comparison of alpha and beta tests showed significant improvements, with the beta test being rated 4.38 and considered "Excellent" and the alpha test's overall mean being "Very Good." These results demonstrate that the mobile application satisfies user needs and allows beta testers to engage with the game in a pleasant and satisfactory way.

The game "Anito: Boses ng Ninuno" has been released, uploaded, and can be found on Google Play following the completion of beta user and expert panel acceptance testing. Using a summary statistic available on the Google Play repository site, the researchers can pinpoint the exact figures associated with program installations, uninstalls, and ratings. It could be helpful for the researchers to maintain track of the different versions of Android that the program works with.

RECOMMENDATIONS

The recommendations from the researchers were intended to give next studies a variety of concepts that they may apply to enhance the game. Some of these suggestions might be worth considering by future academics as they strive to improve the game application:

- First, make the voice command more recognizable, then add more 3D objects, increase the game's difficulty, add more NPCs.
- Second, work on the graphics to make the game more visually appealing like modern games, add more Philippine heritages as maps and Filipino mythological creatures, and lastly add a multiplayer mode or Player versus player (PVP) mode.

ACKNOWLEDGEMENTS

Before anything else, we would want to sincerely thank Ms. Aeriane Charmaine Dizon, our capstone advisor from Mabalacat City College's Institute of Computing Studies. We, the Proponents, are able to demonstrate our own skills and refine our personalities in order to finish our research because of her expertise and patience, as well as his support and advice throughout our study. Her efforts and words of support inspired us to keep going for our goals in life. She thus merited recognition, and we are incredibly appreciative of having an advisor. We are also extremely appreciative to our parents, who supported us through all of our highs and lows and given us the willpower to never give up on our goals. We sincerely appreciate their love and, of course, their support and understanding. We additionally wish to express our gratitude to our close companions and sister and brother that have faith in us.

We are grateful to the Dean of the ICS, the Faculty Staff, and the ICS in its whole. They help us to achieve our goals, and their competence is the reason for the information and skills we have acquired.

Lastly, I would want to express my gratitude to everyone who helped us, in some way or another, to finish the research project.

REFERENCE

[1] The Impact of Video Games | Sutter Health. (n.d.). https://www.sutterhealth.org/health/parenting-preteens- teens/digital-safety/video-games

[2] Topic: Video game industry. (2022, November 17). Statista. https://www.statista.com/topics/868/video-games/

[3] Qin, W., & Li, C. (2017). Voice-Control as a New Trend in Games Applications. In Advances in intelligent systems and computing (pp. 232–240). Springer Nature. https://doi.org/10.1007/978-3-319-60639-2_24

[4] Voice Provides a More Immersive Gaming Experience. (2021, May 19). Speech Technology Magazine. https://www.speechtechmag.com/Articles/ReadArticle.aspx?ArticleID=146964&fbclid=IwAR1eeEHOLqobgXQelNtb2d9 9eEFfFWbkR81g6loQiQu0JN2uuIxt_gJngBo

[5] "Hislop-Anitism-Survey-Religious." Beliefs-Native-Philippines.Pdf %20 (n.d.): ASJ-09-02-1971. https://www.asj.upd.edu.ph.

Brgy. Camachiles Management: Cloud Hosting and Infrastructure

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ABSTRACT

The study focuses on enhancing barangay management through the implementation of a modern Barangay Camachiles Management System. Despite technological advancements in the Philippine government, certain areas, like Barangay Camachiles, still rely on outdated methods, leading to manual work and potential data security issues. The new system leverages contemporary technologies, such as Amazon Web Services (AWS), for cloud hosting, ensuring scalability and security. Replacing traditional paper processes the online platform allows both employees and residents to efficiently interact. Residents can sign up, request certificates, and make online payments through platforms like PayPal and G-Cash eliminating the need to visit the barangay hall. The technology stack, including HTML, CSS, PHP, Visual Studio Code, MYSQL and AWS contributes to an user-friendly platform. The study discusses the roles of the Barangay Captain and Secretary in managing accounts and overseeing certificate issuance. The Barangay Camachiles Management System addresses outdated practices, aiming to improve functionality, ensure data security and contribute to overall barangay development. Recommendations emphasize further enhancements and the adoption of modern methods for future research endeavors.

General terms

Web Application

Keywords

Certificate, Amazon Web Service

INTRODUCTION

The rapid growth of the technology improves the development of all industrial sectors. It has a huge improvement mostly in the Philippine Government. The improvement of the technology can provide a scalability and security into the management that allows the employee can be more productive. [1]

Nowadays, some of Local Government Units are allowing the online payment to improve the process of transaction and avoid long line that can cost a lot of time.[2] Two of the most trusted and popular option because of its convenience, accessibility and security. It allows the users to buy load online and online purchase suing the application from their phone. PayPal and G- Cash application utilized the encryption, it allows the users to use the registered pin code or their fingerprints to login their application account. It can also access by anywhere and anytime by as long as you have an internet connection.[3]

One of the best trends in technology today is Cloud it is mostly used in different corporations or business. Cloud computing is famous in the industry because it improves the scalability of the management. It also can be access by connecting into the internet connection that allows the developers in charge will easily manage the system everywhere. [4]

A wide range cloud service is provided by Amazon Web Services that uses Amazon Light sail. It satisfies the customers because of its sustainability, performance efficiency, reliability, security and operational excellence. It also provides a “pay-as-you-use” option that allows costumers lessen their expenses. [5] One of the famous open-source databases that is being used by many is MySQL that develop, distributed and supported by Oracle

Corporation. All the data that stored in MySQL are being separated by tables. “Structured Query Language” or also known as SQL is the common standard language that is used to access databases. GPL (GNU General Public) License is being used by MySQL and it is a open source software that is completely free to used. [6]

Technological advances in helping and supporting. It is believed that all forms of human labor are equally useful. Technology is one of the information tools people need to get information faster and more accurately. As an information carrier, it is inseparable from what is necessary for a network of computers. A network that connects the world is the internet. using a network to transmit and trade data in the form of files, movies, audio, and so forth. A website is a popular media and it used to promote and spread information extensively in a company. One of the advantages that websites provide technical support that may be felt. The development of web applications also became popular because it could be accessed easily on mobile devices, which let the users access any web applications anywhere by a cellular data or WI-FI connection. Mobile devices are also a critical platform for developers, because the web applications must be responsive where they can be optimized for mobile devices. [7]

The web applications are the most used application today because it can be easily to access by using the internet connection through the browser. By the evolving of technology today cloud computing may also applied to a web application that led the creation of a huge range of it, including the banking system, online bookings, social media platforms and etc. [8] However, some Local Government Units left behind into the technical modernization that are still using the old framework. It can be time consuming because it only allows the employee work manually because they need to type in the resident data every time the resident request a document and the management taking a risk for their data because it only allows to store their data into a trusted drive that can be prone to viruses or corrupted issues. And also the resident only allows to request a document to the Local Government Units by going on the government offices. [9]

General objectives

The general objective of the study is to develop an application entitled “Barangay Camachiles Management System”.

Specific objectives

- To gather information about Barangay Camachiles, researchers conducted an online search, conducted interviews with both barangay officials and residents in order to acquire relevant documents.
- To identify the necessary hardware and software requirements for development.
    - Hardware
        - Barangay officials are using Windows 10 as their operating system.
        - i7 9th Gen k
        - 8gb ram
        - Gb of hard drive storage & graphics card
    - Software
        - HTML&CSS
        - PHP
        - Visual Studio Code
        - MYSQL
        - Amazon Web Service
- To design and develop the system has a module,
    - Story board.
    - Use case
    - Data Flow Diagram
    - Entity Diagram
- To create a web-based application with the following features:
    - Login/Register
    - Navbar
    - Home
    - About
    - Service
        - Certificates
    - FAQ
    - Payment type
        - PayPal
        - G-Cash QR Code
- To test and evaluate the web-based application using the ISO 25010
    - Functional Suitability
    - Performance Efficiency
    - Compatibility
    - Usability
    - Portability

Scope and limitations

Researchers gathered info from Camachiles online and through interviews. The system, running on Windows 10, streamlines processes for barangay officials. General users can access the website using HTML, CSS, PHP, and MYSQL. Certificates are obtained by logging in and awaiting barangay confirmation. AWS is used for system infrastructure. Ongoing analysis ensures smooth functioning and easy user access.

FOR CAMACHILES MANAGEMENT SYSTEM

The Barangay Camachiles Management System well-organized and efficient functioning tasks such as:

CERTIFICATES

The system provides additional certification options for individuals interested in obtaining a certificate.

Barangay clearance Barangay id

Certificate of indigency/residency Certificate of business closure Certificate of guardianship Certificate of building permit

Locational clearance and zoning compliance Certificate of unemployment

Non-quarantine certification

PAYMENT

Certificate issuance with a user-friendly payment system. Residents can pay online through PayPal or G-Cash, with swift confirmation. In-person payments at the Barangay office are also hassle-free, verified with a reference code or screenshot. Once confirmed, residents can collect their certificates, ensuring a secure and convenient process.

FOR CLOUD-HOSTING

The Barangay Management System in Camachiles operates efficiently on Amazon Web Services (AWS), streamlining certificate issuance and resulting in significant cost savings. Utilizing AWS eliminates the need for physical servers, allowing for resource efficiency and cost-effective administration in Barangay Camachiles.

DATA

We added a feature to make sure Barangay certificates have accurate and reliable information. This feature takes a snapshot of the system when a certificate is made, keeping data accurate and providing a record for checking changes and verifying information.

SYSTEM DEVELOPMENT METHODOLOGY

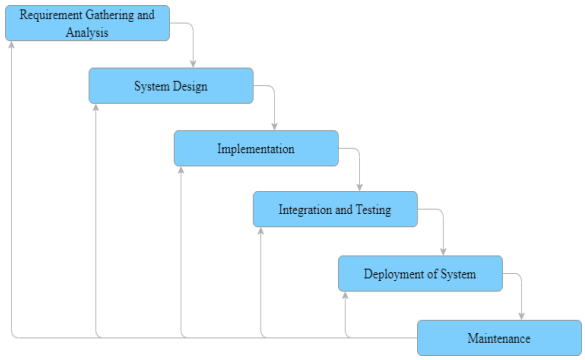


Figure 1: Methodology

The Modified Waterfall methodology combines the structure of the Waterfall model with agile practices, allowing flexibility and adaptability. It emphasizes iterative processes for continuous improvement within the Waterfall framework, ensuring enhanced project development outcomes.

RESULTS AND OUTCOME

In this part, we look at and explain the Alpha and Beta testing we did. We show the results using tables that display information about each test case. We also talk about the features of the web application.

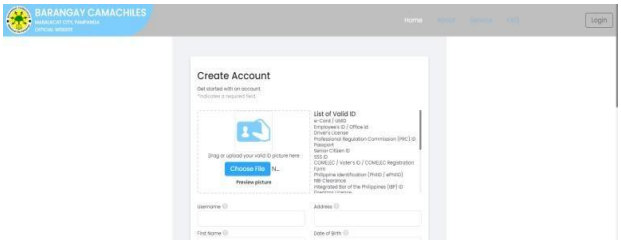


Figure 2: Registration

The Barangay Camachiles Management System enables users to create accounts. New users undergo a registration process, providing personal details and uploading a valid identification document for verification.

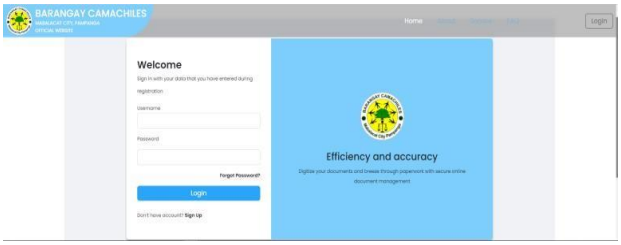


Figure 3: Login

The Barangay management system mandates resident login for certificate requests, ensuring secure and authenticated access.

Figure 4: Navigation bar

The researcher developed a game application with a navigation menu, including a prompt on the website. The prompt features a navigation bar with elements like the system's logo, Home, About, Service, Frequently Asked Questions, and Login.

Figure 5: Home page

Barangay Management System homepage to find a list of dedicated officials serving the Camachiles community. Explore the rich history and discover convenient services, including barangay certificate issuance. Check the FAQ section for answers to common queries and learn more about your community.

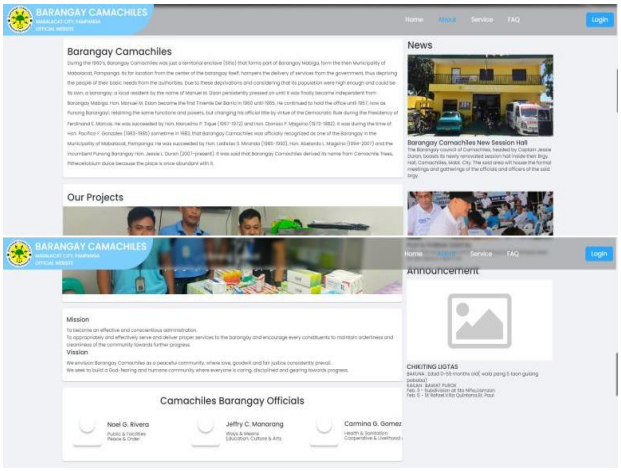


Figure 6: About

The Barangay Camachiles Management System is a digital hub that organizes community information, tracks history and projects, and showcases barangay officials' roles. It provides updates on news and announcements, keeping residents involved and informed. It's our centralized platform for everything happening in Barangay Camachiles.

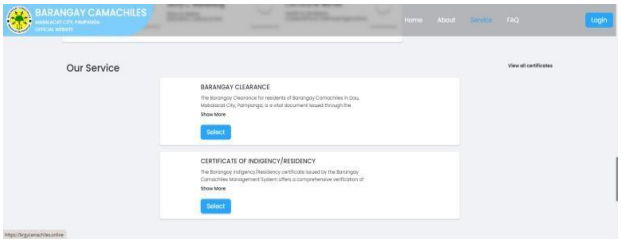


Figure 7: Service

The Barangay Management System offers a seamless and efficient service, allowing residents to easily request and obtain various barangay certificates, ensuring a hassle-free experience for the community.

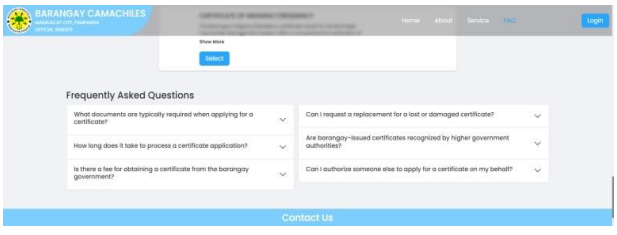


Figure 8: Frequently Ask Question

Here in Frequently Ask Question addresses a common query in a Barangay Management System helping users understand how to engage with the system and manage their expectations regarding response times.

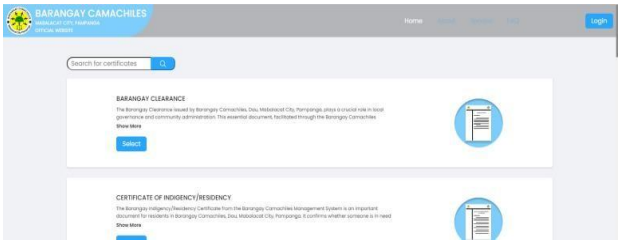


Figure 9: Certificate

Residents can electronically request barangay certificates online, and upon successful application, they can collect the certificates at Barangay Camachiles.

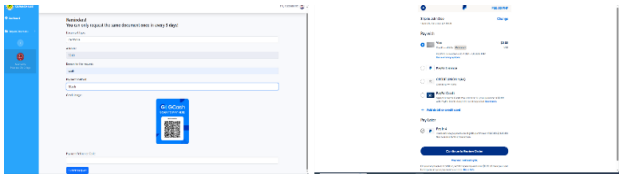


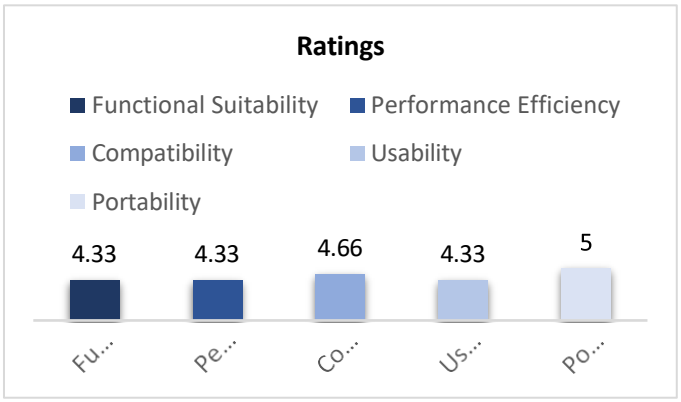
Figure 10: Payment

Residents can choose between online payment methods like PayPal or G-Cash QR Code. For those who prefer, in-person payments are accepted at Barangay Camachiles to obtain a Barangay certificate.

Alpha testing

In the Brgy. Camachiles Management System Alpha testing, three IT experts are evaluating its performance, aligning with ISO 25010 standards for Functional Suitability, Performance Efficiency, Compatibility, Usability, and Portability.

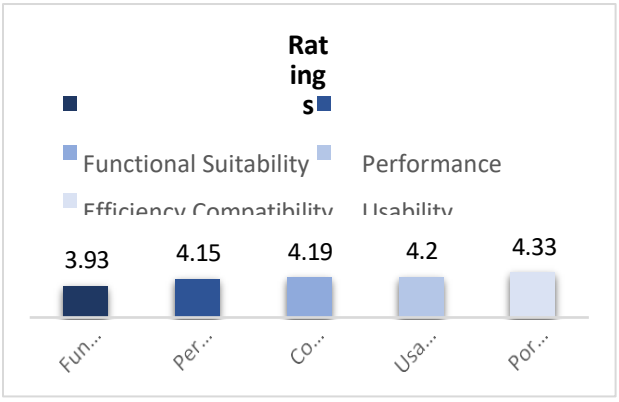
Table1: Overall Evaluation Result of Alpha Testing



Beta testing

During the beta testing phase 40 individuals including 8 Barangay Camachiles employees and 32 local residents evaluated our system basic functions. This phase occurred in Barangay Camachiles, Mabalacat City, Pampanga. The feedback from these testers is crucial for enhancing our system, addressing user preferences, and ensuring it meets real-world needs.

Table2: Overall Evaluation Result of Beta Testing



DESIGN AND DEVELOPMENT

The researchers were able to develop the web application along with the back-end server that has the following requirements which is presented by the Demographic, Use Case, Data Flow and Entity Relationship below:

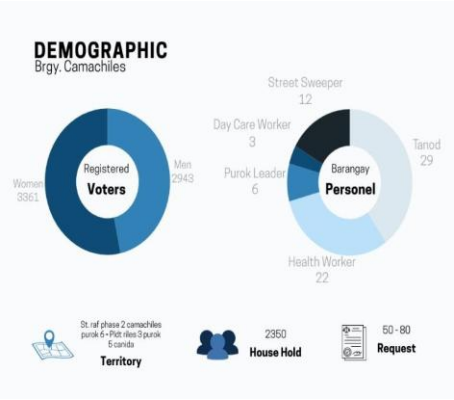


Figure 11: Brgy. Camachiles Demographic

Barangay Camachiles demographic data covers registered voters, barangay personnel, territory, households, and certificate requests, offering a concise snapshot of its community composition and administrative dynamics.

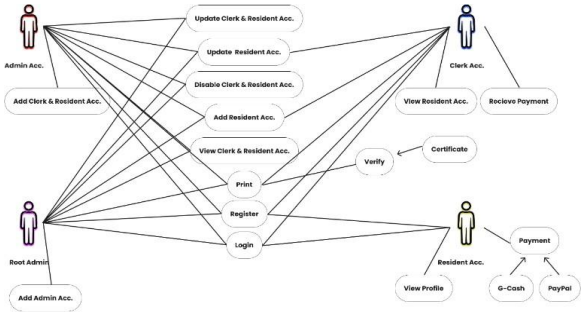


Figure 12: Use Case Diagram

This use case diagram provides a comprehensive overview of the functionalities each user account can perform within the Barangay Camachiles Management System, ensuring clarity and understanding of the system's operational aspects.

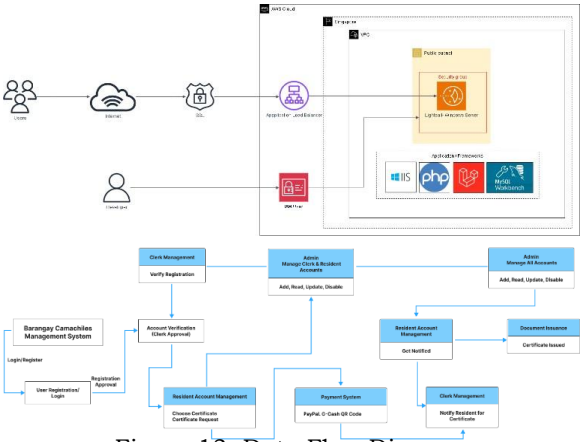


Figure 13: Data Flow Diagram

These DFDs illustrate the flow of data within each component, emphasizing interactions between AWS and the Barangay Camachiles Management System.

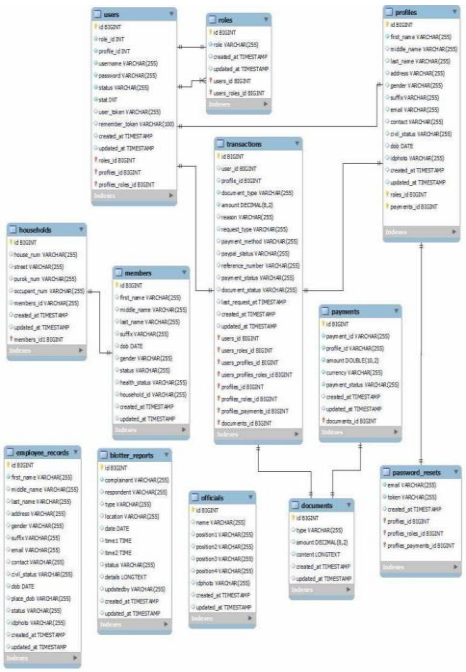


Figure 14: Data Flow Diagram

The Entity Relationship Diagram (ERD) succinctly illustrates how entities like Residents, Employees, Certificates, and Payments interact within the system. It visually represents the connections between these entities, showcasing processes such as Residents requesting certificates and Employees managing records. The ERD serves as a concise blueprint, providing a quick overview of the system's structure and functionality.

Conclusions

The study successfully achieved its primary goal by creating the Barangay Camachiles Management System, an online platform. The researchers utilized online resources, literature, and studies as essential tools for development. The user-friendly interface covers all features, allowing easy navigation. The ISO 25010 evaluation tool guided both alpha and beta testing, ensuring satisfactory performance. The web-based application enables residents to track and address requests promptly, providing a reliable tool for Barangay Camachiles.

Recommendations

Based on the study findings, the following recommendations are suggested for enhancing the Barangay Camachiles Management System web-based application:

- Develop a user-friendly registration system for easier access to the Barangay Camachiles Management System.
- Integrate PayPal and G-Cash QR Code payment services for a more efficient and streamlined financial transaction experience.
- Prioritize enhancements in financial transactions within the web-based application, aiming for a more accessible experience for residents in managing utility payments and community contributions.

REFERENCES

[1] Abiad, A., & Khatiwada, S. (2018, October 18). 5 ways technology is improving governance, public service delivery in developing Asia. Asian Development Blog. https://blogs.adb.org/blog/5-ways-technology-improving-governance-public-service-delivery-developing-asia

[2] Agcaoili, L.** (2020, May 24). *More government agencies, LGUs allowing e-payments*. Philstar.com. https://www.philstar.com/business/2020/05/24/2016041/more-government-agencies-lgus-allowing-e-payments

[3] PayPal. (n.d.). PayPal account Mobile wallet and more PayPal PH. PayPal. https://www.paypal.com/ph/home

[4] Accenture. (n.d.). Cloud consulting services & solutions. Accenture. https://www.accenture.com/ro-en/services/cloud

[5] Eliot, S., & Valverde, L. (2018, May 15). The 6 pillars of the AWS Well-Architected Framework. AWS Partner Network Blog. https://aws.amazon.com/blogs/apn/the-6-pillars-of-the-aws-well-architected-framework/

[6] Alison Topper (2022). https://study.com/learn/lesson/record-management-system- overview.html

[7] Web Application 3-Early Detection of Overheating.pdf (unitomo.ac.id)

[8] Amazon Web Services. (n.d.). Web apps vs. native apps vs. hybrid apps – Difference between types of web and mobile applications. AWS. https://aws.amazon.com/compare/the-difference-between-web-apps-native-apps-and-hybrid-apps/

[9] Troxel, S., Stec, B., & Casanova, N. (2023, April 12). The importance of modernizing old technology — and how to do it. The SHI Resource Hub. https://blog.shi.com/next-generation-infrastructure/infrastructure/the-importance-of-modernizing-old-technology-and-how-to-do-it/

COMPSIMU: A 3D Assembly and Disassembly Simulator

Best Capstone (*Desktop Application Category*)
Presented at International Research Conference on Information Technology Education (IRCITE) 2024

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ABSTRACT

The present technology is evolving at a fast pace, and a lot of today's youths are becoming interested in it. Today's generation is more involved in technology than we are. They are exposed to technology from a young age, making them fall in love and curious. The researchers thought about how students interested in computer-related courses could be illiterate in some aspects and cause accidents that would result in damaged equipment and concluded that would resolve the problem. The researchers made a study for a 'Computer Simulation.' The modified waterfall method was used in the study as a guide for the development. The researchers successfully conducted alpha and beta tests administered to 3 IT professionals and 26 random students of Mabalacat City College. Based on 25010 and the Likert scale as a base and guide, the overall rated mean of the alpha test is 4.76, an "Excellent" Score, while the beta test's total mean is 4.74, also an "Excellent" Score. The results of both the Alpha and Beta tests indicated that the application met the specified requirements. Consequently, the researchers determined that the overall objectives were successfully achieved.

Keywords
Computer Simulation / 3D simulator / PC Application / Assembly / Disassembly

INTRODUCTION

The present technology is evolving at a fast pace and a lot of today's youths are getting interested in it. Today's generation is more involved in technology than we are. From a young age, they are given or shown videos from gadgets such as phones, tablets, smart TVs, etc.

Growing up in this era makes kids more attached to technology, making them curious and fall in love with it. Technology has affected a lot more than just kids; it has affected business, the economy, education, the environment, and the world.

The researchers thought about how students interested in computer-related courses could be illiterate in some aspects and cause accidents that would result in damaged equipment and concluded that would resolve the problem. The researchers made a study for a 'Computer Simulation.'

More equipment would be used to provide the best learning experience for the students. Still, this equipment does not magically appear in the learning facilities. These pieces of equipment were bought and brought to the facility by the school administrators, and they cost money. So, it would be costly if a student with little to no knowledge knocks down or ruins these. Hence, simulators are helpful to avoid accidents like these.

The goal of the study is to spread knowledge to students who are interested in computer-related subjects and prepare them for their studies. This study would revolve around the simulation application that the researchers make.

The 'CompSimu' created by the researchers is a Simulator Application that can teach users how to assemble and disassemble desktop computers. This application would have two modes, 'Easy mode' and 'Explore Mode'. Once the accessible mode is chosen, the user would have to choose between assembly and disassembly. Each respective choice would have the simulator teach the user how to execute the move properly; the user won't be able to move freely as their moves.

Research objectives

Generally, the study aims to develop a simulation called CompSimu: A 3D-Based PC Assembly and Disassembly Simulator. Specifically, the researchers aim to attain the following specific objectives:

- To gather data through the use of articles, books, and other related works that are found on the internet.
- To create the Simulation using the following features: Disassembly Steps, Assembly Steps, Compatibility of hardware components, Displays final specification of the simulated assembled computer.
- To design a desktop simulation application using the following analysis and designing tools: Storyboard Diagram, Visual Table of Contents
- 4.To create a desktop-based application using the following software tools and technologies: Unity 2020.3.18f1, Blender 3D 3.3, Paint, Microsoft Visual Studio Code 2022, C#, Adobe Premiere Pro 2024
- To evaluate the computer-based application using ISO25010 as an evaluation tool with the following criteria: Functional Suitability, Compatibility, Learnability, Operability, and Accessibility.
- To deploy the simulator desktop application in Microsoft Store.

Scope and limitations

The scope of this study is to primarily aimed at design, develop, examine, and assess the desktop simulator titled "CompSimu: A 3D Base PC Assembly and Disassembly Simulator."
The simulation app was developed using the Unity 3D 2020.318f to generate the system that has Assembly, Disassembly, and Hardware Compatibility on computers. The researchers used Blender and Paint to render 3D images of the components; these are the CPU/Processors, Motherboards, RAM/Memory, Graphics Card, Power supplies, Storage, CPU cooling, and Case of Chassis. These are the components that the user will assemble and disassemble in the simulation app. The researchers used c# as a programming language to build the simulator. Additionally, the simulation background music was royalty-free from the motion array.
The application opens with five buttons: Easy mode, Explore mode, Settings, About Us, and Exit (figure 3). Easy mode provides a step-by-step guide for assembly (figure 4) and disassembly (figure 5), while Explore mode shows five objects for assembling and disassembling: a CPU, a TV, a shelf (figure 6), and a book (figure 7). After completing the activity, the simulator displays the final computer specifications and future scalability suggestions. COMPSIMU is an innovative educational tool that effectively introduces computer technology to students, enhancing their learning experience and advancing their abilities in this field, making it a valuable resource.
The simulator is designed for educational use on desktop devices running Windows 10 or higher, offering optimized visuals and smooth operation on a three-dimensional platform. It suitable to be played in full screen or windowed.
The researchers administered alpha and beta testing tools, thus alpha testers were three (3) IT experts and twenty six (26) computer related students (IBCE) of Mabalacat City College.
The application was evaluated using the software quality standards ISO 25010 which covers the Functional Suitability, Compatibility, Learnability, Operability, and Accessibility.
The following are the limitations of the study:
The CompSimu application would run on the Windows Operating System at least windows 10 on a three-dimensional platform with optimized visuals.
The study, "CompSimu: A 3D-Based PC Assembly and Disassembly Simulator", offers significance to the following:

Global Context

The study aims to benefit students globally by highlighting the benefits of technology in daily life, enhancing education for IT educators and students, and predicting a growing popularity of simulation in the technological future.

Economical Context

The study can save the learning institute's budget by using a simulator as a substitute instead of purchasing costly physical components for students.

Environmental Context

The study aims to reduce environmental waste by eliminating the production and disposal of plastic and metal waste.

Societal Context

The study aims to enhance teacher-student engagement in IT fundamental course discussions and demonstrations using an app, providing young practitioners with easy access to computer technology knowledge without costly resources.

Definitions of terms:

Researchers – supports or advocates for a specific cause or concept. This indicates that they are a person who makes recommendations or gives vocal or written support to them. A person or team who creates and conducts a research proposal. [1]
Processor - A computer's processor is an electronic device that is networked and used to perform

calculations. It performs basic operations such as input/output (I/O), logic, mathematics, and other commands from an operating system (OS). A machine that processes something.[2]
Simulator – An application that allows the user to simulate or recreate circumstances that are likely to happen in everyday life. It generates a virtual representation of a thing, location, or anything else in the actual world or a work of fiction, frequently for educational or experimental purposes.[3]
3D – The three dimensions of space—width, height, and depth—are three-dimensional, or 3D, properties. These three dimensions are embodied in all we see and encounter in our physical surroundings. [4]
Computer - An automated machinery that made for processing, storing and displaying information. [5]
Application - Also known as a software program designed to execute specific duties for end-users, allowing them to accomplish specific objectives or purposes, with the program performing necessary operations for user benefit.[6]
Hardware - Refers to physical computer components like CPUs, RAM, storage devices, input/output devices, displays, NICs, and motherboards, which are essential building blocks for computer systems. [7]
Software - A set of instructions, procedures, and documents that a computer processor uses to perform various functions, essentially a set of programming codes. [7]
GPU- Graphics Processing Unit, commonly known as GPU, is a computer component specializing in accelerating graphic rendering.[8]
RAM- Random Access Memory, is a crucial component in a computer's short-term memory, storing data the processor uses quickly and is essential for system functionality. [9]
GB- GB stands for gigabyte, referring to the capacity of a storage device or the amount of data stored, with one billion bytes equivalent to one Gigabyte, e.g., 500 GB HDD. [10]
MHZ- Megahertz or MHz, is a unit of measurement in the International System of Units, representing the speed at which data travels within and between components. [11]

METHODOLOGY

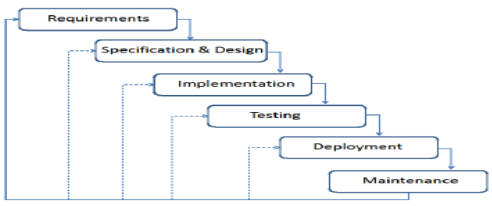

Figure 1: Modified Waterfall Model

Requirements

The researchers collected information online from old or new academic articles, journals, governmental websites, social and question-and-answer websites, and game store websites to define the problems and identify the fundamental requirements for simulator development. The researchers routinely exchanged emails with their technical and capstone adviser to get updates on the simulator's development and documentation status. The researchers developed activity plans, exchanged ideas, acquired opinions, and distributed specific tasks based on the scope of the study.
For building the simulator application, they used the Microsoft Operating system and a desktop computer with hardware specifications of core i5 11400H 2.70 GHz processor, sixteen gigabytes of RAM, and 516 GB of memory. The simulation development tools include Blender 3D for making 3D applications for the development of the simulator, Microsoft Visual Studio Code, Adobe Premiere Pro 2024, and Unity engine, which will be utilized to enable the production of the simulator desktop or laptop devices. The simulator's features and capabilities will also be tested. Additionally, Researchers would design, test, and debug desktop Applications using the Windows SDK.

Specifications and design

In this development phase, the researchers used the designing tools to demonstrate the simulator's function during this development stage. The researcher used the storyboard, component models, and design tools. Researchers will use a Visual Table of Contents (VTOC) for the diagram and Gantt chart. The storyboard is used for the user to understand the functionality and flow of the simulation. Researchers used 3D Blender for design tools to make 3d object models of components for the simulator and Visual Table of Contents (VTOC) to arrange the interfaces of the COMPSIMU Simulator (see the figure 2). Additionally, researchers used Gantt chart to properly plan, manage, and organize their work for simulator.

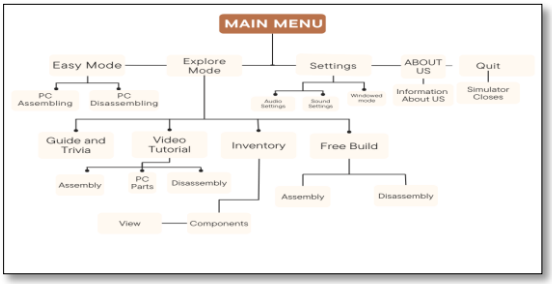

Figure 2: Visual Table of Contents (VTOC)

Implementation

In the Implementation phase, the Unity engine is the software tool used to design and build the simulator. The 3D simulator offers a comprehensive learning experience for users to understand computer components, their features, functions, and compatibility. Each element in the simulator provides accurate information, making it easy to differentiate between them. Users can navigate the simulator using arrow keys and mouse clicks to move and orient components. The tool includes a step-by-Step guide and video tutorial for disassembling and assembling computers, along with maintenance guidelines and do's and don'ts. Additionally, the simulator assesses compatibility and suggests possible upgrades for scalability, enhancing the overall educational experience.

Testing

For the testing phase, the researchers adopt a questionnaire based on the ISO25010 checklist during the testing phase in order to determine whether the simulator application has met the necessary goals. The Microsoft Store will be used for uploading and making the researcher's simulator available. The researchers will use the random and purposive sampling method.

Random Sampling This method is the most straightforward of all the probability sampling method since it only involves a single random selection and requires little advance knowledge about the population. [29] The researchers surveyed by choosing randomly selected students with ITESS and ICOMP subjects.

Purposive Sampling, A collection of non-probability sampling strategies known as "purposive sampling," involves choosing units for your sample based on their possession of specific qualities [30]. The researcher surveyed Mabalacat City College, and the respondents were random students with a Bachelor of Science in Information Technology.

Instrumentation

The researchers will approach three (3) IT specialists to serve as alpha testers. The researchers will ask twenty-six (26) BSIT students from Mabalacat City College to test and assess the Simulator application as part of beta testing. The researchers utilized a survey based on the ISO25010 criteria to determine if the simulator application met the required objectives.

Question administration

The survey was administered at Mabalacat City College on December 12, 2023. Researchers provided simple instructions on how respondents fill out the checklist based on their experience with the simulator during the distribution and presentation of the questionnaire. The researchers may use the mother tongue to facilitate communication and comprehension.

Table 1: Desktop specification during Beta Testing

Components	Capacity
Processor	i5-11400h processor
RAM	16GB RAM 3200Mhz
Internal Memory	516GB SSD
Graphics Card	NVIDIA GeForce RTX 3050

Data gathering

Beta questionnaires were administered, distributed, and collected by the researchers. Respondents who have used and experienced the developed simulator application will complete the form in less than 6 (minutes). On December 12, 2023, the researchers will begin collecting user data and conducting beta tests. This process lasts until December 12, 2023.

Data analysis

Descriptive statistics will be used in this study. Descriptive statistics are techniques used to compute, characterize, and summarize gathered research data rationally, significantly, and effectively. [31]

The study utilized frequency distribution to show the number of cases at each score in the demographic profile. Scores were grouped into categories with step intervals. These intervals represented contiguous possible scores. A variable indicating case order was categorized, and the frequency was tabulated in each category.

The mean is the average or computed central value of a set of integers and is used to determine the data's central tendency. The mean formula in statistics for a set is defined as the sum of the observations divided by the total number of words. The mean formula for a set of given observations can be expressed as, Mean = (Sum of Observations) ÷ (Total Numbers of Observations)

$\bar{x} = \Sigma fx/\Sigma f$

where,

$\bar{x}$ = the mean value of the set of given data.

f = frequency of each class

x = mid-interval value of each class

The Likert scale is used in the study. A rating scale known as the Likert scale is utilized in survey or questionnaire forms. After the calculations of each mean score of each survey tool, sub-criteria and criteria, the researchers used the Likert scale to interpret the result into its corresponding verbal interpretation.

Table 2. 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

Data processing

Tally sheets were used to process the data. The tally summary was created after the respondents had finished filling out the beta surveys. The researchers proceed to record and count respondents' data using the tally sheets form.

Deployment

During the deployment stage of the simulation, potential users can access the Microsoft hosting site to download the simulator. The download process involves specifying that the application is exclusively intended for desktop or laptop devices. The hosting website is a platform for promoting and distributing the simulator application, facilitating its deployment to a broader user base.

Maintenance

The simulator program will be available on a public repository site for the gaming industry during this stage. Users can test the program, report any bugs or issues they encounter, and suggest improvements. The developers can then use this feedback to understand user requirements and make necessary modifications to enhance the application's functionality and user experience. Users can also learn about the development process and contribute to the program's improvement by visiting the hosting repository website. This collaborative and iterative development process will ultimately result in a better user product.

RESULTS

Researchers gathered reliable data for their project through online and library exploration, ideation, and strategizing. With technical guidance, they formulated concepts, conducted Internet-based research on various platforms, and consulted regularly with advisors. Using the modified waterfall method, they developed COMPSIMU, a 3D PC Assembly and Disassembly Simulator, ensuring a systematic and flexible approach for high-quality, reliable software. Unity, Blender, Paint, Adobe Premiere Pro, and Microsoft Visual Studio were used. 3D modeling was done in Blender, with minor edits in Paint. Adobe Premiere edited tutorial videos. Microsoft Visual Studio and Windows SDK were used to compile and deploy to the Microsoft Store. Design and analysis tools like a storyboard and VTOC were employed. (See Figure 2)

After alpha testing with IT professionals, Mr. Frederic Santos, Mr. Darrel Malig Jr, and Mr. Richard Turla, adjustments were made based on their recommendations. Beta testing on December 12, 2023, involved 26 students aged 18 and above, using ISO 25010 and the Likert scale for evaluation (See Table 2). The survey yielded excellent results, affirming the simulator's quality. The Alpha test's total mean is 4.76 while the Beta test got 4.74 both an "Excellent Score" (See Table 3 and Table 4)

Table 3. Summary of Alpha Test Result

Test Case	Result	Verbal Interpretation
Functional Suitability	4.88	Excellent
Compatibility	4.83	Excellent
Usability	4.79	Excellent
Performance efficiency	4.33	Excellent
Security	5	Excellent
Total Mean	**4.76**	**Excellent**

Table 4. Summary of Beta Test Result

Criteria	Result	Verbal Interpretation
Functional Suitability	4.72	Excellent
Compatibility	4.67	Excellent
Usability	4.74	Excellent
Total Mean	**4.74**	**Excellent**

CONCLUSION

These conclusions stem from the study's objectives, comprehensive analysis, and thorough testing and evaluation of the developed game. The study centered on designing, developing, and assessing "COMPSIMU: A 3D Assembly and Disassembly Simulation."

In conclusion the researchers have created and deployed a simulation application that can be accessed offline, the said application is exclusively downloadable at Microsoft Store and can be executed on windows operating system. The simulation can execute Assembly and Disassembly Steps, it has compatibility of hardware components, and it displays the final specification of the simulated built system unit. The creation of CompSimu, was made possible thanks to Blender, Unity, Paint, Windows SDK, and Microsoft Visual Studio.

The testing and evaluation phase was completed during the Alpha and Beta Testing where the testers evaluated the simulator by answering surveys that was based on ISO 25010 and rating it using the Likert scale. (See Figure 2)

In conclusion, CompSimu emerges as a solid and effective 3D-based PC assembly and disassembly simulator, ready to make a substantial contribution to computer hardware education and training.

Figure 4. Game Application Mode Easy Mode (PC Assembling)

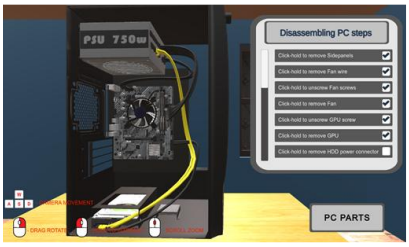

Figure 5. Game Application Mode Easy Mode (PC Disassembling)

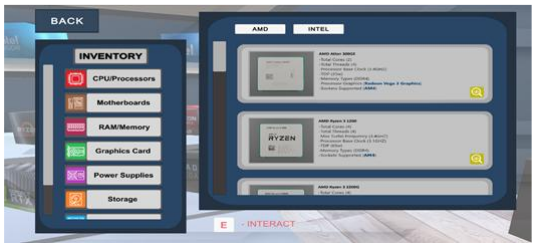

Figure 6. Inventory Shelf (Explore Mode)

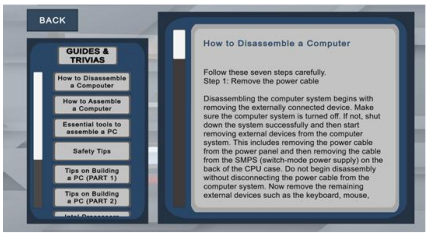

Figure 7. Guide & Trivias (Explore Mode)

ACKNOWLEDGEMENT

Completing this study required the work of numerous individuals who have contributed to the success of this project. We would like to express our gratitude and appreciation for the following: Mr. Robbert Bamba, our Technical Adviser, and Mr. Dennis Tacadena, our Capstone adviser, for their invaluable guidance, suggestions, and ideas for improvement. To all alpha testers, for validating and making recommendations for improvement. Their expertise played a considerable role in enhancing our project quality. Mrs. Josephine Evangelista, Ph. D., Dean of IBCE, for allowing us to conduct and make this research/study possible. The researchers would like to thank the Beta Testers for giving us time and effort to answer all the questionnaires honestly. The researchers have greatly appreciated their support. A special thanks to our Family and Friends, who gave us never-ending support and patience throughout our journey in this research. Their love, prayers, and support became our pillar in times of doubt and hardship. This research would fail if our special ones are not on our side. Finally, We would like to thank each member of the group who gave their time and effort and contributed great ideas.

We, the researchers are whole heartedly expressing our gratitude.

REFERENCE

[1] Merriam-Webster. (n.d.). Researcher definition & meaning Merriam- Webster.https://www.merriam webster.com/dictionary/researcher

[2] Rouse, M. (2023, October 2). What is a processor? definition from Techopedia. Processor https://www.techopedia.com/definition/28254/processor

[3] Merriam-Webster. (n.d.-b). Simulator definition & meaning MerriamWebster.https://www.merriamwebster.com/dictionary/simulator

[4] Barney, N., & Sheldon, R. (2022, November 18). What is 3 (threedimensions or three-dimensional)? - definition fro TechTarget.

[5] WhatIs.https://www.techtarget.com/whatis/definition/3-D three-dimensions-orthreedimensional#:~:text=3D%2C%20or%20three%20dim nsional%2C%20refers,in%20it%20are%20three%20dimensi nal.

[6] Pottenger, W. M., Hemmendinger, D., & Swaine, M. (202 December 28). Computer. Encyclopædia Britannica.

[7] https://www.britannica.com/technology/computer

Gillis, A. S. (2021, October 6). What is an application definition from searchsoftwarequality. Software Quality https://www.techtarget.com/searchsoftwarequality/definiti on/application

[8] GeeksforGeeks. (2023, April 27). Difference betwee hardware and software. GeeksforGeeks https://www.geeksforgeeks.org/difference-between-hardware-and-software/

[9] https://www.intel.com/content/www/us/en/products/doc s/processors/what-is-a-gpu.html#:~:text=What%20does%20GPU%20stand%20for,v deo%20editing%2C%20and%20gaming%20applications.)

[10] .(Villinger, S. (2023, November 1). What is Ram and wh does random access memory matter https://www.avast.com/c-what-is-ram-memory#:~:text=RAM%20(random%20access%20memory)% 20is,is%20critical%20for%20system%20performance.)

[11] .(Sheldon, R., Peterson, S., & Wilson, S. (2021, October 21 What is a gigabyte (GB) and how is it measured?. Storage https://www.techtarget.com/searchstorage/definition/giga yte#:~:text=A%20gigabyte%20is%20a%20specific,only%202 0%20GB%20of%20data.)

Course Evaluation and Enlistment for BSIT Program in MCC

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ABSTRACT

The BSIT program at Mabalacat City College plays a crucial role in shaping the future of aspiring IT professionals. However, course evaluation and student enlistment are critical aspects that require enhancement to ensure the program's effectiveness and administrators' satisfaction. This capstone project aims to address a comprehensive framework for improving course evaluation and student enlistment procedures within the BSIT program. This system can reduce the traditional method of using pen and paper to evaluate students, duplicate entries of typos, and incorrect information. Aligned with Sustainable Development Goal (SDGs) 4, it focuses on quality education. Under the modification of the waterfall method, researchers will ensure continuous improvement through feedback. The Alpha and Beta evaluations and results show performance in functional suitability, compatibility, usability, security, and portability, with consistently high scores on all dimensions. In conclusion, the alpha and beta results show the system's effectiveness, and users meet the functional requirements, facilitating easy portability. The project will contribute to a more seamless approach based on assessment and insights from evaluators, ultimately improving the educational experience of the BSIT program.

Keywords:
Course Evaluation, Course Enlistment, BSIT Program, Curriculum, CSV File, Student Record, Manage Staff, Manage Admin, ISO25010, Sustainable Development Goal (SDGs)

Categories and subject descriptors
Web Application
General terms
Certificate,

INTRODUCTION

Course evaluation referred to evaluating grades to learners based on performance in a specific course. It is a process of appraising the quality of student work based on set criteria [1]. Grades served as a measure of academic success for students and could help students find areas for development. In evaluators' grades it was essential to identify which students could take the prerequisites. Prerequisites were classes that had to be completed before a student registered for the next level of courses, ensuring that the students had some prior knowledge of a subject or course [2]. Course Evaluation was required to be performed in academic institutions to determine if the curriculum was effective for the students. The curriculum was a standards-based sequence of planned activities in which students practiced and mastered subjects and applied learning abilities. Curriculum was the central guidance for all educators in terms of what was required for teaching and learning so that every student had access to quality academic experiences [3].

The curriculum's Course Evaluation was a crucial step that aided educators in assessing the performance of their programs, identifying areas for improvement, and making judgments regarding potential future modifications [4]. The University of Hawaii had a Course Evaluation System where evaluators used this system to easily evaluate students. CES (Course Evaluation System) was available to UH members of the administrative staff, who could use CES to administer it for their organization [5]. The Bachelor of Science in Information Technology (BSIT) program at Mabalacat City College used a traditional method of course evaluation by using pen and paper. Students were required to enter the school for evaluations that only took 2 minutes. This study aimed to develop a system, Course Evaluation and Enlistment for BSIT Program of MCC, to make the work of the evaluators

easier and error-free and to save time and effort for students. SDG (Sustainable Development Goals)
4: Quality Education
o 4.6 By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy
o 4.a Build and upgrade education facilities that are child, disability, and gender sensitive and provide safe, non-violent, inclusive, and effective learning environments for all
o 4.c.1 Proportion of teachers with the minimum required qualifications, by education level

General objectives

The general objective of the study is to develop a web application entitled "Course Evaluation and Enlistment for BSIT Program of MCC (Mabalacat City College)".

Specific objectives

- To gather the information and relevant data from the evaluators, interviews and online research were conducted. Hardware. To identify all of the software and hardware for developing online systems, the necessary components were identified.
- To design the online system, the following design tools were used:
  - Use Case Diagram (UCD)
  - Data Flow Diagram (DFD)
  - Visual Table of Contents (VTOC)
  - Entity Relationship Diagram (ERD)
- To create and develop a system that had the following features, the necessary functionalities were implemented:
  - Academic Listers
  - Course Evaluation
- Uploading CSV file from the registrar of grades and class list
- Process of traditional curriculum into online system
- Records of the GWA computation per semester
  - Student Record
- To test and evaluate the system, ISO 25010 was used with the following features: Functional suitability, Usability, Reliability, Security, Maintainability, and Portability.
- The system was deployed using Hostinger.

Scope and limitations

The study aimed to develop an online course evaluation and enrollment system for MCC's BSIT program. The system covered course evaluation, subject code qualification, and academic list enrollment. Admin and evaluators handled responsibilities like entering grades and managing the dean's list. The system automatically assessed courses but didn't manage program shifts. Admin had primary access, managing evaluators through website registration. They used CSV files for manual grade input, facilitating automatic course evaluation. The system's development occurred on a desktop PC with Microsoft OS and specific hardware.

HTML and CSS handled front-end design, while PHP and JavaScript managed back-end functionality. Tools like VTOC, ERD, and a use case diagram illustrated the system's UI, database structure, and user interactions. Rigorous developer testing followed ISO 25010 standards, covering various aspects. Beta testing gathered user feedback for system improvement. Survey results underwent statistical analysis. Convenient sampling ensured sample representativeness.

Post-testing modifications led to system deployment on a web domain hosting site. The research team provided ongoing maintenance, addressing modification requests collaboratively with the institution. Regular maintenance ensured the system remained updated, secure, and optimized.

SYSTEM DEVELOPMENT METHODOLOGY

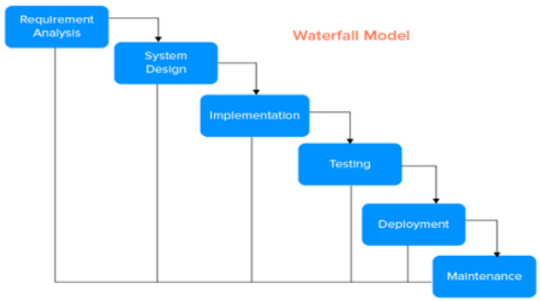

Figure 1: Methodology

The researchers used the waterfall technique, a linear process model that divides development operations into sequential project phases. Unlike iterative models, each phase is only performed once. The preceding stages' outcomes are used as assumptions in the next phase. In software development, the waterfall model is extensively employed [39]

RESULTS AND OUTCOME

The researchers used a questionnaire based on the ISO 25010 criteria. We conduct the alpha and beta testing to have a result on our web-based system, to test if it matched the required objectives.

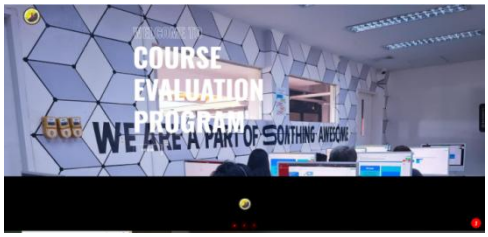

Figure 2: Homepage

When you go to our web-based system, the first feature you will see is our homepage and the title of our system.

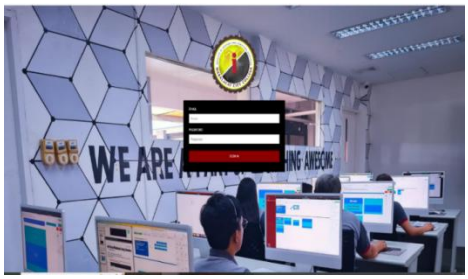

Figure 3: Login

In order to provide safe and verified access, the system requires users to login.

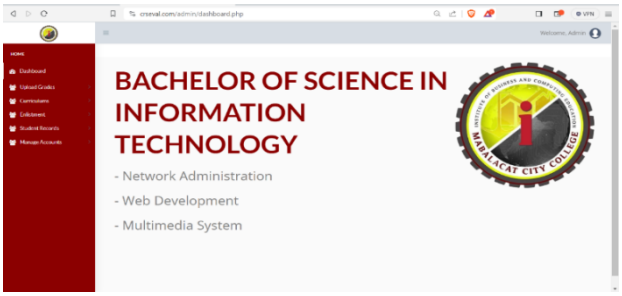

Figure 4: Dashboard

The Dashboard show all the features of the system uploading grades, curriculum, enlistment, student records and manage grades also in the upper right of the dashboard the human icon it shown there the logout and the profile of the admin

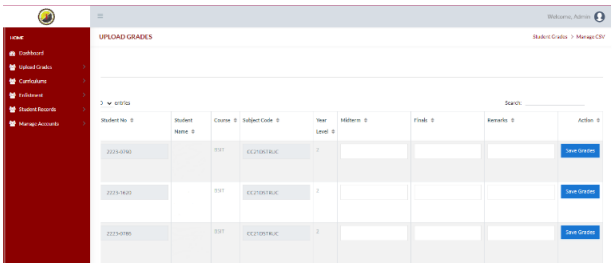

Figure 5: Upload Grades

The first step in our web-based system is to upload grades. Here, you can enter grades and add subject codes. The system offers two options for uploading grades: manually or through a CSV file.

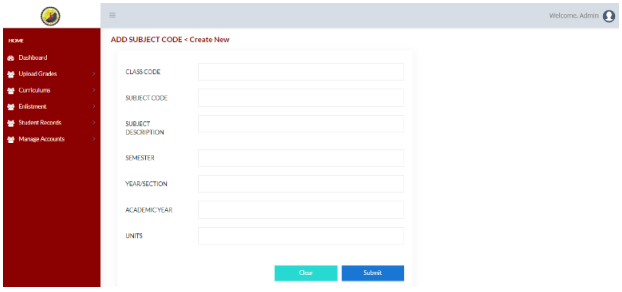

Figure 5.1: Add Subject Code

The manual input of the subject code, description, semester, academic year, units, year, and section is the task of this feature.

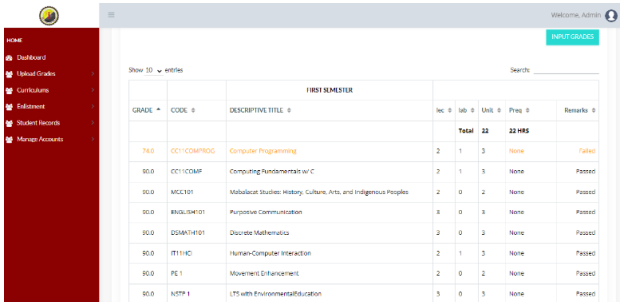

Figure 5.2: Input Grades

Inputting grades involves manually entering each one individually. This function is intended for staff members or evaluations who must manually enter grades.

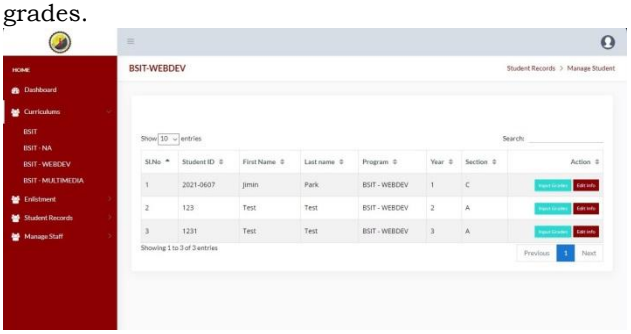

Figure 6: Curriculum

The specializations are presented in the curriculum for the student records for evaluation and the BSIT program.

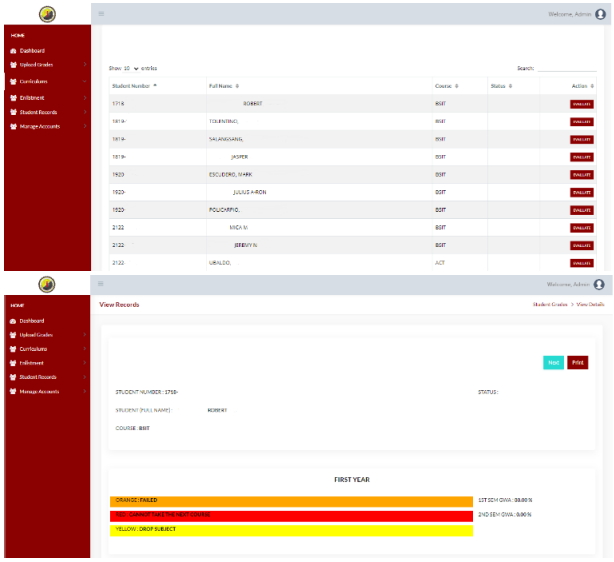

Figure 6.1: Evaluation

This section of the evaluation will display the student's semester grades. The system will automatically highlight any marks that the student receives—pass. Failed (orange), Prerequisites (red), dropped subjects (yellow). perquisites(red), dropped subject (yellow) it will automatically be highlighted.

The "next button" in the upper right corner displays the students' grades for the upcoming semester. For the upcoming semester, required these characteristics and specifications it needed to be printed.

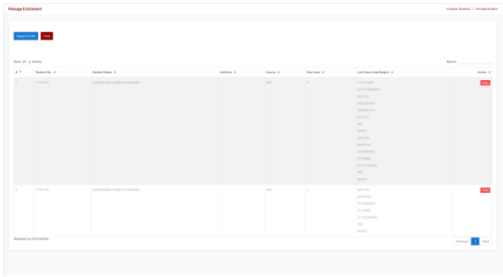

Figure 7: Enlistment

This displays the enlistment of both regular and irregular students. Here, it will automatically display the courses that students can enroll in for the upcoming semester. The distinction between regular and irregular students is that the regular students will shows their information such as Student number, Name, Institute, Program, Year and Section. While, the irregular students will have a list of available courses or class codes for the upcoming semester.

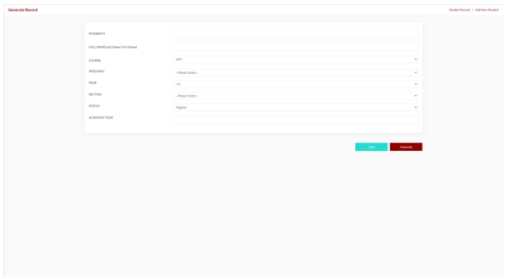

Figure 8: Student Records

This section contains a generate code that allows you to search for a specific student by entering their details. In the upload class list, staff and administrators use a csv file to upload the student's information for each semester. In the regular and irregular student sections, staff and administrators can edit the student's details, including the section and status, as well as view the student's prior files.

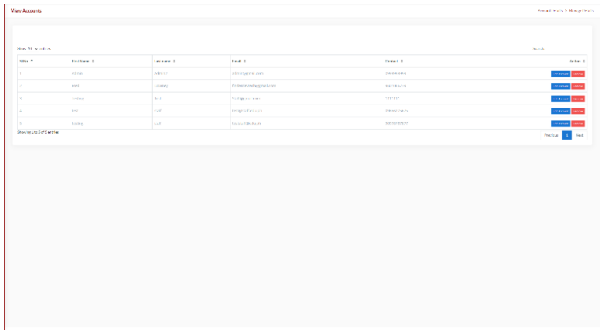

Figure 9: Manage account

The administrator's only access to manage accounts is to add and remove accounts, as well as examine staff member details.

Alpha testing

The Alpha Testing was conducted face to face by three IT expert. In order to assess how well our web-based system performed in accordance with ISO25010, which specifies functional suitability, reliability, performance efficiency, operability, security, compatibility, maintainability, and portability, three IT experts conducted face-to-face alpha testing.

Table1: Overall Evaluation Result of Alpha Testing

ISO 25010 Criteria	Mean Score	Interpretation
Functional Suitability	3.53	Good
Compatibility	3.20	Acceptable
Usability	3.77	Good
Reliability	3.53	Good
Security	4.30	Excellent
Maintainability	3.36	Acceptable
Portability	4.06	Good
Total	3.67	Good

Beta testing

Four (4) respondents/IT professionals assessed the functionality of our web-based solution during the beta test. This was done at Mabalacat City College through in-person testing.

Table2: Overall Evaluation Result of Beta Testing

ISO 25010 Criteria	Mean Score	Interpretation
Functional Suitability	3.03	Acceptable
Compatibility	2.57	Marginal
Usability	2.95	Acceptable
Reliability	2.84	Acceptable
Security	2.75	Acceptable
Maintainability	2.92	Acceptable
Portability	2.91	Acceptable
Total	2.85	Acceptable

Design and development

The researchers met the requirements given in the Use Case, Data Flow, Entity Relationship diagrams, and Visual Table of Content by successfully developing a web-based system with a corresponding front-end and back-end server.

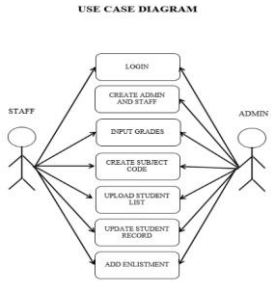

Figure 11: Use Case Diagram

A use case diagram ensures that the operational characteristics of the system are understood and offers a clear overview of the functions that each user account can conduct within the Course Evaluation and Enrollment.

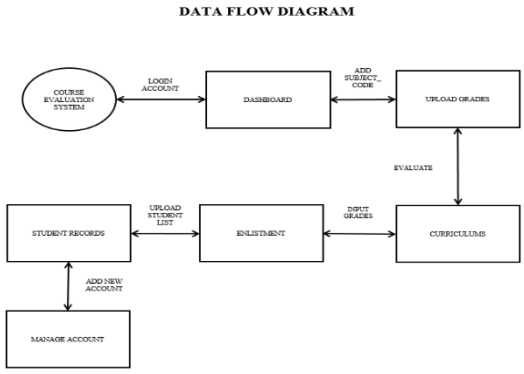

Figure 12: Data Flow Diagram

The Course Evaluation System (DFD) shows how information moves around. Users log in using the Login Account to reach the Dashboard. A teacher can add grades and assess performance. Admin tasks include managing curriculums, entering grades, enlisting, and adding student lists. Student records are kept, and new accounts are added through Manage Account. The DFD gives a simple picture of how data flows in the system.

The diagram shows how student information is organized. Students have details like ID, name, year, and course. Accounts have group ID, name, email, and password. Courses have an ID and name, and subjects have an ID and name. Students and courses are connected through "Student Course," and courses and subjects through "Course Subject." There are two types of enlistments: regular ("Enlistment Reg") and irregular ("Enlistment Irreg"). They include student details, course information, and, for irregular enlistment, subject codes. The diagram helps understand how everything in the student system is relate

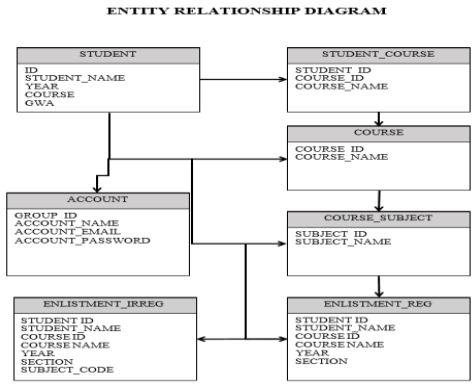

Figure 13: Entity Relationship Diagram

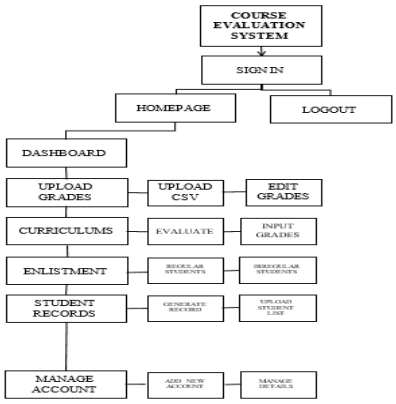

Figure 14: Visual Table of Contents

Virtual Teaching and Operations Center, is like a helpful tool for schools. When you log in, you'll see a simple homepage. From there, you can do different things like checking a dashboard, adding grades, changing grades, and looking at how well students are doing. It also helps with organizing the teaching plans, and you can easily put in grades. The system is good for managing regular and irregular students. You can keep student records neat and generate lists easily. If you're in charge, you can also manage accounts, add new ones, and update details. Overall, VTOC makes it easy to handle lots of important things for schools in one place.

CONCLUSIONS

The research accomplished its main objective by establishing the Evaluation and Enlistment system, an internet-based platform. The development process relied on online resources, literature, and studies as crucial elements. The user interface is designed to be user-friendly and encompasses all functionalities for effortless navigation. Both alpha and beta testing were guided by the ISO 25010 evaluation tool, ensuring satisfactory performance. This web-based application provides a streamlined and error-free method for staff and administrators to evaluate and enlist students in the BSIT Program.

RECOMENDATIONS

The following suggestions are made for improving the web-based system of Course Evaluation and Enlistment for the BSIT program at MCC based on the study's findings.

- Respondents recommend using a CSV file to simply add student lists and grades.
- Respondents suggest automatically generating a list of subject suitable for irregular students.
- The enlisting procedure should have a clickable option to add subjects.
- The listers is add manually.
- The system provides printed copies of subjects for both regular and irregular students.

REFERENCES

[1] Torah High. (n.d.). Assessment and evaluation of student achievement. Torah High. https://torahhigh.org/assessment-and-evaluation-of%20student-achievement/

[2] Lynch, M. (2022, February 1). What is a prerequisite? The Edvocate. https://www.theedadvocate.org/what-is-a-prerequisite/

[3] LinkedIn. (n.d.). How do you manage and coordinate the resources and timelines of your curriculum evaluation project? LinkedIn. https://www.linkedin.com/advice/1/how-do-you-manage-coordinate-resources-timelines#:~:text=Curriculum%20evaluation%20is%20a%20systematic,opportunities%20and%20challenges%20for%20improvement

[4] University of Hawaii System. (n.d.). Course Evaluation System (CES). https://www.hawaii.edu/ces/

DrivED: A 3D Virtual Reality Mobile Educational Game

Best Capstone (*Multimedia Application Category*)
Presented at International Research Conference on Information Technology Education (IRCITE) 2024

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ABSTRACT

Driving has become an indispensable aspect of modern life, offering convenience, time savings, and economic opportunities. Unlike time-consuming commuting, driving allows efficient schedule management, particularly crucial for accessing jobs, education, and healthcare, especially in rural areas with limited public transportation. However, the privileges of driving come with responsibilities, as it involves inherent risks such as accidents leading to severe harm or fatality. This study centers on the creation of "DrivED: A 3D VIRTUAL REALITY MOBILE EDUCATIONAL GAME" to address the need for responsible driving. The researcher monitored the timeline, made sure that deliverables were made on time, and planned the project using the Modified Waterfall Model as a SDLC reference. The game features have three modes: career, endless, and time-trial with a visually appealing garage and virtual reality capabilities accessible through a gamepad controller and VR box. Employing a modified waterfall methodology as a development guide, the study successfully utilized homogenous purposive sampling, alpha, and beta testing tools. Utilizing the adopted MEEGA+ survey tool, the alpha test yielded an overall mean rating of 4.21, interpreted as "Excellent," while the beta test achieved a slightly higher overall mean score of 4.29, also interpreted as "Excellent." This indicates iterative improvements during development. The study concludes that the overall objectives and application acceptance were met.

General Terms

Mobile application

Keywords

Driving, Virtual Reality, 3D

INTRODUCTION

According to the World Health Organization (WHO) states that traffic accidents are a major public health concern because it claims the lives of 1.35 million people annually worldwide. Furthermore, one of the leading causes of death for young people between the ages of 15 and 29 was traffic accidents. The WHO Report on Global Road Safety states that implementing efficient road safety measures was essential to reducing the frequency of traffic accidents and improving public health outcomes. Understanding the factors that contributed to accidents, such as driver behavior and adherence to traffic laws and regulations, was essential to developing successful interventions to improve road safety and prevent injuries from traffic accidents [1].

Road safety was a key issue in the Philippines, as evidenced by the alarming 2018 statistics from the Philippine Statistical Office (PSA), which recorded 116,906 road accidents, resulting in the death of 12,900 and injuries to 185,000 [2]. This data highlighted the urgency of taking action to ensure the safety of drivers, pedestrians, and passengers on the road. Most accidents occurred on national roads and motorways, which tended to have more traffic and higher speeds than local roads. Motorcyclists, in particular, were the most vulnerable group due to the widespread use of motorcycles as a mode of transport, especially in rural areas where public transport options were limited. However, the small size and lack of protection for motorcyclists increased the risk of accidents. The PSA report identified several factors that contributed to traffic accidents, including driving errors such as reckless driving, distraction, and driving under the influence

of drugs or alcohol. Additionally, poor road conditions such as potholes and insufficient lighting could further increase the risk of accidents. But nowadays, drivers always forgetting the importance of defensive driving and discipline on the road.

With this, the developer's conclusion is that by using Virtual Reality [4], the proponents would create an application that would make the users interested and entertained in knowing LTO signs and traffic laws

General Objective

The general objective of the study was to develop a 3D virtual reality mobile educational game called DrivED that aimed to enhance the knowledge and skills of drivers, particularly for new drivers and driving students, on road rules and safe driving practices.

Specific Objectives

The following are the specific objectives of the study:

- To gather needed information through interviews, collaboration, and internet research.
- To identify hardware and software requirements for the development of the game application.
- To design a game application using the following diagrams; Storyboard, Game Menu Tree, Flowchart
- To create the game using the following software technologies; Unity v2021.3.28f1, Blender v3.4.0, Audacity v3.3.1, FL Studio v20.7.1, Adobe Photoshop 2020, Adobe Illustrator 2021, Fish-Net: Networking Evolved, Android Software Development Kit (SDK)
- To develop a game application using the following features; 3D Graphics, Urban City Settings, Vehicles, Virtual Reality and Non – Virtual Reality Environment, Career Mode, Endless Mode, Time Trial, Vehicle Selection, Car, Motorcycle, Jeep, Garage, Learn, Settings
- To incorporate a pointing and feedback system within the game application, providing insights for player`s driving performance and progress.
- To provide manuals within the game application, offering information on the most common road signs, traffic laws and pavement markings.
- To test the quality of game application using MEEGA+ in terms of player experience and usability from the viewpoint of casual gamers.
- To deploy the game application in Google Play Store.

Scope and Limitations of the Research

This section specifies the study's scope and limitations beyond the developed application.

By clicking the start button, the game will be navigated to the three modes which are, Career, Endless and Time Trial. For the career mode, there are 50 levels, each level corresponds to one quest that needs to be answer and complete by the player. After the level selection, the game will proceed to vehicle selection then play and back buttons are provided to navigate to previous part of the game. If the player click the Play button, it will proceed to the gameplay. For the gameplay, a start button will appear. The game will start by pressing the start button. UI touches is provided to maneuver the vehicle. A line renderer is used to navigate the vehicle`s direction. Collectibles are also shown in the as the checkpoint, each levels consists of quiz and situational quest, wherein the quiz is need to be answer correctly in order to proceed to the next level, there is 20 seconds of countdown timer whenever answering a quiz. For the endless mode, the player could toggle the VR mode into Non-VR or VR. In this mode, the VR button is always located at the settings of the game. The player can also enter into VR mode in the main menu but it is only supported in endless mode. In time trial mode, the player also chose between single-player or two-player mode. If the player selected single-player mode, it proceeded to vehicle selection; however, if the player selected two players, it proceeded to lobby to establish the connection of the players' devices. Player one needed to open the device's hotspot as the server, and player two needed to open the device's Wi-Fi to join the server and establish a connection between the two devices.

The researchers administered alpha and beta testing tools, thus alpha testers were three (3) IT experts and beta testers consisted of thirty (30) casual gamers. The application was evaluated using the Meega+ in terms of player experience criteria categories, and the sub-categories are focused attention, entertainment/fun, challenge, social

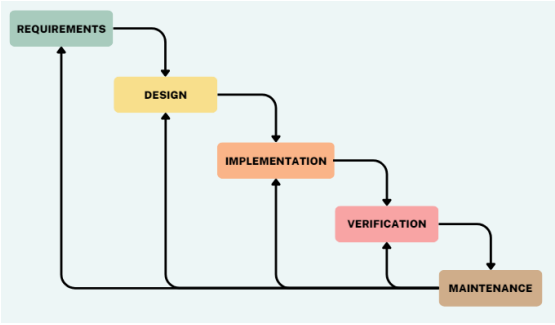
interaction, confidence, satisfaction, perceive learning, error prevention, and recovery. And under the usability category, the sub criteria are aesthetic, learnability, operability and accessibility.

Android phones without a gyroscope sensor were unable to use the application's virtual reality features. Utilizing capabilities like tilting the phone to play racing games and an accelerometer to detect the phone's rotation improved the general gaming experience There were only three vehicles, and they were all in automatic transmission. The game application was limited to LTO road signs to simulate, featuring only 40 of the most common road signs and laws and 10 pavement marking rules. The user needed both a Bluetooth controller to operate the application's functionalities and a VR box to use the VR functionality.

METHODOLOGY

This section describes and contains the methodology on how the application is developed and what are the tools and techniques the proponents used.

Figure 1 is Modified Waterfall Model [3] the researchers utilized the Modified Waterfall Model, also referred to as the iterative waterfall model, as a software development methodology. This methodology consisted of different phases that included requirement gathering and analysis, design, implementation, verification, and maintenance.



Requirements

Data was collected online, and its authenticity and value were confirmed by the researchers. The researchers organized, planned, and carried out library and internet research to come up with ideas for the capstone project. researchers started the process by compiling information from scholarly publications, journals, official websites, and application sites in order to characterize the issues and pinpoint the essential needs for the application's creation. With the technical and capstone mentors, the researchers kept each other updated on the progress of the application development and documentation. The researchers set activity calendars, distributed ideas, and assigned specific tasks based on the project's size.

Plan

Using a desktop computer running the Microsoft Operating System, the researchers created the game program. To create the game, developers used programs like the Android Software Development Kit (SDK), Adobe Photoshop, Illustrator, After Effects, FL Studio, Audacity, and FL Studio. The Unity 3D engine was chosen because it allowed game developers to create content for a range of platforms, such as mobile devices, gaming consoles, desktop computers, and augmented reality, and because it provided a free license for students. Since Adobe Photoshop is frequently used in graphic design, photography, and digital art, as well as because it can be useful for editing digital images, it was used. Adobe Illustrator was used to create other elements of the game, including the logo.

Design

The game's functions were illustrated by the development team using design software. Design resources included a storyboard, game menu tree, and flowchart.

The researchers created a storyboard that included an in-depth outline of the game's components as well as a diagram outlining how the game's story shifts (See Appendix A). A storyboard was an essential element of documentation that described the game's progression and acted as a roadmap for the user interface and gameplay. A visual representation of each scene, level, or stage of the game was often included, along with any pertinent details such as the game's goals, mechanics, and laws. Storyboards aided in ensuring that the game's functionality and design were logical, consistent, and simple to use. Additionally, researchers acted as a resource for the development team during the implementation stage, assisting in ensuring that the final output complied with the project's needs and requirements.

Develop

The researcher created a game application main menu and then added a prompt to the game. The prompt has Start, Settings, Manual and Garage. The

player can also change the settings to play in VR or Non-VR, but a condition must be met to play in VR mode and adjust the volume of the background music (See figure 2).

Figure 2. Main Menu of the Game Application

Figure 3. Garage

Figure 4. Gameplay

Figure 5. Scoring

After the player choosed vehicle, the game would begin, allowing the player to control the vehicle up to the checkpoint and answer a question to advance to the next level (See figure 4). Players are granted the freedom to personalize the vehicle. Two vehicles, a motorcycle and a jeep, remain locked initially. To unlock these options, players should have sufficient in-game coins through gameplay. The customization options include change the vehicle's paint, rims, and suspension (See figure 3). If the player succeed, the game would show the distance travel, correct answer/s, the completed level and total coins earned in the game. Then the player can choose if it want to proceed to the next level, restart the game or go back to main menu (See figure 5).

Release

The application underwent a thorough testing process to ensure that the application is working in the manner in which it was intended. There are four main stages of testing that need to be completed before it can be cleared for use: unit testing, integration testing, application testing, and acceptance testing. Also, for the testing of the application, the researchers had released a prototype of the application to test its function. The researchers used an Android phone with versions 13 and 8gb of ram to test the app. The researchers administered homogenous purposive sampling through alpha and beta testing tools. The alpha testers are three experts in the field of Information Technology (IT). The alpha test result would be used to further enhancement of the functionality and efficiency of the application, the beta testers would be thirty (30) casual gamers. The beta test result is utilized to determine the acceptance level of the application to its intended users.

The beta questionnaires were administered, distributed, and collected by the researchers. Respondents completed the survey within ten (10) minutes of playing and using the developed gaming application.

The Likert scale was used in questionnaires to gauge respondents' attitudes, views, or impressions [5]. The researchers employed the Likert scale to translate the results into the appropriate verbal interpretations following the calculation of each mean score for each survey instrument sub-criteria and criteria.

Table 1. Likert Scale

Response	Value	Range	Verbal Interpretation
Strongly Agree	5	4.21 – 5.00	Excellent
Agree	4	3.41 – 4.20	Good
Neutral	3	2.41 – 3.40	Acceptable
Disagree	2	1.41 – 2.40	Marginal
Strongly Disagree	1	1.00 – 1.40	Poor

Statistical Treatment

In the study, the average score (or mean value) of the respondents' set of data is compared to the total of all the values in the data set (divided by the total number of values) to see if it is equal. The formula for the mean (or average) is:

$$A = N/S$$

Where:

A = average (or mean),

N = number of terms (the number of items or numbers being averaged, and

S = sum of the numbers in the set of interest (e.g., the sum of the numbers being averaged).

Track and Monitor

The game was deployed and published by the researchers, and that it is now easily accessible at Google Play after passing acceptability testing by beta users and a set of panelists. Using a summary statistic from the Google Play repository site, the researchers were able to determine the exact numbers for application installations, uninstalls, and ratings. It could be useful for the researchers to keep track of the various android versions that the app is compatible with.

RESULTS

Alpha Test

In order to determine the acceptability of the application, alpha test was conducted after the data gathering and analysis. Alpha Testing is the final testing before the software is released to the locale and to its potential users. It is typically performed by developers and IT experts.

Table 2. Alpha Test: Summary of MEEGA+ in terms of Player Experience criteria

Player Experience Sub-criteria	Mean	Verbal Interpretation
Focused Attention	4.33	Excellent
Entertainment / Fun	4.33	Excellent
Challenge	4	Good
Social Interaction	3	Acceptable
Confidence	3	Acceptable
Satisfaction	4.2	Excellent
Perceive Learning	4.08	Good
Error prevention and recovery	5	Excellent
Total Mean	**3.99**	**Good**

Table 3. Alpha Test: Summary of MEEGA+ in terms of Usability criteria

Usability Sub-criteria	Mean	Verbal Interpretation
Aesthetic	4.5	Excellent
Learnability	4.67	Excellent
Operability	4.5	Excellent
Accessibility	4	Good
Total Mean	**4.42**	**Excellent**

Table 4. Alpha Test: Summary of MEEGA+

MEEGA+ Criteria	Mean	Verbal Interpretation
Player Experience	3.99	Good
Usability	4.42	Excellent
Total Mean	**4.21**	**Excellent**

The scores assigned to each aspect were determined through a systematic evaluation process that considered specific criteria associated with each category. Focused Attention earned an excellent score of 4.33 which have a verbal interpretation of “Excellent” based on its demonstrated ability to capture and maintain concentration effectively. Entertainment/Fun achieved an excellent rating of 4.33 which have a verbal interpretation of “Excellent”, reflecting its capacity to provide engaging and enjoyable experiences. Challenge garnered a good score of 4 which have a verbal interpretation of “Good”, indicating a commendable level of difficulty and engagement. Social Interaction and Confidence both received acceptable scores of 3 which have a verbal interpretation of “Acceptable”, signifying satisfactory, yet there is room for improvement in these areas. Satisfaction obtained an excellent score of 4.2 which have a verbal interpretation of “Excellent”, indicating a high degree of contentment with the overall experience. Perceive Learning earned a good rating of 4.08 which have a verbal interpretation of “Good”, suggesting a positive perception of the learning process. Notably, Error prevention and recovery excelled with a perfect score of 5 which have a verbal interpretation of “Excellent”, signifying outstanding performance in ensuring the identification and rectification of errors (See table 2). These scores collectively provide a comprehensive assessment of various aspects, reflecting the strengths and areas for enhancement within the evaluated context. shows the summary of alpha test results of the game in terms of MEEGA+ Usability test. Aesthetic received a commendable score of 4.5 which have a verbal interpretation of

"Excellent", indicating a high level of visual appeal and design finesse. Learnability achieved an excellent rating of 4.67 which have a verbal interpretation of "Excellent", signifying the superior ease with which users can comprehend and navigate the system. Operability obtained an excellent score of 4.5 which have a verbal interpretation of "Excellent", showcasing its seamless functionality and operational efficiency. In the case of Accessibility, a good score of 4 which have a verbal interpretation of "Good" was assigned, suggesting a solid performance in facilitating user interaction, albeit with room for improvement. The assessment criteria encompassed factors such as user interface clarity, navigational intuitiveness, and overall user experience (See table 3). The Total Mean, which represents the average of these evaluations, was an excellent 4.21, indicating the overall effectiveness of both Player Experience and Usability. The assessment criteria included factors such as interface intuitiveness, game mechanics, and overall user satisfaction, which provided a comprehensive view of the gaming experience (See table 4).

Beta Test

Table 5. Alpha Test: Summary of MEEGA+ in terms of Player Experience criteria

Player Experience Sub-criteria	Mean	Verbal Interpretation
Focused Attention	4.4	Excellent
Entertainment / Fun	4.4	Excellent
Challenge	4.06	Good
Social Interaction	3.88	Good
Confidence	4.25	Excellent
Satisfaction	4.3	Excellent
Perceive Learning	4.39	Excellent
Error prevention and recovery	4.22	Excellent
Total Mean	**4.24**	**Excellent**

Table 5 summarizes the game's beta test results in terms of the MEEGA+ Player Experience test. Focused Attention and Entertainment/Fun received similar 4.4 ratings, indicating a high level of effectiveness in capturing and maintaining attention, as well as providing engaging and enjoyable experiences. Challenge received a rating of 4.06, indicating a commendable level of difficulty and engagement. Social Interaction received a score of 3.88, indicating sufficient but potentially improved performance in facilitating social engagement. Confidence received a rating of 4.25, indicating a high level of user assurance in the evaluated context. Satisfaction, at 4.3, indicated a strong sense of contentment among users. Perceive Learning received a score of 4.39, indicating a positive perception of the learning aspects in the evaluated context. Error prevention and recovery achieved a score of 4.22, indicating a highly effective system for identifying and rectifying errors.

Table 6. Alpha Test: Summary of MEEGA+ in terms of Usability criteria

Usability Sub-criteria	Mean	Verbal Interpretation
Aesthetic	4.43	Excellent
Learnability	4.24	Excellent
Operability	4.39	Excellent
Accessibility	4.3	Excellent
Total Mean	**4.34**	**Excellent**

The assigned scores for Aesthetic, Learnability, Operability, and Accessibility were derived from a thorough evaluation process that took into consideration specific criteria associated with every measure. Aesthetic, with a score of 4.43, demonstrates a high level of visual appeal and design finesse in the evaluated context. Learnability received a score of 4.24, indicating a commendable ease with which users can comprehend and navigate the system, highlighting efficient learning processes. Operability was given a score of 4.39, indicating seamless functionality and operational efficiency, demonstrating an effective operational framework. Accessibility received a rating of 4.3, indicating a high level of usability and ease of access for users.

Table 7. Beta Test: Summary of MEEGA+

MEEGA+ Criteria	Mean	Verbal Interpretation
Player Experience	4.24	Excellent
Usability	4.34	Excellent
Total Mean	**4.29**	**Excellent**

Table 7 shows that the researchers determined that the game met the predetermined criteria for evaluation based on the beta test evaluation's overall mean score of 4.29 and verbal interpretation of "Excellent."

Comparison of Alpha and Beta Testing

In the comparison of the Alpha Test (4.21) and Beta Test (4.29) results, it is evident that the Beta Test yielded a slightly higher overall score. This suggests that the system or product under evaluation demonstrated improvements or refinements in its performance, features, or user experience during the

transition from the Alpha to the Beta stage. The difference of 0.08 between the two scores may be indicative of iterative enhancements made during the testing and development phases. Further analysis and consideration of specific feedback or changes implemented between the two testing stages would provide additional insights into the observed score disparity.

DISCUSSION

These conclusions and discussions are based on the study's objectives, completed analysis, and evaluation and testing of the developed game. It also includes the developers' suggestions for further improving the game for future academics.

To ensure the accuracy and dependability of the data, the researchers conducted online research before collecting it. Researchers worked together to generate ideas for capstone projects through brainstorming, planning, and library and internet research. Using the internet, the researchers first collected information from academic journals, governmental websites, application store websites, and scholarly articles to characterize the problems and identify the fundamental requirements for the application development. The technical and capstone advisers were regularly consulted by the researchers to get updates on the progress of the application and documentation development. Based on the investigation's criteria, the researchers made activity plans, shared concepts, and assigned specific tasks to each participant.

The game has been made using software development tools such as Unity v2021.3.0, Blender 3D v3.4.0, Adobe Photoshop 2020, Adobe Illustrator 2021, Audacity v3.3.1, FL Studio v20.7.1, Fish-net: Networking Evolved and the Android Software Development Kit (SDK). Using a desktop PC with hardware specifications of Ryzen 5 3600 6 Cores 12 Threads, Gigabyte 500GB Nvme SSD, Trident Z Rgb 16GB 3200MHz, and ASUS ROG STRIX GTX 1080 8GB GDDR5X the researcher was able to install the needed software development tools and produce the APK file product that can be installed, launched, tested, and played on any supported Android devices. During the game development, the researcher used design and analysis tools such as storyboards and game menu tree. A flowchart to help the player see the graphical representation that visually displayed the sequence of steps, processes, or decision-making pathways within the game. Using Blender 3D, the researcher was able to perform the 3D modeling of assets in the game including logo that suits the developed game. The game was planned using Gantt Chart to visualize the work and tell the deadline of a specific task and help the researchers allocate resources. The researcher adopted and used the MEEGA+ survey tools, set a homogeneous purposive sampling [40], and successfully conducted it with three (3) Alpha testers and thirty (30) Beta tester participants (figure 19) (figure 20). Likert scale, mean score, and frequency distribution are examples of statistical formulas that the researchers have utilized. The standard criteria outlined in MEEGA+, namely Player Experience and Usability, form the basis of the survey questionnaires. In Mabalacat City, the researchers executed the beta test from January 1, 2024, until January 2, 2022.The researchers predicted that the game application has been interpreted as excellent and very satisfactory, having met the evaluation criteria with an overall mean score of excellent 4.21 in alpha test and excellent 4.29 in the beta test. The researchers predicted that the game application has been interpreted as excellent and very satisfactory, having met the evaluation criteria with an overall mean score of excellent 4.21 in alpha test and excellent 4.29 in the beta test. Homogeneous purposive sampling was used in the study in order for the researcher to reach a targeted sample quickly. The alpha tester respondents were 3 IT experts. The beta tester respondents were thirty (30) casual gamers at Mabalacat City. The researchers assumed that the game had been judged to be very satisfactory and had met the evaluation criteria based on the alpha and beta test evaluation. The "DrivED" game application has finally been released and uploaded by the researchers to the Google Play store [54] (Figure 21). The researcher concluded that the overall objective and scope of the study had been fully met with the evidence presented in the summary of findings. The researchers arrived at the conclusion that the study's overall goal had been achieved after considering all the available data.

RECOMMENDATION

The researchers' recommendation was intended to provide future academics with various ideas that could be used to improve the game. Future researchers might want to consider some of these suggestions as they work to improve the game application. To the multiplayer section of the game, the researchers suggests that jittering of the vehicles

should be reduce in order to increase the performance and playability. Another is the Virtual Reality mode; researchers recommend to add other kind of technology such as Augmented Reality. Lastly, the researcher also suggests add more road signs and laws.

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REFERENCE

[1] World Health Organization. (n.d.). Global status report on road safety 2018. Retrieved from https://www.who.int/publications/i/item/9789241565684.

[2] Causes of Deaths in the Philippines (Preliminary): January to December 2020. Philippine Statistics Authority.

Retrieved from https://psa.gov.ph/press-releases/id/164052.

[3] Prashant. What is a waterfall model?: Modified waterfall model. The Study Genius. Retrieved from https://thestudygenius.com/waterfall-model-in-software-engineering/

[4] Lutkevich, B. (2023, January 27). What is virtual reality gaming (VR gaming)? -- definition from TechTarget. WhatIs.com. Retrieved from https://www.techtarget.com/whatis/definition/virtual-reality-

[5] Fleetwood, D. Likert scale: Definition, examples & how to use it. QuestionPro.

Retrieved from https://www.questionpro.com/blog/what-is-likert-scale/

EducVentures: Discovering Madapdap Community Schools in a 3D Virtual Tour Simulator for Personal Computers

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ABSTRACT

This study centers on EducVentures, a 3D simulation software tailored for Madapdap Resettlement High School and Madapdap Resettlement Senior High School. Its purpose is to revolutionize the school selection process by transcending geographical limitations, providing an immersive virtual exploration experience. The principal aim is to evaluate EducVentures' efficacy in offering an innovative and informative platform for prospective students. The research methodology involves collaborative efforts, brainstorming sessions, and a preliminary survey, forming the groundwork for EducVentures' development. Rigorous Alpha and Beta testing phases engage IT experts and a diverse audience, providing insightful perspectives on the software's functionality. Results indicate commendable user satisfaction with the 3D school environment and overall functionality. Consistent positive feedback is observed for Performance Efficiency and Portability, while Usability reveals concerns regarding button responsiveness. These findings underscore EducVentures' success as an innovative tool for school exploration, emphasizing its potential to reshape the decision-making process. In summary, this study underscores the significance of technological solutions, exemplified by EducVentures, in fostering inclusive and informed educational decisions. The software's positive attributes are recognized, with suggested enhancements for user interaction and interface responsiveness, positioning EducVentures as a transformative tool in the realm of school exploration.

General Terms
Software
Keywords
Virtual Tour, Software, Desktop

INTRODUCTION

The evolution of education, which can be traced back to ancient Greece, has been facilitated by technological progress. Demonstrating a dedication to education, the Philippines possesses sophisticated systems that are on par with those of leading economies. Nelson Mandela's proclamation, "Education is the most potent weapon," underscores the profound societal influence that it engenders, mirroring Steve Jobs' conviction regarding the interplay between technology and human capability.

Education's contribution to sustainable development is acknowledged by UNESCO on a global scale, which is consistent with the World Bank's recognition of the Philippines' advancements. Within this particular domain, technological advancements such as virtual reality (VR) are increasingly being adopted, augmenting comprehension of space and educational achievements.

Mabalacat City College and other esteemed institutions flourish throughout the Philippines, including the province of Pampanga. In accordance with Jean Piaget's theory of active learning, technological developments, specifically virtual tour software, are transformative in the realm of education.

Educational requirements of the Madapdap neighborhood in Mabalacat are fulfilled by establishments such as the Madapdap Resettlement High School. Recognizing the influence of the digital age on the field of education, the research paper suggests the implementation of EducVentures, a 3D simulation application designed to transform the way in which schools investigate new territories. By providing an immersive experience, this instrument effectively mitigates the difficulties associated with conducting in-person school visits.

The historical context, technological advancements, and tenacity of educational expansion in Mabalacat are highlighted in the background. Educational progress was stimulated by the eruption of Mount

Pinatubo, which resulted in the construction of Madapdap Resettlement High School.

With the introduction of EducVentures, difficulties associated with school selection are resolved in an accessible and environmentally sustainable manner. This is consistent with Sustainable Development Goals (SDGs), including Sustainable Cities and Communities (SDG 11) and Industry, Innovation, and Infrastructure (SDG 9). EducVentures functions as a moderating instrument, making contributions to pertinent societal concerns such as technology, education, and urban planning.

General Objective

The general objective of the study was to develop design a simulation software entitled "EducVentures: Discovering Pampanga's Schools in a Virtual Tour Simulator for Personal Computers."

Specific Objectives

The following are the specific objectives of the study:

- To gather information and references of school's buildings and other infrastructures from trusted sources, interviews, and video and photo references from the following schools:
    - Madapdap Resettlement High School;
    - Madapdap Resettlement Senior High School
- To identify the required specifications for hardware and software used for development and testing of the simulation software
    - Computer Desktop;
    - Graphic Tablet;
    - Unity 3.4.1;
    - Blender 3.5;
    - Adobe Photoshop CC 24.3.0;
    - Clip Studio Paint 1.11.14;
    - Sketchup;
    - FL Studio 20.7.2; and
    - Balsamiq 4.7.1;
- To design the software using the following diagrams and analysis tools:
    - Storyboard
    - Concept Art
    - 3D Models;
    - Relational Schema;
    - Menu Tree; and
    - Gantt chart;
- To test the simulation software and system through Alpha and Beta testing
- To evaluate the simulation software using the Software Product Quality standards of ISO25010 in terms of functional suitability, performance efficiency, compatibility, usability, reliability, security maintainability, and portability.

Scope and Limitations of the Research

This section encompasses the scope of the study and presents the limitations which are not covered by the developed system.

The research involved collaborative efforts through brainstorming, group discussions, interviews, and observations to develop the EducVenture simulation software. A preliminary survey of Madapdap Resettlement High School and Madapdap Resettlement Senior High School provided visual references for 3D modeling.

Development utilized specific hardware and software specifications, employing tools like Unity, Blender, SketchUp, Adobe Photoshop CC. The project followed a structured approach, utilizing diagrams, storyboards, and Gantt Charts for efficient project management.

EducVenture featured advanced movement controls, a user-friendly tutorial, and detailed information about selected schools. The app allowed users to explore virtual environments, access various features, and use functionalities like waypoint marking and quick travel. A camera feature enabled users to take screenshots and access real-time character location information.

Conceptualization prioritized realistic movement mechanics for enhanced user immersion. User-level systems provided personalized experiences based on preferences. The software underwent rigorous alpha and beta testing, focusing on ISO 25010 software product quality standards.

The researchers administered alpha and beta testing tools, thus alpha testers were three (3) IT experts and a total of 30 students, faculty, admin, and non teacher personel of madapdap resettlement highschool and senior highschool

The application was evaluated using the software quality standards of ISO 25010 which covers the functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability and portability.

The software is limited to Windows 10 PC with the minimum requirments of atleast 4gb of ram and I 3 or Ryzen 3 . The software requires internet to download but it can be accessed normally.

METHODOLOGY

This section describes and contains the methodology on how the application is developed and what are the tools and techniques the researchers used.

The researchers picked the Modified Waterfall Model as the Software Development Life Cycle method to use when making the simulation software. Iterative phases and a structured flow of development processes make up the Modified Waterfall Model. These phases include enough documentation and design reviews to make sure that the simulation software the researchers

build is of good quality, consistent, and easy to manage.

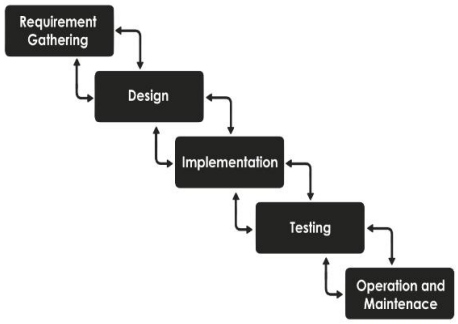

Figure 1: Modified Waterfall Methodology

Requirements

In this phase, the researchers worked together to collect ideas and information on how to create dependable and successful simulation software. This procedure includes group discussions and the exchange of ideas. Improve the functionality and appeal of the simulator, the researchers have gathered data about the school's measurements and information.

Plan

In this phase, the researchers had a meeting to identify what would be the scope of the software. The researchers conducted an interview to the principal of the locale. The researchers ready some questions about the study using iso 25010 and has consulted the capstone adviser for the validity of the questionnaire. The principal gave us necessary information about the school. The principal also gave the researchers permission to do the measurements of the school to provide a more accurate 3D simulation of the school. The researchers thought what hardware and software specification would be use in the development of the software. Also, the researchers thought about what software applications they would use in their proposed study such as UNITY 3D to develop and run the software. Blender is for developing visual effects, and that would help to create 3D objects of the school and to create an animation to the 3D objects. Canva would be use in terms of the graphics of the application. Sketchup was mainly used to create buildings and facilities of the school.

Design

The researchers utilized Canva for creating and editing user interface components like symbols, buttons, menus, and backgrounds. They imported these assets to Unity during the development of EducVenture. Sketchup and Blender were employed to design 3D models of school maps, buildings, and surroundings, including detailed objects like furniture. Blender and Sketchup were also used to map and apply textures to the 3D models. These models were imported into Unity to create virtual maps for each school in the simulation software. Unity was the main platform for developing EducVenture's mechanics, including user movement controls and navigation tools.

User movement in EducVenture was implemented through key press functions, allowing actions like jumping, crouching, and moving in different directions. Various navigation tools, such as a location button, mini-map, and real-time character location text, were integrated to facilitate easy exploration. Users could activate waypoints for guidance, and settings for graphic quality and sound control were incorporated.

Unity was further utilized for developing the user interface of EducVenture, covering splash screens, menus, and settings. For sound and music, FL Studio was used to produce and edit effects and music, which were then imported into Unity for implementation.

Figure 2: Main Menu of the application.

Figure 3: Settings

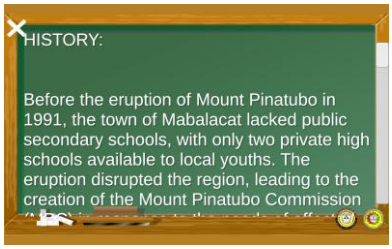

Figure 4: School Information

Figure 5: First Person View

Figure 6: Map Large View

Release

The software underwent a thorough testing process to ensure its intended functionality. The testing stages included unit testing, integration testing, application testing, and acceptance testing

The researchers administered both alpha and beta testing, involving three IT experts as alpha testers and a total of 30 individuals, including students, faculty, admin, and non-teacher personnel from Madapdap Resettlement High School and Senior High School, as beta testers. The software evaluation was based on the software quality standards of ISO 25010, covering functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability.

Table 1. Likert Scale

Response Categories	Numerical Value	Range Interval
Strongly Agree	5	5.00 – 4.50
Somewhat Agree	4	4.49 – 3.50
Neutral	3	3.49 – 2.50
Somewhat Disagree	2	2.49 – 1.50
Strongly Disagree	1	1.49 – 0.00

ISO 25010 is the criteria based on the questionnaire provided by the researchers. Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security and Maintainability used for the application evaluation. The data to be collected compiled and analyzed so conclusions can be derived. Frequency Count utilized to determine the number of responses.

The data to be collected will be compiled and analyzed so conclusions can be derived. Frequency Count will be utilized to determine the number of responses. The results from the Likert's Scale will be used to find out the overall assessment of the respondents (see Table 1).

Statistical treatment

Arithmetic Mean will be utilized to compute for the average of the criteria as described in the software testing tool established on the ISO 25010 standards. The formula is:

$x = \sum fx / n$

Where: x = arithmetic mean; f = frequency; x = responses; n = total frequency.

After the application has been completely developed, it is ready for deployment; the researchers will formulate an release plan.

RESULTS

This chapter explains how the objective of the study is met, which is to provide a EducVentures: Discovering Madapdap Community Schools in a 3D Virtual Tour Simulator for Personal Computers. Also included in this chapter is a discussion of the requirements gathering and analysis, design and implementation, and testing results

Alpha Test

In order to determine the acceptability of the application, alpha test was conducted after the data gathering and analysis. Alpha Testing is the final testing before the software is released to the locale and to its potential users. During the alpha testing phase, the system underwent a comprehensive evaluation by three IT professionals. The evaluation, conducted according to ISO 25010 standards, encompassed various dimensions such as Functional Completeness, Functional Correctness, Functional Appropriateness, Performance Efficiency (Time Behavior, Resource Utilization, Capacity), Compatibility (Co-Existence), Usability (Appropriateness, Recognizability, Learnability, Operability, User Interface Aesthetics, Accessibility), Reliability (Maturity), Security (Confidentiality), and Portability (Installability). The alpha testers that were selected are Ms. Joanna Marie Bautista, who is a former Technical Operations Engineer at Paymaya Philippines, and Mr. Jan Humphrey Salangsang, a Web Developer and IT assistant at Saint Paul American School. The other practitioner is Ms. Dionela Caintic, who is a Senior IT Supervisor at Luenthai Phils. (CLARK).

Table 2. Summary of Alpha Test Results

Category	Mean Rating	Interpretation
Functional Suitability	4.17	Very Good (Excellent)
Performance Efficiency	4.15	Very Good (Excellent)
Usability	4.12	Very Good (Excellent)
Portability	4.13	Very Good (Excellent)

Table 2 reveals a positive trend in user satisfaction across various aspects of the software. In the Functional Suitability category, users expressed contentment with the "Options" button functionality

and the overall 3D school environment. Despite suggestions for improvement in the School Information section, the mean rating of 4.17 indicates a generally consistent and functional experience during the Alpha test. The Performance Efficiency ratings, with a mean of 4.15, highlight users' consistent positive evaluations for features like the mini-map and teleportation tab. Usability feedback was generally high, with a mean rating of 4.12, reflecting satisfaction with background music and movement functionality, but also indicating room for improvement in responsiveness to button inputs. Portability received positive feedback, with users finding the software easy to install on various operating systems, resulting in a mean rating of 4.13. Overall, the summary of Table 2 underscores positive user experiences while identifying specific areas for enhancement in subsequent testing phases or a wider release.

Beta Test

After alpha test and for the completion of the application evaluation, During the transition to the beta testing phase, a total of thirty (30) individuals from Madapdap Resettlement High School and Senior High School contributed significant insights. The group consisted of ten (10) Grade 7 pupils, five (5) senior high school students, ten (10) faculty members, and five (5) non-teaching professionals from the school.

Table 3. Summary of Beta Test Results

Category	Mean Rating	Interpretation
Functional Suitability	4.20	Very Good (Excellent)
Performance Efficiency	4.15	Very Good (Excellent)
Usability	4.12	Very Good (Excellent)
Portability	4.17	Very Good (Excellent)

Table 3 reveals a continuation of positive trends in user satisfaction during the Beta testing phase. In the Functional Suitability category, the mean rating of 4.20 underscores users' commendable satisfaction, particularly highlighting the success of the "Options" button functionality and the alignment of color elements with the school's branding. However, identified areas for improvement in the School Information section and the responsiveness of the "Tour" button emphasize the ongoing need for refinement in specific features. Performance Efficiency, reflected in the mean rating of 4.15, indicates the software's continued effectiveness in addressing user concerns and enhancing overall performance. Users expressed satisfaction with features such as the minimap, teleportation, and waypoint functionalities. The structured evaluation based on ISO 25010 standards ensures a comprehensive understanding of the software's capabilities in this domain. In Usability, the mean rating of 4.12 suggests users consistently reported a high level of satisfaction, with ISO 25010 facilitating a detailed evaluation of usability aspects like background music, volume settings, and shadow settings. Positive feedback indicates the software's continued effectiveness in meeting user needs, particularly in movement functionality. Regarding Portability, the mean rating of 4.17 highlights ongoing positive feedback on the installation process, emphasizing the software's ease of installation on various operating systems. The use of ISO 25010 standards contributes to a thorough assessment of user satisfaction in this regard. Table 3, overall, portrays a positive trajectory in user satisfaction during the Beta testing phase, guiding further improvements for an enhanced user experience.

Comparison of Alpha and Beta Testing

Comparing the Alpha and Beta testing phases reveals a positive trajectory in user satisfaction and incremental improvements in various aspects. In Functional Suitability, the mean rating increased from 4.17 in Alpha to 4.20 in Beta, indicating slight improvement. Both phases highlighted the success of the "Options" button functionality, with Beta testing emphasizing color elements aligned with the school's branding and identifying areas for improvement in the School Information section and "Tour" button responsiveness. Performance Efficiency maintained stability with a mean rating of 4.15 in both phases, showing consistent user appreciation for features like the minimap and teleportation. Usability sustained a mean rating of 4.12, emphasizing ongoing high satisfaction with background music, volume settings, and movement functionality. Portability saw an increase from 4.13 in Alpha to 4.17 in Beta, reflecting continued positive feedback on the installation process. Overall, the structured evaluation based on ISO 25010 standards proved valuable in guiding refinements and ensuring a comprehensive understanding of user satisfaction throughout both testing phases.

DISCUSSION

EducVentures, developed for Madapdap Resettlement High School and Madapdap Resettlement Senior High School, successfully addresses challenges in traditional school selection. The 3D simulation software, a result of collaborative efforts, offers an immersive exploration experience. Aligned with Sustainable Development Goals, EducVentures promotes inclusive education globally, contributing to environmental sustainability by minimizing physical visits.

The systematic development process, including advanced features and testing phases (developer, Alpha, Beta), ensures the software's reliability. Evaluated under ISO 25010 standards, it covers various aspects, such as functional suitability, performance efficiency, usability, reliability, security, maintainability, and portability.

EducVentures' significance lies in revolutionizing educational accessibility, aligning with international goals for sustainable development and providing a model for innovative decision-making in education. The software stands as a testament to technology's transformative power in reshaping traditional processes.

RECOMMENDATIONS

According to the study's findings, the researchers propose the following recommendations to enhance and develop Educventures.

1. The incorporation of 3D customizable characters into EducVentures would improve user engagement by introducing dynamic features inside the virtual environment.
2. The researchers suggest enhancing the virtual environment of EducVentures by optimizing its buildings and assets to improve the user experience, making it more seamless and efficient.
3. Add interior to enhance the user experience in EducVentures by incorporating detailed designs into the virtual rooms and buildings.

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REFERENCES

[1] N. Barney and R. Sheldon, "What is 3d (three dimensions or three-dimensional)? - definition from TechTarget," WhatIs.com, 18-Nov-2022. [Online]. Available: https://www.techtarget.com/whatis/definition/3-D-three-dimensions-or-three-dimensional#:~:text=3D%2C%20or%20three%20dimensional%2C%20refers,in%20it%20are%20three%20dimensional. [Accessed: 19-Apr-2023].

[2] Admin, "The positive side of 3D virtual tours on the education system -," itourvista3D, 12-Feb-2023. [Online]. Available: https://itourvista3d.com/the-positive-side-of-3d-virtual-tours-on-the-education-system/. [Accessed: 26-Apr-2023].

[3] J. Harwood, "The top 5 reasons to use Virtual Tours on your school's website," Concept3D, 12-Apr-2023. [Online]. Available: https://concept3d.com/blog/virtual-tours/the-top-5-reasons-to-use-virtual-tours-on-your-schools-website/. [Accessed: 26-Apr-2023].

[4] R. E. Calingasan, J. B. Ramos, E. J. Espinosa, B. C. Casipagan, and S. C. Alviar, "Into the campus: Creating an Android-Based Interactive Virtual Tour of ...," Research Gate, May-2019. [Online]. Available: https://www.researchgate.net/profile/Ronmar-Calingasan-2/publication/343682226_Into_the_Campus_Creating_an_Android-Based_Interactive_Virtual_Tour_of_La_Verdad_Christian_College_-_Apalit_using_Unity_3D/links/5f38a0b0299bf13404c85420/Into-the-Campus-Creating-an-Android-Based-Interactive-Virtual-Tour-of-La-Verdad-Christian-College-Apalit-using-Unity-3D.pdf?origin=publication_detail. [Accessed: 30-Apr-2023].

[5] M. Alenazi and F. Demir, "UNDERSTANDING VIRTUAL REALITY TOURS: A USER EXPERIENCE STUDY WITH THE PRINCESS NORAH UNIVERSITY," International Journal of Current Research in Life Sciences (IJCRLS), 30-Oct-2019. [Online]. Available: http://www.journalijcrls.com/sites/default/files/issues-pdf/01933.pdf. [Accessed: 30-Apr-2023].

[6] D. Thompson, "Unity: A powerful and versatile game engine," Science Times, 27-Feb-2023. [Online]. Available: https://www.sciencetimes.com/articles/42604/20230227/unity-a-powerful-and-versatile-game-engine.htm. [Accessed: 08-May-2023].

[7] "Sustainable development goals: United Nations Development Programme," UNDP. [Online]. Available: https://www.undp.org/sustainable-development-goals. [Accessed: 07-May-2023].

[8] World Bank. (2021). Philippines - Education Sector Assessment: Meeting the Challenges of the 21st Century. Retrieved from https://documents.worldbank.org/en/publication/documents-reports/documentdetail/792531619461525327/philippines-education-sector-assessment-meeting-the-challenges-of-the-21st-century

I-CDRRMO-MO: A Public Emergency and Response System for Mabalacat City

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ABSTRACT

Nowadays, immediate emergency and response became one of the priorities in both national and local government. The City of Mabalacat City Pampanga is geared towards becoming the most liveable province of the Philippines. The goal of this study is to develop a web-mobile based application. The purpose of the proposed solution is to improve the operational efficiency of to achieve this goal, disaster risk reduction and climate change adaptation must be anchored well so as to move to its destination of shared socioeconomic advancement. The researchers employed a modified waterfall methodology to move through project phases methodically. The system underwent a comprehensive evaluation process, wherein the system received an overall score of 4.53 from the alpha test and an overall rating of 4.68 from the beta test. The alpha test result is marginally enhanced in the beta phase which signifies the implementation of additional enhancement addressing potential vulnerabilities identified in the alpha testing phase. The system's functional suitability, compatibility, usability, security, and portability criteria were achieved wherein the system performed all intended functions efficiently, was user-friendly, had strong security measures, and was highly adaptable. It was ensured that the developed system aligned with and contributed towards the achievement of specific Sustainable Development Goals (SDGs). After conducting a thorough study, it has been concluded that the goals have been achieved successfully. However, to further enhance the system's performance, several improvements have been suggested. By implementing these suggestions, we can ensure the best possible system performance, which will ultimately benefit the users.

CCS Concepts:

- Emergency Response → Web-Mobile Based Applications;

Keywords

Web-Mobile Based Application, Emergency Response

INTRODUCTION

Throughout the years, there has never been a chance that we would be spared from disasters or occurrences like floods and storms, which are the most frequently occurring hazards. Aside from the mentioned natural calamities, the country also experiences human-induced disasters influenced by political or socio-economic factors. Violence, traffic hazards, road accidents, broken pipes, or electric wires, for instance, have caused public anxiety, loss of lives, destruction of properties, and living discomforts. [1]

Emergencies interrupt health systems and have a severe impact on population health, particularly among vulnerable groups such as refugees, certain migrants, and other displaced individuals in countries whose health systems are already deficient. Emergency responses must be complemented measures to recover, restore, and enhance the health system. [2]

Accidents are one of the leading causes of car-related deaths and injuries globally, with an estimated 1.3 million fatalities and 50 million injuries occurring each year. They are also the second most significant cause of mortality in children and adolescents aged 5 to 14 and 15 to 29 globally. [3]

Emergencies and disasters can happen anytime and anywhere, causing occupational injuries and illnesses. Employers and workers may be called upon to respond to a crisis when least expected, and planning is required to respond effectively.

Local Disaster Risk Reduction and Management Office (LDRRMO). - (a) Each province, city, and municipality must establish an LDRRMO and a

Barangay Disaster Risk Reduction and Management Committee (BDRRMC) to oversee disaster risk management programs within their jurisdiction. The LDRRMO will report to the governor, city or municipal mayor, and Punong Barangay in the case of the BDRRMC. The LDRRMOs will be initially established and constituted of a DRRMO whose three (3) staff members will assist in charge of (1) administration and training, (2) research and planning, and (3) operations. Warnings. The LDRRMOs and BDRRMCs will organize, train, and manage the local emergency response teams and ACDVs. Given the emerging challenges brought by disasters of our times, the provincial, city, and municipal DRRMOs or BDRRMCs shall perform the following functions with impartiality: design, program, and coordinate disaster risk reduction and management activities consistent with the National Council's standards and guidelines; operate a multi-hazard early warning system, linked to disaster risk reduction to provide accurate and timely advice to national or local emergency response. Continuously to maintain, provide, or arrange the provision. The Punong Barangay must promote and secure the participation of at least two (2) CSO representatives from current and active other regular financials. Maintain a record of the LDRRMO/BDRRMC's source(s) and budgetary support. Personnel resources, equipment, directories, and locations of vital facilities and their capacity, such as hospitals and evacuation centers; Develop, enhance, and operationalize systems for collaboration with community-based organizations representing the barangay's most vulnerable and disadvantaged groups. [4]

The researchers developed a web-mobile application entitled "I-CDRRMO-MO: A Public Emergency and Response System for Mabalacat City" to allow individuals to report home emergencies and car accidents swiftly. This application offers a reliable and efficient system for home emergency reporting, traffic accidents, and emergency response to lower the number of fatalities brought on by delays in receiving aid during emergencies—the number of deaths caused by delays in seeking emergency assistance.

Background of the study

In the demand for web-mobile applications, the researchers needed some concepts and ideas to develop the study.

The researchers brainstormed and exchanged ideas to make an application that is a reliable and efficient system for home emergency reporting, traffic accidents, and emergency response.

The development of an application that enables drivers to report accidents and give authorities real-time location data. The study also highlights the benefits of using push notifications to alert officials of accidents, which can improve emergency response times.

Location-based services (LBS) would track I-CDRRMO-MO vehicle movements and enhance traffic management. The study identifies the benefits of LBS technology, such as real-time traffic data, which can inform better decision-making and reduce congestion and accidents. Additionally, the developed web-based accident reporting system allows for real-time collection and analysis of accident data.

The City Disaster Risk Reduction Management Office of Mabalacat City aim is to achieve a comprehensive disaster risk reduction and management program that aims to strengthen the capacity of the LGU, together with the partner stakeholders, to build the disaster risk resilience of the community and to institutionalize arrangements and measures for reducing disaster risk and enhancing disaster preparedness and response capabilities of all levels. To uphold the people's constitutional rights to life and property by addressing the root causes of vulnerabilities to disasters, strengthening the city's institutional capacity for disaster risk reduction and management, and building the resilience of local capabilities to disasters, including climate change impact. [5

The researchers also include features such as vehicle location monitoring and instant notification to emergency services. The researchers show the potential benefits of using technology to improve vehicle accident reporting and LGU vehicle location monitoring. Mobile applications, push notifications, and LBS technology can provide real-time data to inform better decision-making and improve emergency response times.

The Sustainable Development Goals (SDGs) establish a global framework for achieving a sustainable future for everyone and the planet. The SDGs are essential because they provide a framework for addressing some of the most pressing problems the world is currently dealing with,

including poverty, hunger, inequality, and climate change. The SDGs are interrelated; therefore, to achieve one goal, addressing issues closely related to other purposes is usually necessary. The SDGs are significant because they define a common objective for a brighter future while providing an agenda for getting there. Governments, corporations, civil society organizations, and individuals worldwide must collaborate and take action to accomplish the SDGs. The researcher identified some SDGs covered in this study. In line with this, this study aims to achieve the following specific Sustainable Development Goals:

The researchers found several examples of sustainable development goals.

Goal 8. Encourage inclusive, long-term economic growth, full and productive employment, and decent work.

8.4 Increase global resource efficiency in both consumption and production. Gradually, until 2030, strive to divorce economic growth from environmental deterioration, following the 10-Year Framework of Programmed on Sustainable Consumption and Production, with developed nations leading the way.

Goal 9. Create a strong infrastructure, promote inclusive and sustainable industry, and encourage innovation.

9.1 Develop high-quality, dependable, long-lasting, and resilient infrastructure, including regional and trans-border infrastructure, to promote economic growth and human well-being, emphasizing affordable and equitable access for everyone.

Goal 11. Improve cities' and human settlements' inclusiveness, safety, resilience, and long-term viability.

11.2 By 2030, offer access to safe, cheap, accessible, and sustainable transportation networks for everyone, primarily by increasing public transportation, focusing on the needs of vulnerable women, children, people with disabilities, and older people.

Goal 17. Strengthen and revive the implementation mechanisms of the Global Partnership for Sustainable Development.

17.1 Increase domestic tax and other revenue collection capacity by boosting domestic resource mobilization, mainly through foreign aid to poor countries.

17.7 Encourage the development, transfer, dissemination, and diffusion of ecologically sound technology to developing nations on advantageous conditions, including concessional and preferential terms agreed upon.

General Objective

The general objective of the study is to develop a web- mobile application entitled "I- CDRRMO-MO: A Public Emergency and Response System for Mabalacat City."

Specific Objectives

This study has the following specific objectives:

- To gather data information through interviews, surveys, articles, scholarly published research, and library research.
- To identify the mobile hardware and software requirement specifications of the application.
    - Visual Studio 2019
    - PHP
    - HTML
    - Java Script
    - CSS
    - Ionic Angular
    - My SQL
- To design a system using the following designing tools:
    - Block Diagram
    - Use Case Diagram
    - Story Board
- To create a web-mobile application with the following features:
    - Administrator;
    - Vehicle Users;
    - Dashboard;
    - Locator;
    - Categories;
        - Fire;
        - Vehicular Accidents;
        - Floods;
        - Earthquake;
    - Departments;
    - Reports;
    - Real-time Chat box;

- To evaluate the system using ISO 25010 criteria namely: Functional Suitability, Security, Compatibility, Usability, and Portability.
- To deploy the system using Hostinger and Google Play Store.

Scope and limitation of the study

The researchers joined forces to collect thoughts and understandings on constructing a solid and efficient system for emergency and response accidents in Mabalacat city and the police officers of the town. It involved brainstorming sessions, group discussions, and idea-sharing activities. The researchers conduct interviews and observations with local government I-CDRRMO-MO units and police stations to gather information on the systems and identify possible process innovations.

The researchers gathered data through interviews where they visited the Mabalacat City-CDRRMO Office Head Officer and those employees at their Office at Xevera, Mabalacat City, to gather the required information for developing the system. The researchers gathered research data through surveys using ISO 25010 to collect data from a total of three (3) IT expert respondents for the alpha test and a total of thirty (30) random respondents, including the staff of the Mabalacat City CDRRMO for the beta test. The researchers also gathered research data through articles, scholarly published research, and library research to find and gather supporting evidence of the study conducted.

The identification of hardware and software was accomplished by utilizing gathered data. For hardware, personal computers, laptops, and smartphones were mainly used to create and run the system. As for software, Visual Studio Code was used to build the front end and support the back end and debugging, then PHP and XAMPP for the back end primarily, and Canva for graphic editing of the system. Each software component was used for code/text editing and as a local web server.

To create the system, the researchers employed relevant tools and technologies such as web frameworks like Laravel and database management systems using XAMPP, a software package that included several components that were commonly used in web development, including a DBMS (MySQL), a web server (Apache), and an interpreter for server-side scripting languages such as PHP. Aside from that, third-party applications were also used, such as HPanel for managing hosting accounts, SMTP2GO as an email delivery service, Pusher as a hosted API service, and GitHub.

The researcher designed the system using a variety of analysis tools. The storyboard was used as a guide to visualize and refine the flow of the website. The Use Case Diagram was effectively used to identify the different actors, the admin, and users involved in the system and the functionalities they required. Lastly, the block diagram was used to visualize the representation of the website's content hierarchy, providing a flow for admin and users to navigate the website.

The researcher furthered the system's success using the Modified Waterfall Methodology since it offered a systematic progression of design phases with adaptable iterative phases. This approach helped them ensure that documentation and references were adequate and relevant, guaranteeing the created system's quality, dependability, and maintainability. The Frequency Distribution, Weighted Mean, and Likert Scale were used as statistical treatments that aided the researchers in collecting, analyzing, and organizing the data effectively and efficiently.

The researchers had created a user-level access front-end and back-end system. They were involved in designing and developing a system that allowed different types of users with appropriate levels of access and permissions to access the system and its features. This system provided an accessible front-end user interface with helpful views and controls for each user type, such as admin and users.

The system will be launched on a web domain hosting site when it is tested and all essential changes made. The developers would provide ongoing pilot testing and support, and any requests for system changes or adjustments would route to the researchers for local suggestions.

The researchers would work closely with the institution to ensure the system meets their ever-increasing demands and expectations. This application is only available on Android and runs through Data and Wi-Fi. The application was recommended for Android phones.

The log-in page served as a passage where the admin could input the credentials such as e-mail and password, which allowed the admin to proceed to the home page and access I-CDRRMO-MO for desktop

and mobile. The administrator provides the credentials for logging in.

The admin would be redirected to the home page after logging in. The home page is connected to different functional pages, such as dashboards, locators, categories, departments, vehicle users, and reports. When visiting other pages, the top-left navigation item redirects the admin to the home page.

The admin is greeted by the home page upon logging in. When users scroll down to the home page, the rest of the statistics report's details from 2021 to 2023 and the guidelines for I-CDRRMO-MO are shown.

The researchers include the locator tab to easily track the user if they need help wherever they are, and the real-time chat box for the admin and user can also be seen there.

E.g., Name – Type of Vehicular Accident- Hours Pass

"Jeremy R. Silva – Bike Collision – 14 hours ago"

It also contains a category list tab, where the administrator may analyze all the different sorts of accidents and their descriptions, which can assist them in determining the type of accident.

In admin management, there is also an option or tab for the admin: the department tab. Admin could filter the departments by searching or sorting the results by existence. The admin could edit the department's information on this page or add a new department to the list. To create a new department, the admin should fill in the name, acronym of the department and their description fields to admit the user. Once all the necessary information is done, the admin can create the department, and the user can choose what they desire.

In profile management, the admin has multiple options to select and edit. The Vehicle users' list page is one of the options. With this feature, the admin could manage the users' information. Admin could import new users and edit a user's email, role, and department on this page. To find the user quickly, the admin could search for the specific user or department, and this feature helps track and manage admins who have access to or are associated with particular vehicles. The locator and vehicle user list have similarities in tracking accidents.

The application also contains a reports tab that allows the admin to view completed responses. This feature could be valuable for the administrators to track their progress or review past activity.

The researchers tested the system by using developer testing, alpha testing, and beta testing. First, Developer testing involved the evaluation of individual system components and modules to ensure that they performed properly and fulfilled their respective requirements. Alpha testing comprised a limited number of IT experts testing the system as a whole in an appropriately controlled setting. This testing focused on discovering any serious bugs or issues, as well as verifying that the system met the demands of its users. In Beta testing, the system was evaluated in an actual scenario with an increased variety of external users. This testing focused on finding usability issues and collecting user feedback to enhance the system.

The researcher used ISO 25010 to evaluate the system's functional suitability, compatibility, usability, security, and portability.

The researcher used Hostinger as its domain registrar. The deployment procedure consisted of setting up hosting and domain registration with Hostinger, configuring the server environment, and uploading the relevant files and databases to the server. The researchers ensured that the system corresponded with the Hostinger hosting environment and performed any necessary adjustments or optimizations to preserve optimal performance.

The development process included defining user roles and responsibilities, creating a user interface, developing backend functionality, implementing user-level access control, testing, and deploying the system to a production server.

However, there were certain limitations to this study. The study cannot account for accidents in areas with limited internet connectivity or mobile data access. The study cannot guarantee that all public members would be used the system or report accidents accurately. Moreover, the study would focus on a specific geographic area and may not be applicable or transferable to other regions or communities.

Significance of the study

The researchers developed the web-mobile application for Android mobile phones. The

application provided an Emergency and Response System for Mabalacat City. The study would be beneficial for the following:

In the global context, the application would provide significant opportunities for technological innovations to reduce accidents globally.

In the economic context, the study would allow application enthusiast to put their ads into the mobile application and make it profitable.

In the environmental context, the study would give accessibility by installing the mobile application in the Google Play Store, which is available to different Android smartphone devices.

In the societal context, the study would provide emergency and response features for the people in Mabalacat City, making an interactive space for the users.

METHODOLOGY DESIGN

The modified waterfall is an organized development cycle incorporating numerous flexible, iterative steps to ensure the design and documentation's precision, quality, reliability, and maintenance of the software created. The MWF method is preferable for complicated and technical projects requiring customized software design. In this method, there are several phases that the software would go through. The steps include the requirements gathering and analysis phase, the system design phase, the implementation phase, the integration and testing phase, and the maintenance phase. [5]

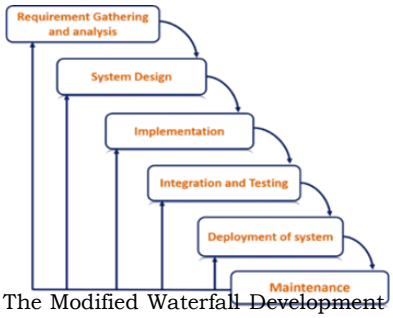

Figure 5: The Modified Waterfall Development Methodology of Techy Stud2

(Source: *https://www.thestudygenius.com/wp-content/uploads/2020/04/modified-waterfall-model-e1588262461818-1024x891.png*)

The researchers chose the modified waterfall methodology (See Figure 5). This methodology was suited to the development of the study. In addition, unpredictable changes and risks are inevitable during the study's development process; thus, this methodology helped with the study's needs.

Requirements Gathering and Analysis

The researchers brainstormed and planned the titles presented at the title defense. Among the proposed titles, the panelists approved the study. After the title defense, the researchers collaborated with the chosen adviser to further improve the initial functions of the study. In addition, the researchers also did the initial research on a few related studies and web-mobile application requirements that could help determine the project's functions—the programmer prepared by watching and understanding video tutorials in the project development area. The researchers chose a technical adviser who could help with the project's technical side.

The researchers met with the capstone adviser twice per week to verify and identify the essential information gathered to be used to create the project's strategy documents. The researchers collected data through the Internet and the school library for additional ideas and knowledge to develop the study further.

The researchers shared those thoughts and devised an idea to create a web-mobile application entitled "I- CDRRMO-MO: A Public Emergency and Response System for Mabalacat City." The Software and Hardware Specification for application development (see Table 1) shows the software and hardware used to develop the project.

Table 1. Hardware and software developmental tools

Hardware Specification	**Software Specification**
Smartphone	Visual Studio 2019
Android version 9.0 (Pie) Up to Android 12 (Snow Cone)	HTML
	CSS
	Java Script
Computer	PHP
LAPTOP i5 4th gen	Ionic Angular
8GB RAM	My SQL
Integrated graphics	

System Design

System designs are an essential part of any software project. It is also a process that involves the team's cooperation and the target user's opinion because when the developer does the system design task, the researchers and the target user do the user testing. So, the developers can present the new design requested or the users' feedback at the next meeting.

The researchers used the designing tools to illustrate the administrator and user environment. The designing tools are Block Diagrams, Use Case Diagram and Story Board.

The researchers used the Block Diagram as a fundamental element in the project's analysis tools, providing a beneficial outcome. The blocks that give the block diagram a name symbolize many system components. The lines and arrows indicate the relationships between the blocks. These graphic features present a high-level, functional overview of the system that is simple to ingest and comprehend. Creating block diagrams allows everyone engaged in a project to understand and learn exactly what is required for something to function. They clearly understand the components that must be combined to get the desired result. This ensures that everyone in the team is on the same page and working toward a shared objective.

The researchers used the Use Case Diagram as a fundamental element in the project's analysis tools, providing a compelling, beneficial outcome. First, it is an instrument that provides a holistic functional overview, encapsulating various user interactions and system functionalities. Through visual representation, it comprehends how users will engage with and navigate through the system. Second, Use Case Diagrams bridge stakeholders and developers, facilitating the specification of functional requirements. The visual nature ensures a shared understanding of project goals and objectives. The researchers conducted the identification of the user-level access.

The researchers developed a storyboard that outlines the application's activities, and a storyboard can help developers immediately understand what work needs to be completed. Anyone can see completed work once the team updates the storyboard. It provides the product owner transparency and helps the team visualize the sequence and interconnectedness of user stories. Storyboards can be physical or digital.

Implementation

The project team created and developed the software following the design guidelines and requirements gathered in the earlier stages. Implementing the system's features, the researchers created a user-level access front-end and back-end system administrator by accessing the homepage; the admin could input the credentials such as e-mail and password. The user could also input their credentials to proceed to the home page. The admin homepage is connected to functional pages such as Dashboard, which shows all the statistics report details from 2021 to 2023. Locator, Categories, Departments, Vehicle Users, and Reports allow the admin to view all the completed responses. This feature could be valuable for the administrator to track their progress or review past activity. The researchers used certain portions of the XAMPP, PHP, MYSQL, and Laravel as the framework for developing the system. The researchers used HTML 5 and CSS/Bootstrap to design the system's user interface. Canva was used to create/edit graphics for the system, and Visual Studio Code was used as text-editing software.

Integration and Testing

In this phase, system testing was done by the project team. System testing examines the entire software to ensure it complies with specifications and is error-free. First, the researchers used simple random sampling because it can guarantee representativeness, remove biases, is straightforward, and uses statistical methods. These elements make it a valuable and trustworthy sampling technique in research projects, enabling researchers to get precise information on the target population. Second, the system was tested using Developer Test, Alpha, and Beta Testing, wherein Developer Test would be for the developers, Alpha would be for IT experts, and Beta would be for non-IT experts. The researchers will approach three (3) IT experts as alpha testers to test the system. For Beta Testing, the researchers selected thirty (30) end-users, the random respondents and Mabalacat City CDRRMO staff, to test the system's functionality. The system was evaluated using ISO 25010, Functional Suitability, Security, Compatibility, Usability, and Portability.The researchers used an ISO 25010 and set the psychometric scale format to a Likert scale (see Table 2) questionnaire to evaluate the application. The test questionnaires used by the

researchers were based on the standard criteria specified in ISO 25010.

Table 2: Likert's Scale

Response Numerical Categories	Value	Range Interpretation Interval	Verbal
SA	5	4.21-5.00	Excellent
A	4	3.41-4.20	Good
N	3	3.41-4.20 Acceptable	
D	2	1.81-2.60 Marginal	
SD	1	1.00-1.80	Poor

The Likert scale is a rating system used in personal interviews to measure people's attitudes, opinions, or perceptions. The researchers applied the Likert scale to translate the result criteria obtained into those verbal interpretations after calculating the means for each sub-criteria and standard of the survey tool.

Etikan (2016) cited that the purposive sampling method, also known as the judgment sample, is a measured selection of a person because of the individual's characteristics. It is not a random method that does not require using the primary theories of science or a specific number of participants. Simply put, the researchers determine what information needs to be understood and then set out to locate an organization that can and is willing to share information based on circumstances of knowledge or expertise.

Homogeneous purposive sampling was used because researchers could obtain the correct sample in a short period and where proportionality sampling was not the primary goal.

Deployment of System

The deployment of the system phase was after the integration and testing phase. The deployment phase includes testing required to ensure the project's development, and the requirements must be well-shown to the users. The team executed the tasks during project implementation and reported the progress data through constant group meetings. The project manager used this data to keep control of the project's direction by comparing the progress reports with the project plan to scope the accomplishment of the project activities and take remedial action as needed. The software may be distributed to users in a few environments, increasing at the end of every emphasis or iteration.

After identifying an initial feature list, prioritizing it, and estimating it, the team held a deployment plan to establish the overall release schedule and determine which features could likely be delivered. The comprehensive deployment plan in prioritized features feeds individual iteration plans. Acceptance testing is also included in the deployment phase, where the panel of panelists authorizes the researchers to release the web-mobile application in the Google Play Store.

The users can download the web-mobile application by accessing the Google Play Store, which is only available for Android devices.

Maintenance

The maintenance phase comprises the processes needed to monitor, review, and organize the progress and results of the project. That would also find any areas where adjustments are required and start the necessary changes.

In this phase, the system still needs maintenance. The researchers may significantly enhance the web-mobile application using user feedback and recommendations from the Google Play Store. It includes any or all of the following: updating systems, patching them, putting software upgrades in place, or testing for flaws and correcting them if they occur. The user must have Android version 9.0 Oreo or 12.0 Snow Cone as a minimum requirement to download and use the application "I-CDRRMO-MO" for the best experience.

RESULTS

The study primarily presents the design, development, and testing of the web-mobile application entitled "I- CDRRMO-MO: A Public Emergency and Response System for Mabalacat City."

5.1 Data and Gathering Requirements

The researchers conducted online data, gathered information through internet searches, and understood the web-mobile application development. During this phase, the researchers used the Internet to hold virtual meetings to collaborate and collect

data. The researchers also discussed the application used, environments, properties, tools to be used and other important information. The group's leader has assigned tasks to each team member. The panelists' recommendations significantly impacted the creation of the paper and web-mobile applications.

Figure 6. PC Specification

The researchers identified and used the required hardware and software during the application testing. The researchers used an Android phone for the test project, with the following software: Android OS 9.0 (Pie) for the mobile operating system, 3GB RAM (minimum), 4GB RAM, and for the recommended mobile operating system: Android OS 12.0 (Snow Cone) 4GB (maximum) for memory, and 64 GB for internal storage.

The researchers identified and used a desktop PC powered by Microsoft Operating System (as shown in the photo above) to developed the web-mobile application.

Alpha Testing

The researchers presented the result using the frequency and percentage tabular presentations for the alpha testing. The researchers successfully achieved alpha testing by administering a web-based system and collecting the alpha questionnaires from the respondents. The respondents had to fill out the form in less than ten (10) minutes after they used and experienced the developed web-mobile application. The researchers started conducting alpha test and gathering data surveys on September 19, 2023, ending on October 14, 2023.

Table 3. The summary Alpha Test result of ISO 25010 criteria in terms of Functional Suitability, Compatibility, Usability, Security, and Portability.

Criteria	**Mean**	**Verbal Description**
Functional Suitability	4.66	Excellent
Compatibility	4.25	Excellent
Usability	4.11	Good
Security	4.83	Excellent
Portability	4.83	Excellent
Total	**4.53**	**Excellent**

As shown in Table 3, the system underwent a comprehensive evaluation. It was found highly suitable for its intended purpose based on various criteria such as functional suitability, compatibility, usability, security, and portability. The system's functional suitability, which pertains to how well it met its requirements and objectives, was rated 4.66 out of 5, indicating an "Excellent" performance. The system's compatibility with other related systems was rated 4.25 out of 5, which is also considered "Excellent". The system's usability, which refers to how easy it is to use and learn, was rated as "Good.", with a weighted mean of 4.11. The system's security was also assessed and was found to be highly secure based on a weighted mean of 4.83 out of 5. Lastly, the system's portability, which measures its ability to be used on different platforms and environments, was rated 4.83 out of 5, indicating an "Excellent" performance. Overall, the system demonstrated exceptional performance in various areas, making it a highly recommended option for its intended use.

According to the survey conducted by the researchers, the system's functional suitability, compatibility, usability, security, and portability criteria were thoroughly evaluated and found to be equally and accurately achieved, with a total rating of 4.53. As a result, the overall system was deemed "Excellent." It is highly functional, compatible with different devices and platforms, user-friendly, secure, and easy to move to new environments.

Beta Testing

The system was evaluated using researchers' test cases inspired by ISO25010. Different student and faculty members evaluated the system's functionality suitability, usability, and portability. In addition, the composition of respondents was also provided, which is helpful for future analyses with replicated studies and guides in making a fair policy.

The respondents had to fill out the form in less than ten (10) minutes after they used and experienced the developed web-mobile application. The researchers started conducting beta tests and gathering data surveys on September 19, 2023, ending on October 14, 2023.

The researchers approached thirty (30) respondents to test the application. The beta testers comprised ten (10) Mabalacat City Disaster Risk Reduction Management personnel and twenty (20) Mabalacat City College students enrolled in the 1st Semester of the Academic Year 2022-2023. The survey was conducted at Mabalacat City College and CDRRMO Office.

As shown in Table 4, the thirty (30) respondents to the beta test rated the system's functional suitability weighted mean as 5.00, which had the verbal description of "Excellent" and had the highest rating because of the completeness of the functions; the system executed every function correctly and provides appropriate functions to facilitate the accomplishment of specified user-level tasks.

The system was evaluated, and the results indicate that it performed exceptionally well on all criteria assessed. The system's compatibility was rated with a weighted mean of 4.73, which falls under the "Excellent" category, indicating that the system can function seamlessly with other systems and software. In terms of usability, the system scored a weighted mean of 4.76, which also falls under the "Excellent" category, indicating that the system is user-friendly, easy to navigate, and efficient in performing its intended functions. The system's security was also rated as "Excellent," with a weighted mean of 4.91. This indicates that the system is secure and protected from vulnerabilities, threats, and unauthorized access. Additionally, the system's portability scored a weighted mean of 4.91, indicating that it can be easily transported and set up in various locations without losing functionality.

Above all, based on the survey findings by the researchers, the system has met all the required standards in terms of Functional Suitability, Compatibility, Usability, Security, and Portability, with a total score of 4.86. The survey concluded that the system performed exceptionally well in all the criteria above and was deemed "Excellent" overall.

Table 4: The summary Beta Test result of ISO 25010 criteria in terms of Functional Suitability, Compatibility, Usability, Security, and Portability.

Criteria	**Mean**	**Verbal Description**
Functional Suitability	5.00	Excellent
Compatibility	4.73	Excellent
Usability	4.76	Good
Security	4.91	Excellent
Portability	4.91	Excellent
Total	**4.68**	**Excellent**

Deployment

The completion of the web-based system was accepted by the capstone adviser, technical adviser, beta testers, alpha testers, and the board of panelists was achieved. With this, the researcher developed a web-based system that would be freely accessed and utilized at the domain repository website address of i-cdrrmo-mo.online

The main focus during the system's design was the achievement of specific sustainable development goals (SDGs), and all of these goals have been accomplished. The development process had a clear objective of creating a solution that would positively impact the environment, society, and economy, and the system has been able to deliver on all of these fronts. The team behind the project demonstrated hard work and dedication, which has played a vital role in achieving these goals. The system's effectiveness in promoting sustainable development has been proved by accomplishing these goals..

DISCUSSION

The study aims to develop an "I-CDRRMO-MO: A Public Emergency and Response System for Mabalacat City." The researchers identified the hardware and software requirements required for the system by gathering data through research, interviews, and surveys. With the use of a storyboard, case diagram, and block diagram, the researchers were able to visualize the design and

identify the flow of the system's process, which makes the development process efficient and minimizes the tendency of errors.

Different diagrams were created to guide the development and save time. The Dashboard, Locator, Categories, Departments, Vehicle User List, and Reports were accessible to the administrator. Meanwhile, the admin and other permitted users designated user pages to be seen.

Afterward, technologies required to satisfy the diagrams were downloaded and used to develop the website. The researchers also registered to several third-party websites to share the code and avail the service necessary to host the web system on the Internet.

Several challenges were encountered, such as compatibility of the new package with the existing packages, limited financial and time constraints, and integration of front-end and back-end interfaces. Another bottleneck is that the development server loads slowly at the start yet runs fast after some optimization.

The web system also scored highly on coexistence and interoperability. Therefore, the score for compatibility was high on average. The score indicated that the system could work with different browsers of different devices running on various OS.

The system undergoes a developer test, alpha test, and beta test. The researchers evaluated the system using ISO 25010 criteria: functionality, compatibility, usability, security, and portability. The system is now on a virtual private server via Hostinger.

The system got high scores for adaptability and installability. The system can run independently from software and hardware vendors and on different hosting sites that support My SQL and PHP. On average, the system was perfect for the criteria of portability.

The system's design was centered around achieving specific sustainable development goals (SDGs), which have all been successfully attained. The development process had a clear objective of creating a solution that would positively impact the environment, society, and economy, all of which the system has been able to deliver. The team behind the project demonstrated hard work and dedication, which played a vital role in accomplishing these goals. The system's effectiveness in promoting sustainable development has been proven through the successful attainment of these goals.

REFERENCES

[1] Deodhare, S. (2018). Public Emergency Response System Retrievedfrom https://www.researchgate.net/publication/312249492_Public_Emergency_Response_and_Report_Tool_Alerrt/citations

[2] Public health emergency preparedness and response Retrieved from https://www.who.int/tools/refugee-and-migrant-health-toolkit/module-1/tool-3

[3] Sun X, Hu H, Ma S, Lin K, Wang J, Lu H. Study on the Impact of Road Traffic Accident Duration Based on Statistical Analysis and Spatial Distribution Characteristics: An Empirical Analysis of Houston. Sustainability. 2022; 14(22):14982. https://doi.org/10.3390/su142214982 Retrieved from https://www.mdpi.com/2071-1050/14/22/14982

[4] The Phil. Law REPUBLIC ACT No. 10121 Retrieved by https://lawphil.net/statutes/repacts/ra2010/ra_10121_2010.html/

[5] Pharsant (2019) What is Modified Waterfall Model Retrieved from https://www.thestudygenius.com/what-is-waterfall-model/

iTrade: Reverse Vending Machine for Empty Plastic Bottles

Best Capstone (*Internet of Things Category*)
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ABSTRACT

Comprehensive exploration of the transformative potential of incentivized reverse vending machines (RVMs) in mitigating the global plastic pollution crisis. The escalating environmental challenges posed by plastic waste demand innovative solutions, and the integration of RVMs into waste management systems emerges as a promising strategy. The researchers used a prototyping model to encourage active user participation, enabling quick identification and resolution of bugs or issues, facilitating necessary adjustments and improvements based on user feedback. The researchers used the ISO 25010 Software Quality Standards, the alpha test results for the iTrade application and prototype show exceptional performance in Functional Suitability, with a mean score of 4.77 and an "Excellent" grade. This highlights iTrade's efficacy in addressing environmental issues related to plastic waste, showcasing its capacity to manage recycling responsibilities in practical scenarios. Even in locations with erratic network connectivity, the system keeps a strong connection, demonstrating a robust and dependable interface. In the beta test, usability stands out more in the results, receiving an "Excellent" grade and a mean score of 4.76. Appropriateness Recognizability received the best rating, highlighting iTrade's user-friendly currency claims and bottle entry design. In conclusion, the iTrade system excelled in Functional Suitability, Maintainability, Usability, Performance Efficiency, and Security.

Keywords
Reverse Vending Machine, Recycling with Incentives, Mobile Application, Plastic Wastes

INTRODUCTION

Plastic waste has emerged as a critical environmental concern that is causing damage to the entire world. The repercussions of plastic dependency are severe, ranging from contaminating our oceans and streams to endangering animals and human health. Rapid urbanization in various countries has resulted in a significant increase in plastic production and massive consumption. The globe created 367 million metric tons of plastic waste in 2020, a figure that is expected to rise tremendously in the future years [1]. Many regions of the world are facing significant waste disposal challenges due to being ill-equipped to cope with the massive amounts of plastic waste produced. One of the best approaches to reducing the plastic waste impact is recycling, the process of transforming waste products into usable materials [2]. Several countries, cities, and manufacturers have all vowed to minimize their plastic waste and recycle more plastic over the last two decades. While the recent COVID-19 outbreak happened it caused a more severe increase in the consumption of single-use plastic products especially plastic bottles where every minute, around 1.2 million are consumed by humans [3].

[4] Only less than 10% of the seven billion tons of plastic waste generated globally to date has been recycled. Millions of tons of plastic garbage are lost to the environment or are transported thousands of kilometers to be burned or discarded. In the Philippines, plastic pollution continues to become a major problem due to the lack of sanitary landfills. In fact, the country ranks third in the world for its contribution to plastic pollution [5]. Authorities use recycling as a means of managing waste, one of the most significant waste management projects in the country is the Philippine Alliance for Recycling and

Materials Sustainability (PARMS), one of its ways is to promote recycling habits among kids and establish a residual plastic recycling facility. In 2001 the Republic Act (RA) 9003 was signed into law also known as the Ecological Solid Waste Management Act of 2000. The Act is established to protect the environment and the people in the community while establishing suitable segregation criteria to reduce trash when composting, recycling, and so on. Despite the government's attempts to promote recycling and limit the quantity of plastic waste produced, the recycling rate for plastic is still relatively low at only 9% [6]. Recycling is an important practice for waste reduction and protecting the environment, however, for a variety of reasons, people may grow frustrated or overwhelmed with recycling. These may include a lack of understanding of the recycling process, inconvenience, a lack of access to recycling facilities or services, and the idea that recycling is a burden and meaningless. Therefore, Reverse Vending Machine (RVM) automated innovation aims to help with waste reduction, [7] it is a recycling machine that collects used or empty containers such as bottles or cans in exchange for a reward or incentive. The process involves users inserting their empty containers into the machine's chute, tapping a button to complete the transaction, and receiving a receipt indicating the value of their recycling refund, which can typically be redeemed directly from the machine, or at the cash register in regions with container deposit laws. [8]. Offering incentives can be a successful tactic for encouraging recycling and reducing waste making recycling more enjoyable and rewarding that can inspire people to incorporate recycling into their regular waste disposal habits. Reverse vending machines have been widely implemented in various countries worldwide, especially in regions where recycling is mandated. In the United States, several states with container deposit laws have embraced these machines, with approximately ten states and eight Canadian provinces requiring refundable deposits on containers to promote recycling. Countries like Sweden, Canada, and Norway also have a significant presence of reverse vending machines. The machines are commonly found in supermarkets across the United States and Canada as a means to encourage recycling and raise awareness. In Malaysia, Klean's reverse vending machines are located in shopping malls and petrol stations, incentivizing customers to recycle through discounts [9].

General objective

The general objective of the study was to develop an Arduino-based system entitled "iTrade: Reverse Vending Machine for Empty Plastic Bottles" as a sustainable movement for waste management solutions, especially for empty plastic bottles.

Specific objectives

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

- The researchers gathered data through surveys, interviews, online articles, academic articles, existing literature and studies.
- The researchers identified the hardware and software specifications using the following tools and technologies: Arduino Mega 2560, Power Supply 12V 5A, Nodemcu, Ultrasonic Sensor, IR Sensor , Inductive Proximity Sensor, Tilt SW 520D, 20x4 LCD with i2C, 45V Input DC-DC Step Down Converter, Push Button Circle, ,Allan Universal Coinslot with AntiCoin Hooking, Servo Motor, Capacitive Sensor, Arduino IDE, Blynk, Blender, Adobe Photoshop
- The researchers developed the IoT device with the following features:
    - Bottle Slot with Detector, Detect Unwanted Materials, Segregate Plastic Bottles and Unwanted Materials, Coin dispenser, LCD for Total Reward, Detect Force, Plastic Bottle Bin Storage, Unwanted Materials Bin Storage, Coin Slot for Donation Option.
- The researchers developed a mobile application with the following features:
    - Monitor for trash bin, Monitor for coin stock. Notification when the bottle storage bin is nearly full, Notification when coins are insufficient, Notification when tampers are detected in the machine.

Scope and limitation

The scope of this study is to focus on building an Arduino-based vending machine entitled "iTrade: Reverse Vending Machine for Empty Plastic Bottles". It features the ability to accept plastic bottles within a specific diameter range, from 5.5cm to 8.6cm, offering credits to users. For every five empty plastic bottles inserted, users earn 1 peso credit. The user interface on the LCD screen greets users with the main message "iTrade: REVERSE VENDING MACHINE FOR EMPTY PLASTIC BOTTLES" Once users start depositing items, it displays the message "SAVE THE ENVIRONMENT FOR A GREENER WORLD," alongside "Bottles:" and "Credits:" for tracking. The system can also recognize and accept cans and other non-credited materials, clearly distinguishing between plastic bottles and unwanted

items, when the system detects an object other than plastic, it will briefly display the message "UNRECOGNIZED OBJECT DETECTED" for 4 seconds. At the same time, it will open the trash for the unwanted materials. After 5 seconds, the barrier will close again. This process occurs to separate and handle items that are not plastic bottles. The sorted materials are effectively separated into two trash bins. To redeem the earned credits, users need to press and hold the button for 2 seconds. Once pressed, there will be a 0.50-second delay before the coins are dispensed. After the coins are dispensed, a message of gratitude will appear on the LCD screen, saying, "THANK YOU FOR MAKING THE EARTH MORE CLEANER" for 3 seconds, this message acknowledges the user's contribution to environmental cleanliness, and will revert to the main message. If there are not enough coins for the coin dispenser, which is when the count is less than or equal to 20 coins, the system will display "MACHINE UNAVAILABLE" on the LCD. Additionally, the bottle insertion will be temporarily closed until an adequate number of coins is refilled. When the coin count is no longer insufficient, the bottle insertion will reopen after a 5-second delay. Subsequently, the display will revert to the main message. Furthermore, the system features a donation slot that accepts both old and new peso coins, specifically 1 peso, 5 pesos, and 10 pesos coins. The accumulated funds will be donated to the Aeta community. When coins are inserted into the donation slot, the LCD will display the message "THANK YOU FOR DONATING GOD BLESS" after 0.30 seconds, accompanied by "TOTAL DONATIONS:". The paired mobile application, exclusively designed for system staff, offers a comprehensive range of monitoring and notification features to ensure the smooth operation and security of the recycling system. Users can track the system's status in real-time, making informed decisions and taking timely actions. The application provides a clear and intuitive dashboard displaying the percentage of filled trash bins for plastic bottles, along with the current stock percentage for the coin dispenser. Moreover, the application leverages push and pop-up notifications to deliver alerts. When the bin for plastic bottles approaches the 80% threshold, staff receive immediate notifications, indicating that the bins are nearly full, enabling prompt collection and emptying. To strengthen security, the machine is equipped with an angle or slope detection sensor. In the event of suspicious movement or tampering with the machine, the application immediately sends a notification. If the system is tampered it delivers notification, ensuring the utmost security and timely response. This comprehensive mobile application empowers staff to maintain efficient operations and enhance security measures, contributing to the effective management of the recycling system.

The study's limitations encompass several aspects of the system. Firstly, the iTrade reverse vending machine can process only one bottle at a time, with a maximum accepted bottle size of 1000 ml and a minimum of 200 ml. It's crucial not to apply excessive force during insertion, as the front sensor may fail to detect unwanted items, requiring precise and gentle force for proper object insertion. Other than the system accepting the cans and other non-credited materials, the system will also accept but won't give credit to plastic bottles that aren't completely empty. Additionally, the coin dispensers can only dispense one coin at a time, and the coin stock has a capacity of storing up to 100 coins. Furthermore, if the bottle inserted is below 5 bottles and credits is zero, pressing the dispense button won't clear the LCD and dispense a coin. Donations made through the donation slot are temporarily displayed on the screen for 7 seconds before disappearing and the coin storage for this feature can't be monitored in the application.

METHODOLOGY

In this chapter, techniques applied to create the reverse vending machine were explained including the data, methods, and designs that were employed in the creation of the system. In addition, methodologies and research instruments used by the researchers to gather data were also included in this section. Different types of diagrams were added to further illustrate the flow and the design of the study.

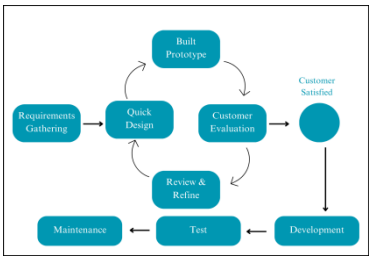

Figure1: Prototyping Model

The researchers used the Prototyping model (See figure 1). It has 8 design stages: Requirements gathering, Quick Design, Built Prototype, Customer Evaluation, Review and Refining, development, Test and the Maintenance.

Requirements gathering

The researchers conducted internet research and interviews to gather data for the requirement analysis phase, ensuring that the data were correct and of the highest integrity. In order to come up with ideas for the capstone project, the researchers planned, brainstormed and carried out internet and

library research. The researchers kept in close contact with their technical and capstone adviser to get updates on the progress of the application development and documentation. In accordance with the size of the study, the researchers divided specific tasks, set activity schedules, and shared ideas.

Quick design

The researchers used designing tools to demonstrate the functions of the system within the design phase. The circuit diagram, flowchart, storyboard, architecture design and gantt chart were the design tools that were used. A circuit diagram (see Figure 2) was employed to illustrate the system's electronic components and connections. The storyboard (see Figure 2) illustrated frames or panels that depicted the flow of the application of the system. A user manual (see Figure 3) is made with images or graphics to make instructions easier to understand and more practical by illustrating what the reader is supposed to do. Moreover, this is especially useful for things that need complex procedures or have a lot of moving parts.

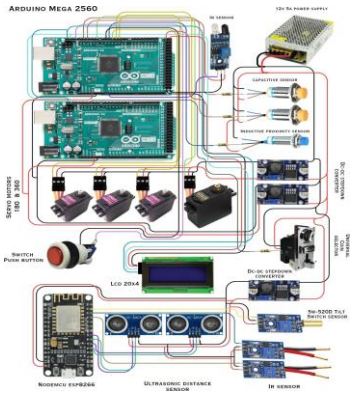

Figure 2. Circuit diagram

Built prototype

The reverse vending machine system is designed to enhance bottle recycling efficiency and user interaction. It includes a bottle slot with a detector for users to easily deposit plastic bottles. A capacitive sensor identifies empty bottles, and an IR sensor counts accepted bottles, adjusting the plastic bin and coin tower thresholds accordingly. A servo motor opens a barrier for the materials to reach the designated trash bin. An LCD display provides users with information such as acknowledgment messages, donation amounts, and total credits earned. The Coin Dispenser uses a servo motor to automatically dispense coins for bottle recycling. The system features a donation slot, security measures against tampering, and a mobile application for staff to monitor trash bin fullness and coin stock, ensuring continuous and efficient operation through communication with the Arduino Mega 2560 via Nodemcu and the Blynk application.

Customer evaluation

The focus will be on collecting feedback and insight from users of the iTrade reversed vending machine system in the customer evaluation phase. This phase aims at assessing the user's satisfaction, identifying areas where improvements are needed and collecting suggestions on how to enhance its functionality. Feedback collection in which the survey methods will be used to obtain feedback from customers. Identify areas where improvements of the system can be made by means of an analysis of customer evaluations. These data can help prioritize the development efforts to be carried out and provide guidance for improving the system's features and functionalities.

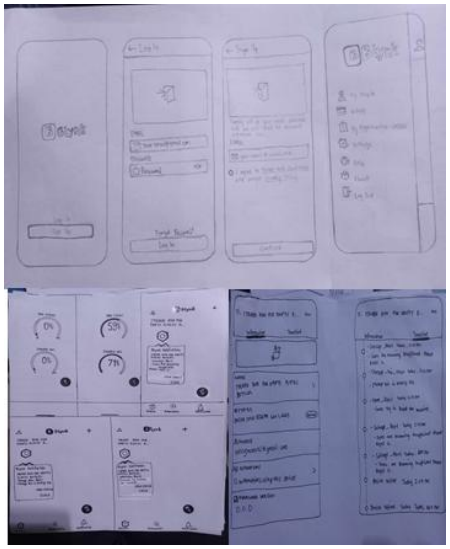

Figure 3. Storyboard

Questionnaire administration

The questionnaire will be administered to participants from various locations over Mabalacat City within a specific time frame. The researchers will adopt a questionnaire based on ISO25010 to know if the system application has met the objectives needed. In the beta testing, the researchers will approach a Total of Thirty (30) Mabalacat City College Students, Specifically Ten (10) IT Students, Ten (10) Random Students enrolled in the Academic Year 2023 - 2024 and Ten (10) Random Individuals to test and evaluate the system and the application. The questionnaire will be presented in a language that ensures comprehension and maximizes participation.

Likert scale

A rating system known as the Likert scale is utilized in questionnaires in order to evaluate respondents' attitudes, views, or impressions and these will be used to assess the reverse vending machine. Respondents will be given a 5-point Likert scale on which to indicate their level of agreement or disagreement. After doing the necessary computations, the researchers will use the Likert scale to translate each mean score of each sub-criteria and criteria from the survey tool into its verbal equivalent. This analysis can help determine the reverse vending machine's strong points and areas for development, as well as how satisfied users are with the device overall.

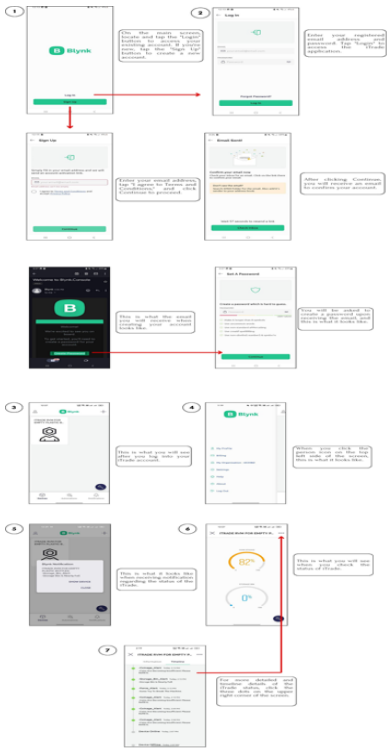

Figure 4. User Manual

Development

A meticulous unit test was performed on the created IoT system. In this step, one capacitive sensor was utilized to identify plastic bottles, while a second capacitive sensor was used to precisely identify materials that were not wanted. The capacitive sensor is tested thoroughly to guarantee accurate detection at the proper distance. It functions when a bottle touches it. To guarantee steady and smooth rotation, the servo motors carry out a variety of tasks that are coded and carefully verified. When bottles are inserted, the first servo motor works to accept them, while the second servo motor works to separate undesired material and place it in the appropriate bin. The precise number of coins that have been credited is dispensed by the third servo motor. The last servo functions and coordinates when the sensor senses the coins are inadequate; it will close and not allow further insertion of bottles. To show the precise number of coins placed, the coin slot precisely reads the coins. The LCD makes sure that the colors and brightness remain constant and that the message is displayed appropriately. Last but not least, the IR sensor was quickly and precisely coded to read the bottle. During the unit phase, the Nodemcu was accurately tested to ensure that the sensor coordinated to deliver data to the mobile application exactly and quickly. This was done in order to construct the associated mobile application.

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

Test

The IoT device was tested in terms of Functional Sustainability, Performance Efficiency, Usability, Maintainability, and Security using the ISO 25010 standards. This is to guarantee that the system functions well, satisfies user expectations, and meets high quality standards. To verify the system's quality, the developers were able to continuously iterate and improve the code until the system complied with the requirements.

Review and refining

After the alpha tester validated the system, several inaccuracies were discovered in a few functions. Particularly, the coin dispensing mechanism, pressing and holding the button resulted in the dispensing of an inaccurate number of coins relative to the credits earned. This issue was addressed through modifications to the hardware, specifically the servo motor, as it was not rotating accurately. Additionally, the coin slot's hook was too thick, causing it to push two coins instead of one at the same time. The servo motor was replaced with a new

one due to defects, and the hook was refined to ensure it pushes only one coin. Moreover, a magnet was placed below the coin dispenser to ensure that the next coin will not be easily moved once dispensed. In addition, a delay was identified in the tilt force alert notification. To rectify this, the ball switch sensor was replaced with a mercury sensor because it is more effective in sensing sensitivity compared to the ball switch. This change was made for a more accurate and faster notification response if force was applied to the machine. After resolving the issues discovered during the alpha test, the researchers proceeded to conduct the beta test.

Maintenance

The IoT device is installed at Mabalacat City College, and potential users can report malfunctions to the administrator. The assigned administrator is responsible for monitoring the device through the mobile application, replacing the trash bin, replenishing the coin stock, and checking the machine's security once notified by the application. Additionally, the paired mobile application is deployed and released on the application repository (Play Store), accessible only to the iTrade administrator. Malfunctions reported by users to the administrator will be conveyed to the developers for further modification and improvement. Routine checks will be conducted once a week for repair work and replacement of malfunctioning parts. Moreover, the application may able to undergo updates that can be done in the Play Store, it is to ensure its functionality and performance, enhancing the overall sustainability of the iTrade system

RESULTS

This portion of the document presents the findings and results derived from the study's established objectives. The discussions and conclusions presented here are rooted in the study's objectives, encompassing a comprehensive analysis and thorough examination of the developed application and system prototype. Additionally, it provides an insightful breakdown and interpretation of the alpha and beta testing carried out by the researchers. The researchers have meticulously calculated the results and outcomes. The emphasis here is on presenting the research output in a structured, cohesive, and comprehensible manner. The researchers conducted internet research and interviews to gather data for the requirement analysis stage. The researchers ensured that the data collected was accurate and reliable. In their pursuit of ideas for the capstone project, the researchers carefully planned, brainstormed, and carried out research in libraries and on the internet. Throughout the development and documentation of the application, the researchers stayed in regular contact with the technical and capstone adviser, staying updated on the project's progress.

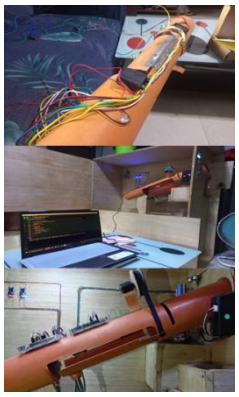

Figure 5. Build prototype

Summary of alpha and beta

The alpha and beta tests that were put into action. The combined mean score for the alpha test was 4.55, which was considered "Excellent," and the mean score for the beta test was 4.73, which was also considered "Excellent". In general, both alpha and beta testing outcomes received an overall rating of "Excellent," indicating that the system successfully met the users' needs. Beta testers had a positive and satisfying experience interacting with the iTrade application and prototype, indicating that the system can meet user needs. Due to the valuable feedback from alpha testers, the pleasant user experience during beta testing made meaningful interactions possible and cleared the path for additional application feature improvements.

DISCUSSION

Thorough research was conducted to identify the necessary software and hardware components for constructing the IoT device. Multiple diagrams were used to guide and facilitate the development process. The device is accessible for the user meanwhile the paired mobile application is designed for the monitoring purpose of the designated administrator. The prototype for the study's system was successfully built (see figure 5), containing essential functionalities. This includes a bottle slot that detects and segregates empty plastic bottles and unwanted materials into their respective bins. The LCD accurately displays the amount of inserted credits and dispenses coins based on earned credits. The system can detect force on the machine, and a mobile application sends notifications to the administrator when the trash bin is full, the coin stock is insufficient, or force is applied to the machine. With all of the evidence presented with a positive outcome, the researchers conclude that the overall objective of the study was met.

REFERENCES

[1] "Plastic Waste Management," Plastics and the Environment Series – Geneva Environment Network, 2023. https://www.genevaenvironmentnetwork.org/resources/updates/plastic-waste-management/

[2] "Recycling," Econlib, Feb. 05, 2018. https://www.econlib.org/library/Enc/Recycling.ht ml

[3] E. Staff, "Fact Sheet: Single Use Plastics," Earth Day, Mar. 29, 2022. https://www.earthday.org/fact-sheet-single-use-pl astics/

[4] "Visual Feature," Beat Plastic Pollution, Mar. 01, 2022. https://www.unep.org/interactives/beat-plastic-pol lution/

[5] "Plastic Pollution Policy Country Profile: Philippines," Feb. 2020. https://nicholasinstitute.duke.edu/sites/default/file s/projects/Plastic-Pollution-Policy-Country-Profil e-Philippines.pdf

[6] "WWF," EXTENDED PRODUCER RESPONSIBILITY (EPR) SCHEME ASSESSMENT FOR PLASTIC PACKAGING WASTE IN THE PHILIPPINES, 2019. https://wwf.org.ph/wp-content/uploads/2020/10/ WWF_A4_Factsheet_PHILIPPINES.pdf

[7] A. Amantayeva, A. Alkuatova, I. Kanafin, S. Tokbolat, and E. Shehab, "A systems engineering study of integration of reverse vending machines into the waste management system of Kazakhstan," Journal of Material Cycles and Waste Management, vol. 23, no. 3, pp. 872–884, Feb. 2021, doi: 10.1007/s10163-020-01161-9. https://doi.org/10.1007/s10163-020-01161-9

[8] X. Y. Tan, K. M. Cheng, C. W. Chong, and A. C. Koo, "Edcraft: Gamified Handicrafts as an Inspiration for Teenagers to Practice Upcycling," MDPI AG, May 2022. [Online]. Available: http://dx.doi.org/10.20944/preprints202205.0 53.v1

[9] R. Teng, "Malaysian reverse vending machine startup eyes scale to tackle plastic crisis," Eco-Business, Jan. 27, 2021. [Online]. Available: https://www.eco-business.com/news/malaysian-re verse-vending-machine-startup-eyes-scale-to-tack le-plastic-crisis/

iVenTaMo: An IoT Vending, Tracking and Monitoring System

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ABSTRACT

Today's market is filled with a wide range of vending machines that can be used to dispense snacks, freshly prepared meals, hot and cold beverages, electrical goods, and much more. A few benefits of vending machines include convenience, accessibility, time savings, a wide range of product offers, cost effectiveness, revenue production, encouraging impulsive purchases, hygienic and safety features, scalability, and income generation. The ordering and administrative procedures at MCC are intended to be streamlined by the suggested system. Through a platform for vending machines, students can easily order a variety of products from the college. This covers the necessities for every student, such as ID lanyards, exam booklets, NSTP uniforms, etc. The prototype model is one of the life cycle models for software development, where a prototype is made with the least amount of requirements. After a completed prototype with all the features required is ready, it is tested and adjusted based on input from the client. This final prototype also functions as the basis for the final product. In the results, the researchers developed IVenTaMo: A Vending Machine, that allows student to easily order a school necessities using the said machine.. In conclusion, IVenTaMo gathered a high results on functionality, suitability, usability and portability result. As a recommendation to future researchers, vending machine requires a lot of time and practices to attest and assure the quality of machine such as features of notification system and QR Scanner.

Keywords

Vending Machine, Prototype Model, Software Development

INTRODUCTION

The first commercial coin-operated vending machines appeared in London, England, towards the beginning of the 1880s. They made it easy to buy envelopes, postcards, and notepaper, the machines were frequently located at railroad stations and post offices. Drinking machines were first used in 1890. Beer, wine, and liquor could all be purchased from the first beverage vending machine, which was located in Paris, France. Soda was first dispensed into cups by vending machines around the beginning of the 1920s. Drinks are currently among the most widely purchased commodities from vending machines. The cigarette vending machine was created by American William Rowe in 1926. But as worries about underage consumers grew over time, their prevalence in the US decreased. Before a purchase could be made, merchants in other nations required some form of age verification, such as a driver's license, bank card, or ID. [1]There are many different vending machines available today that may dispense a variety of commodities, including snacks, fresh meals, hot and cold beverages, electrical goods, and more. All across the world, you can find vending machines in both business and non-commercial settings.In the past, vending machines only accepted money since counterfeit notes were harder to spot than coins. Counterfeit notes could be easily made to seem like the real thing, older vending machines would frequently accept them. The technology in today's vending machines allows them to identify actual coins and bills and provide the correct change when a customer makes a purchase. [2]. In the Philippines, the coffee vending machine brand Barista Choi is well-known. This coffee vending machine is a national franchise that offers a variety of coffee flavors unique to the Philippines. They draw clients in with their affordable, stimulating, and delectable items that are dependable for boosting energy. Chong Cafe is a well-known vending machine franchise that mostly sells coffee and goods

associated with coffee. Their Hot Vending Machine Package, which contains a variety of coffee flavors, is their major offering.The Chong Cafe also offers tasty and high-quality coffee blends, much like Barista Choi. White coffee, hot chocolate, hazelnut, 3-in-1, cappuccino, and caramel are just a few of the varieties available. [3]With services like cashless transactions, face, eye, or fingerprint recognition, and social media connectivity, smart vending machines are the newest trend. The vending machines use the most up-to-date tracking software and vending technology, which ensures timely replenishment of all items and foods. To benefit from a vending machine, feel free to get in touch with us right away. Convenience, accessibility, time savings, a variety of product offers, cost effectiveness, revenue production, stimulation of impulsive purchases, hygiene and safety features, scalability, and income generation are just a few advantages that vending machines offer. Customers may access a large variety of products, make purchases whenever they want, and bypass lines to save time. Businesses can afford vending machines since they need little staff to operate them and they consistently bring in money. Additionally, they encourage impulsive buying, can be built with safety and hygiene elements, and give scalability choices. Vending machines are, in general, a practical, easily accessible, and profitable solution for both businesses and consumers. [4].The proposed system aims to streamline (Mabalacat City College) MCC's ordering and administration processes. Students will easily order various products from the college via a vending machine platform. This includes every student essentials like ID lanyards, exam booklets, NSTP uniform, etc.

General Objective

The general objective of the study is to developed a system entitled "iVentaMo: An IOT Vending, Tracking, and Monitoring System to improve its amenities and offerings, such building an inventory management system. In addition to these activities, the vending machine concept would increase MCC's process efficiency.

Specific Objectives

The following are the specific objectives of the study:

- To gather data through interview, library research and online scholarly research
- To identify hardware and software requirements using the following tools and technologies:
- Fritzing,Arduino IDE,Firebase,Arduino Mega.MIT App Inventor,Draw.io and GitHub.
- To design the system application using: System Architecture Diagram, Use Case Diagram (UCD), Data Flow Diagram (DFD),Storyboard and Schematic Diagram
- To create and develop a vending machine with the following features: Accept coins with monetary value, detect coins if it has monetary value, an LCD that displays the item and its price, bin for the items that has been purchased and buttons to push for the item products
- To develop a transaction record system for the management staff with the following features: Record for every transaction, record for every coin accepted and record for the purchased item,
- To develop client-server systems with the following features: User Access ,Student, Product, Payment, IGP, Recorded Transactions, Student Panel, Place order, Purchase item, IGP Panel, Manage order, Manage sales and Manage product information
- To test and evaluate the system using the Software Product Quality standards of ISO 25010 in terms of functionality suitability, usability, compatibility, reliability and maintainability.

Scope and Limitations of the Research

This section specifies the study's scope and limitations beyond the developed application.

The student must first go to the vending machine, choose the item they want, and They can insert the money into the machine's slot to complete the transaction. After inserting the money into the machine, the student will need to wait for a moment as the vending machine processes the transaction. Once the payment is confirmed, the selected item will be dispensed. The student can then retrieve their chosen item from the designated retrieval compartment. It is important to remember to collect the item that would be dispensed, if applicable, before leaving the vending machine area. The User Interface (UI) of the cashier side enable the cashier to manage the vending machine operations more effectively. With the UI, the cashier would have

access to valuable information. This allows them to keep track of recorded transactions and promptly monitor the machine when necessary, ensuring that the vending machine remains adequately supplied for the students. This includes the ability to adjust prices, ensuring they reflect any changes or promotions accurately.The UI also provides a means to control the quantity of each product offered. the comprehensive features of the cashier's UI empower them to effectively monitor and control the vending machine's inventory, pricing, and product assortment. This ensures a smooth operation, benefiting both the students and the institution. The management procedure is streamlined, and the school staff's workload is decreased, since it would become a Vending Machine, students no longer need to interact with the cashier to order items like school uniforms, school IDs, pins, gray books, and other school-related necessities.

The researchers would create a unit test to test evaluate the system using the Software Product Quality standards of ISO 25010 in terms of functionality suitability, usability, compatibility, usability and portability to ensure the system will work correctly. The researchers would use purposive sampling for the respondents. The researchers will accumulate 3 respondents for the alpha test and 30 respondents for the beta test

The system will not utilized QR Scanner, notification system and other sensors due to constraints in time and resources poses a significant limitation, potentially resulting in manual data entry errors, increased workload, delayed processes, and a lack of real-time information and traceability.

METHODOLOGY

Certain methods were used to collect information that influenced the system's development. The technique that leads to the system's development has been covered in the paper. To assess the effectiveness of the chosen model, an overview of various software process models was conducted. Then, according to the methodology chosen, each phase was discussed.

The study used the modified waterfall model to develop the system. This methodology employs a sequential software development life cycle (SDLC). The researchers first determined whether the study was feasible, then gathered requirements and planned the system's development.

Requirements

In collecting data, the researchers conduct interviews, library research, and internet academic studies to acquire the information they needed. Additionally, the researcher uses the MCC library for research and study, as well as the Internet. In order to ensure that the research project works smoothly and effectively, researchers generally divided different roles. Based on their skills, fields of specialization, and topics of interest, each researcher is given certain duties and obligations. One researcher may be responsible for conducting literature reviews, while another may be responsible for designing the research methodology and data collection tools. Other researchers may be responsible for data analysis, and documentation of the project. Divided duties allow researchers to collaborate effectively, reduce workload, and ensure each task is complete accurately and on time.

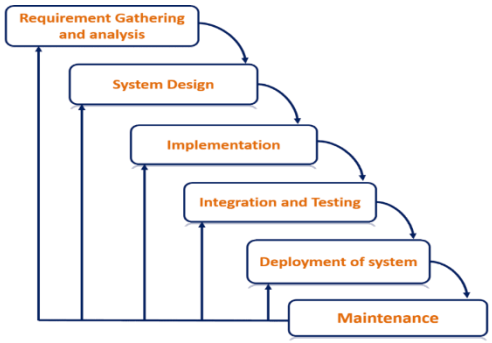

Figure 1. SDLC used in the study

Plan

The desktop computer used with desktop PC powered by Microsoft operation system with a 3.6 GHz AMD Ryzen 5 2400g processor, 16 GB RAM, 1 TB SSD, and 2 GB Video RAM. The developmental tool consists with back-end and front-end system will make use of tools during development. During the development of a back-end and front-end system, MIT App Inventor would be used for the development of the application, Firebase would be used for the database of the system, Arduino IDE as code editor, and Adobe Photoshop would be used for editing the system's logo and buttons.

Design

The Storyboard provide the starting point and depicts the flow of the system that would represent the user involved in the system, and Use Case Diagram(UCD) to draw user actors and their relationship with the system, design the user

interface and overall user experience and Data Flow Diagram to illustrate the flow and sequence of the system, such as how an order is processed and fulfilled.

Draw.io was used to create the Use Case Diagram (UCD), Data Flow Diagram (DFD), and System Architecture Diagram because it would be used to create the various types of diagrams required for the study. The requirements would define and examine in this step to determine how the system should work. The characteristics that would select to include or remove were also assessed by the researchers. In addition, the researchers' tasks in the system's development were assign. In order to complete the tasks, researchers would work on developing the abilities that is require for the position they were assign .

A Gantt chart was created to estimate the time needed to complete the task .The system information diagram will create base on the requirement analysis. At the start of the homepage, the student must sign in to their exclusive MCC accounts, the user interface (UI) typically includes an interface that displays the available school products or services, along with pricing and other related school necessity.

Develop

The system would be used in Mabalacat City College after deployment. This serves as an option for users to report errors or make recommendations for enhancing the software while it is being developed. It also requires responding quickly to address any issues and bugs in the system that may be discovered.

Integration and Testing

The system's test respondents would be chosen randomly using purposive sampling, one of the many sampling methods that would be use . Researchers have chose (how many respondents). respondents from students and teachers, as well as school staff within Mabalacat City College (MCC).

$$.P_s = \frac{A_s}{\sum A_i} x100$$

After gathering the data from respondents, the frequency of yes and no responses was calculated. Then, each percentage was derived for each subcriteria of functional suitability, compatibility, usability, and portability. Ps indicated the percentage of yes or no responses on a given subcriteria. As indicated the raw number of answers, which may be yes or no. $\sum Ai$ indicated the total number of yes or no responses for a given subcriteria

$$\overline{x}_c = \frac{\sum P_s x}{n}$$

Afterwards, the average of these subcriteria was calculated to determine the performance of the system on different criteria). xc indicated the mean score of a criteria. As indicated by, each criterion has a different number of subcriteria.In addition, these subcriteria also have different numbers of percentages of answers that are "yes.". The said percentages were added to get the total percentage, as indicated by the arrow, indicates the weight depending on the answer if yes (1) or no (0).

Maintenance

By doing thorough studies, analyzing the main causes, and applying effective troubleshooting, developers identify and correct errors to guarantee that the system works as planned. Updates to the content are necessary to keep the vending machine relevant and up to date. According on the most recent data, user feedback, and organizational needs, content may be added, changed or removed during this phase. Whether the information appears in text, images, videos, or documents, it must be up to date and correct.

RESULTS

Software and Hardware Requirements

The researchers used a variety of software tools throughout development that are compatible with the existing configuration and open source. The researchers gathers data through library research and browsing through online to implement the system. The researchers used an Advanced Arduino Kit for the investigation. This extensive collection of parts is intended to integrate with the Arduino platform effortlessly, allowing for the development of a wide range of interactive devices. Those who have previously worked with Arduino and want to learn more will find it especially helpful.The Arduino IDE, which includes a C++ text editor, a message box, a text terminal, a toolbar with buttons for common functions, and other menus, is a crucial component of the package. This interface makes it easier to communicate with the hardware, upload programs to the Arduino platform, and code. The Arduino Uno was selected as the main board for the vending

machine project. This board, which is built around the ATmega328P microcontroller, has fourteen digital I/O pins, six analog inputs, a USB port, a power connection, an ICSP header, and a reset button. It also has a ceramic resonator that runs at 16 MHz. Because of its simplicity, it is perfect for microcontroller experimentation without carrying a lot of danger.

The researchers chose a servo motor with an output shaft for accurate movement control. With the use of a coded signal, this motor can position the shaft at desired angles and hold that position for the duration of the signal.For student payments, the vending machine has a coin acceptor that verifies entering coins against those in the sensor. A coin dispenser further collects and records the coins.

Wi-Fi modules or microcontrollers were used to make the vending machine Wi-Fi capable. This makes Wi-Fi order acceptance and device-to-device communication easier.

The researchers would add a touchscreen display that is compatible with Arduino. The goal of this update is to make integration easier for DIY projects, both new and old

Diagrams and Screens

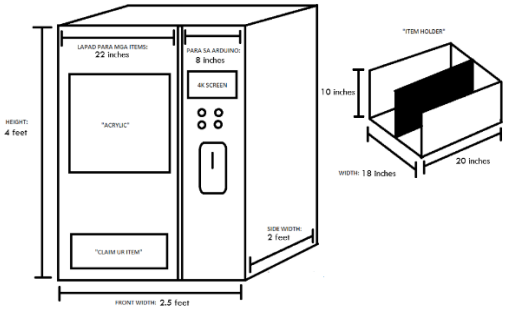

Figure 2: Final Blueprint of Vending Machine

Figure 3:A screenshot on Arduino IDE code on Wifi Module

The main tool utilized to write each system component was the Arduino IDE. In addition to the development the utilization of a MIT App Inventor to execute for the firebase and having an interface on to the app.

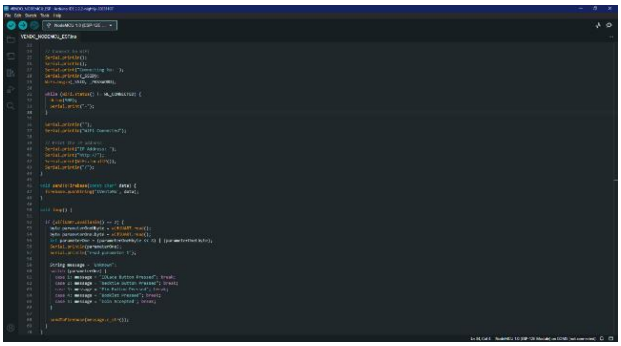

Figure 4: A screenshot on Arduino IDE on Arduino Mega

Figure 5:A screenshot of the application (Screen 1)

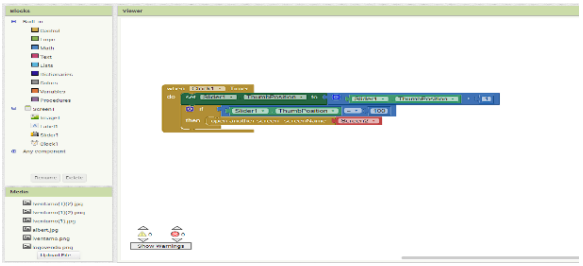

Figure 6: A screenshot of the block of application (Screen 1)

Figure 7: A screenshot of the application (Screen 2)

Figure 8 : A screenshot of the block of application (Screen 2)

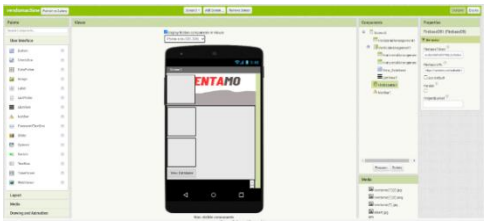

Figure 9 : A screenshot of the application (Screen 3)

Figure 10 : A screenshot of the block of application (Screen 3)

Testing Results Prototype

On Alpha Testers scores, after averages were computed, the system's functional appropriateness score was 94.08%. The system's compatibility score was 83.33%. The system received an overall usability score of 89.81% after averages were calculated. Even though the system performed well in other subcriteria, it received a high rating for accessibility and learnability. The system's portability score was 100%. After some adjustments, the researchers made a test case questionnaire to beta testers. The system received a functional appropriateness score of 96.11% after averages were calculated on the side of beta testers. The system was given an overall usability score of 97%. This means that after some few adjustments, it made clear that the beta testers would likely to implement this on MCC.

Implementation Results

In this section, the mobile app and IoT system have been discussed such as the features and the whole function of vending machine.

Figure 11 : Monitoring Screen with Database info

In the core of our research ecosystem lies the dynamic database, a robust repository meticulously engineered to monitor the sales of our vending machines. Functioning as the nerve center of our system, it seamlessly captures and records user interactions, discerning whether students engage with the vending machine. This pivotal functionality is integral to our comprehensive monitoring system, as each student's utilization is diligently noted and seamlessly integrated into the database.

Figure 12 : Vending Machine

This is the front of the vending machine with acrylic glass for the items and the bottom compartment. The QR Code is for the student to scan and can fill up the feedback form and the students can give suggestion to improvement the vending machine. Students can select items through the push buttons, these push buttons have an logo and number which indicate what item they represented, it also help the student to guide them on using the vending machine. This bottom compartment got an acrylic glass which can be opened outside by the student who purchase school essential through the vending machine. In this compartment, student can claim their item by lifting the acrylic glass.

Conclusion

The primary objectives of the study, the finished analysis, and the assessment and testing of the created system serve as the foundation for these conclusions and discussions. It also contains recommendations from the creators to enhance the system even further for next researchers.

Different diagrams were made to direct and expedite the development process. The vending experience is subtly elevated to new heights by its intelligent environmental features, efficient performance, and easy UI. Meanwhile, the app were designated to be

seen by the IGP or other permitted users. After then, the tools needed to create the diagrams were obtained and put to use in the machine's development. Additionally, the researchers exchange code with one another and use the services required for the machine's development.

A number of difficulties were faced, including integrating the front-end and back-end interfaces, limiting funds and time, and making the new package compatible with the current packages. Another problem is when some components are prone to failures associated with power fluctuations, it becomes vital to ensure the stability of an Arduino-based vending machine project. Using strong power regulation, routine maintenance, and intelligent diagnostics are essential tactics to deal with this bottleneck and keep the system running well. The majority of students responded "yes" to several test situations pertaining to functional appropriateness, functional correctness, and functional completeness. As a consequence, the system's functional the suitability score was virtually ideal since the majority of users had very few problems and the system outputs resources in the right way. Lastly, the system was now at Mabalacat City College to test and let the users use the vending machine.

Recommendation

The researchers suggest the following qualities to future researchers who share their interest, as stated under the study's limitations.

The first obstacle the researchers ran against was inserting a paper bill to a vending machine and making the prices have different amount. Additionally, a QR Scanner ,notification system on the side of IGP Panel and other sensors is excluded from the systems' features due to major constraint is time and resources, which can lead to data entry mistakes, greater expense, slower procedures, and a lack of traceability and real-time information.

ACKNOWLEDGEMENT

It is a challenging endeavor to finish the capstone project, which is a requirement for the Bachelor of Science in Information Technology. With the aid and encouragement of remarkable individuals who gave us unwavering motivation, the researchers were able to accomplish their ultimate goals.

Above all, we, the researchers, would like to sincerely thank Prof. Dessa Lyn De Castro, our technical adviser, for her understanding, generosity, and wisdom-sharing. Her prompt advice and instruction were very helpful to us during our culminating experience.

We would like to give credit to Google Scholar and search for the majority of our sources in related studies and literature besides to our advisor. Future generations will find a wealth of knowledge in the ever-expanding Google.

To our capstone instructor, Dennis L. Tacadena, PCpE, DIT for his guidance and support during every stage of our project—not just for us, but also for my fellow classmates. We would like to sincerely thank you for your guidance throughout the course. We would also like to thank Mrs. Felita C. Tobias, LPT, our grammarian, for making sure that our document is of the highest caliber and clarity, which has allowed us to concentrate on the detailed and logical aspects of our project.

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We would also never forget our families, who encouraged us to succeed and provided us with financial support. We are appreciative of our households for keeping us in contact throughout the project's development and for giving us a roof over our heads on the sleepless nights that followed our arduous efforts to realize our dreams. We finally show our openly faith in God for his grace, answering our prayers in our lowest moments and filling us with hope and light for a better tomorrow, with our resolve and hope.

REFERENCES

[1] B. Mary, "The History of Vending Machines," 2019. [Online]. Available: https://www.thoughtco.com/the-history-of-vending-machines-1992599. [Accessed 26 June 2023].

[2] Logic Vending, "The History of Vending Machines," 2022. [Online]. Available: https://www.logicvending.co.uk/history-vending-machines. [Accessed 26 June 2023].

[3] Flona, "Z.com Philippines," 2022. [Online]. Available: https://web.z.com/ph/blog/how-to-start-vending-machine-business-in-the-philippines. [Accessed 28 June 2023].

[4] Xvend, "The Awesome Benefits of a Vending Machine," 23 Aug 2022. [Online]. Available: https://xvend.com.au/the-awesome-benefits-of-a-vending-machine/. [Accessed 28 June 2023].

Kapam-Pamangan: A Cross-Platform Application for Kapampangan Recipes

Best Capstone (*Information System and Web Application Category*)
Presented at International Research Conference on Information Technology Education (IRCITE) 2024

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ABSTRACT

Technology has become essential to humanity, significantly changing how people live, perform jobs, and socialize. In the Philippines, Pampanga province is a popular destination in Luzon for both locals and tourists. This place is called the "Culinary Capital of the Philippines" due to its exquisite cuisine and vibrant food culture. The general objective of the study is to develop an application entitled “Kapam-Pamangan: A Cross-Platform Application for Kapampangan Recipes. The software development life cycle method that the researchers chose to create the application is the modified waterfall model. As a result, three IT experts evaluated the administrator panel backend system and mobile application during the alpha testing. The survey questions are based on ISO 25010 standards. The administrator panel garnered an overall mean score of 4.65, the mobile application garnered an overall mean score of 4.52, both were interpreted as “excellent”. Also, the beta tester involving sixty students of MCC and five professors from the Institute of Hospitality and Tourism Management rated the system and application as “excellent”. The administrator panel garnered an overall mean score of 4.89, while the mobile application garnered a 4.70, both interpreted as an "Excellent" overall result.

Keywords:

Kapampangan Cuisine, Mobile Recipe Application, Culinary Preservation.

INTRODUCTION

In today's world, technology has become an integral part of human existence, reshaping how people work, communicate, and learn. The widespread use of smartphones, with 81% ownership among Americans, has particularly revolutionized various aspects of daily life, including employment, communication, and education [1]. As technology continues to advance, offering new tools for communication and productivity [2], it is essential to explore its potential advantages and limitations.

Technology's impact is evident in education, where smartphones and mobile devices have transformed learning methods and accessibility to resources [3]. Additionally, technology has significantly contributed to the evolution of the food industry, with advancements in food processing, packaging, and the rise of food delivery through smartphone applications and web platforms [4].

In this context, the Philippines has witnessed the integration of technology into the exploration and preservation of traditional recipes. The development of recipe apps has gained popularity, driven by factors like the COVID-19 pandemic and an increasing demand for home-cooked meals [5]. However, despite the growth in recipe app usage, the representation of regional cuisines, such as Kapampangan cuisine, remains limited.

Kapampangan cuisine holds a significant place in the cultural and culinary history of the Philippines, particularly in Pampanga, recognized as the "Culinary Capital of the Philippines" [6]. The challenge lies in preserving this unique culinary tradition, as traditional methods of transmission, such as oral tradition and handwritten recipes, are at risk of being lost over time [7].

Recognizing the need to address this gap, the researchers developed the "Kapam-Pamangan: A Cross-Platform Application for Kapampangan Recipes." This mobile recipe application, built using Flutter, aims to promote and preserve Kapampangan recipes by providing an interactive platform for users to explore, learn, and create their versions of traditional dishes.

The study conducted a preliminary survey among one hundred and twenty (120) students from the Institute of Hospitality and Tourism Management at Mabalacat City College in Pampanga. The results highlighted the interest and need for a dedicated recipe app for Kapampangan cuisine. Notably, 100% of the respondents agreed on the importance of such an application in preserving the region's culinary legacy.

The Kapam-Pamangan app caters not only to students but also to home cooks and food enthusiasts interested in exploring the diverse flavors of Kapampangan cuisine. The application offers step-by-step instructions, 2D animated cooking demonstrations, grocery lists, and other features tailored to user preferences.

Moreover, the development of the app aligns with Sustainable Development Goals (SDGs), specifically contributing to SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action) [8][9][10]. By showcasing historical recipes and cooking techniques, the app encourages innovation and supports sustainable practices in the food sector, contributing to economic progress in the region.

The study represents a modernized and interactive approach to preserving and promoting Kapampangan cuisine, ensuring the continuity of a rich culinary tradition while contributing to sustainable development goals.

Objective of the study

The general objective of the study is to develop an application entitled “Kapam-Pamangan: A Cross-Platform Application for Kapampangan Recipes.”

Specific Objectives

- To gather information and Kapampangan recipes from published books, trusted sources, and interviews
- To identify the required specifications for hardware and software developmental tools used for the application and back-end system development
- To design the system and application using the following diagrams and analysis tools
- To create an application
- To integrate the user-level
- To test the application and system through Alpha and Beta testing.
- To evaluate the application using the Software Product Quality standards of ISO 25010 in terms of functional suitability, performance efficiency, compatibility, usability, reliability, security maintainability, and portability.
- To deploy and implement the application to the following web domain and application repository site

METHODOLOGY AND DESIGN

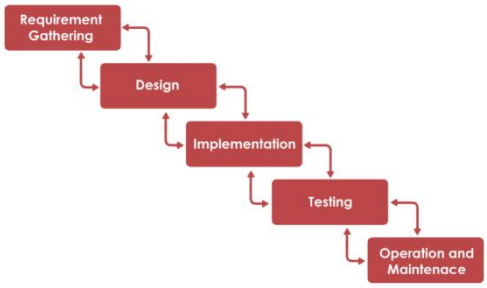

Figure 1: The Modified Waterfall Model

The Software Development Life Cycle (SDLC) method the researchers chose to create the application with is the Modified Waterfall Model (See Figure 1). This model offers a systematic flow of development processes with some flexible, iterative phases including requirements gathering, design, implementation, testing, and operation and maintenance, that give enough documentation and design evaluations to ensure the application's quality, consistency, and maintainability the researchers had built.

Requirements gathering

The researchers collaborated to gather ideas and information for the recipe mobile application through

group discussions, interviews with institutions, surveys, consultations with experts, and studying relevant books from the Holy Angel University library. Key recipe books (See Figure 2) from Holy Angel University, Pampanga, acted as primary sources of content including, "Cocina Sulipeña: Culinary Gems from Old Pampanga" and "Atching Lilian's Heirloom Recipes: Romancing the Past Through Traditional Calutung Capampangan" [11][12].

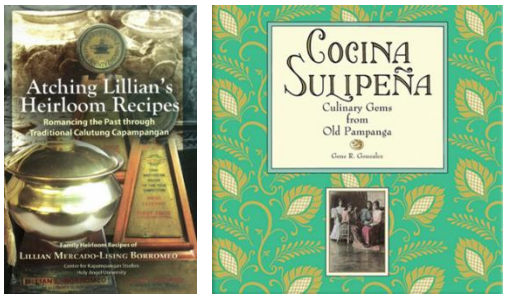

Figure 2: Book covers of the utilized Kapampangan recipe books.

For the application's development, they used Flutter on a Desktop Computer with specific hardware specifications, including an Intel i5 10th Gen processor, 8 GB RAM, 500 GB M.2500 SSD, and 8 GB Video RAM. Additionally, an XP-Pen Artist 13.3 Pro graphic tablet was utilized for 2D animations and assets designing, while Cloud Firestore served as the database. The development tools included Visual Studio Code for scripting, Adobe Photoshop CC and Clip Studio Paint for asset design, and Figma and Balsamiq for prototyping and storyboarding.

Design

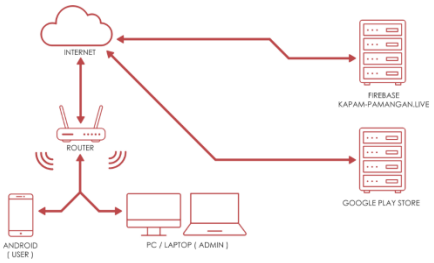

Figure 3: System Architecture Diagram

In this phase, the researchers employed various analysis tools and diagrams for designing the application and administrator panel: Storyboard, Visual Table of Contents, Menu Tree, Use Case Diagram, System Architecture, and Gantt Chart. The Storyboard diagram illustrated the user interface and application flow, aiding developers in designing the initial interface. Visual Table of Contents Diagrams organized interfaces in the Kapam-Pamangan recipe application, while a Menu Tree displayed a hierarchical list of menu items for each recipe category. The Use Case diagram represented system functions and scope, including relationships with actors. The System Architecture diagram, as shown in Figure 3, depicted connections between system components and their functions. A Gantt Chart facilitated effective project time and resource management, helping identify potential obstacles and allocate resources wisely.

Implementation

During implementation phase, Visual Studio Code was used for designing and programming the application and administrator panel's functionality. Extensive work went into creating a visually appealing and user-friendly interface including a home screen showcasing top recipes, a comprehensive recipes gallery featuring Kapampangan recipes and recipes shared by users, and a robust search and filter function. Quality control measures were implemented through a separate administrator panel, allowing careful review and approval of shared recipes. The application incorporated features like a cook button for step-by-step instructions, and interactive elements including liking and bookmarking recipes. A variety of functions, such as meal planning and grocery lists, and reporting, enhanced user experience. The step-by-step directions screen feature included 2D cooking animations, adding an engaging and educational culinary experience. The ingredients list featured user-friendly interfaces, custom ingredient options, and integration with the grocery list and virtual fridge. A personal cookbook, weekly planner, and converter feature provided user personalization and flexibility. The application's account and options feature allowed users to customize preferences, including light and dark display modes. An efficient contact us screen, an about page, and sections on terms of use and privacy policy ensured transparency. Kapam-Pamangan's seamless operation in online and offline modes, designed within Cloud Firestore, catered to diverse user needs. The administrator panel, developed with an extensive set of tools, allowed administrators to manage content efficiently. Features like disabling

and re-enabling accounts, managing recipes, ingredients, animations, and eco-tips, along with a comprehensive dashboard page effectively allowed administrators to manage the content displayed in the mobile application. The careful integration through Flutter and meticulous planning positioned the application and administrator panel as a robust culinary companion, ensuring functionality, readiness for the next development phase, and a reliable and flexible user experience.

Testing

The developed application was evaluated after a preliminary assessment in the testing phase. The researcher used various testing tools for the study, including unit, integration, system, and alpha and beta testing. Before being prepared for administration, the validity of the questionnaire was also evaluated during the testing phase.

Preliminary testing

Unit testing involves evaluating individual components, ensuring code functionality and identifying errors [13]. For unit testing, the researchers manually examined each component, ensuring accuracy and compliance with specifications. This approach identified bugs and inconsistencies early, enhancing reliability.

Integrationtesting assesses software application components as a unified wole, focusing on module interfaces to ensure seamless interaction. The goal is to confirm that multiple modules or subsystems work cohesively to deliver the desired functionality and performance [14]. This testing phase focused on smooth interactions between different parts, such as the weekly planner and recipe gallery. The researchers' hands-on approach ensured effective communication between components, improving overall performance.

System testing assessed the application's functionality in real-world scenarios, covering usage conditions, responsiveness, and data security. This phase ensured the entire system worked cohesively and identified any flaws or contradictions [15]. System testing evaluated the mobile recipe app and the administrator panel comprehensively, assessing how various modules and components collaborated before alpha and beta testing. The thorough assessment confirmed readiness for the next development phase.

Questionnaire validity

The questionnaire underwent validity testing to ensure impartial results. Pre-testing involved stages like preparation, designing, recruiting, conducting, analysis, and reporting, ensuring methodical creation and modification of the application. Ms. Aeriane Charmaine Dizon sought expert advice during the preparation stage. The designing phase involved creating a pretesting tool, such as a prototype, ensuring systematic and uniform development. In the recruiting phase, participants were recruited to guarantee broad applicability, with the sample size and features representing relevant institutions. The conducting stage included providing the tool to participants, data collection, and feedback gathering through surveys, interviews, and usability testing. Analysis of the gathered data identified problems, trends, and patterns, guiding modifications to the application. Reporting at the end included presenting pretesting results, highlighting issues, feedback, and changes made, guiding the final application to meet the intended audience's needs and expectations.

Sampling method

The researchers employed homogenous purposive and random sampling methods to assess the application's usefulness in connected institutions, particularly focusing on culinary practices. Purposive sampling targeted individuals with expertise relevant to the research issue, enhancing validity and reliability. Homogeneous sampling selected participants with similar traits, concentrating on a specific group related to the research question [16][17]. The Institute of Hospitality and Tourism Management at Mabalacat City College served as the study's local site due to its alignment with culinary practices.

Random sampling, specifically simple random sampling, ensured unbiased selection for comprehensive data analysis [18]. The combination of homogenous

purposive and simple random sampling techniques was crucial in developing the Kapam-Pamangan recipe mobile application, ensuring its effectiveness for the target audience at the Institute of Hospitality and Tourism management.

Instrumentation

The researchers used the ISO 25010 software quality product model for assessing the mobile application and administrator panel, employing a survey questionnaire based on ISO 25010 criteria [19]. The questionnaire underwent validity testing to ensure impartial results. Pre-testing involved expert advice, verification of data collection, contrasting test findings with expected results, and evaluating the constructed questionnaire.

To assess the developed application and administrator panel's quality, a validated ISO 25010-based questionnaire was employed, available. The application was published on Google Play Store (Android), and the administrator panel was deployed on a web domain via Firebase and a custom domain from Name.com. Alpha testing involved cooperation with three (3) IT experts, whose feedback guided improvements. Bugs were addressed before beta testing, which included collaboration with five (5) professors and sixty (60) students from Mabalacat City College to test and review the application and administrator panel for functionality and performance.

Questionnaire administration

The questionnaire was administered at Mabalacat City College on November 26, 2023. The researchers managed the distribution, administration, and collection of beta surveys. Respondents spent approximately fifteen minutes completing the form after interacting with the developed application.

Data analysis

For data analysis, descriptive statistics were utilized to examine the study, incorporating frequency distribution, percentage calculations, mean computation, and the Likert scale. Frequency distribution indicated the number of cases at each score, grouped into categories based on demographic profile scores. Percentages were used to measure the relative frequency of demographic profiles. Percentage is a number or ratio expressed as a fraction of 100. This study used the following formula:

$$f = \frac{f}{N} \times 100 = 100f$$

The mean calculated the average of a set of numbers. The mean formula in statistics for a set is defined as the sum of the observations divided by the total number of observations. The mean formula for a set of given observations can be expressed as Mean = (Sum of Observations) ÷ (Total Numbers of Observations)

$$\bar{x} = \Sigma fx / \Sigma f$$

where,

$\bar{x}$ = the mean value of the set of given data.

f = frequency of each class

x = mid-interval value of each class

The Likert scale (See Table 1), employed for sub-criteria and criteria mean scores interpretation, categorized responses into levels of agreement, ranging from "Poor" to "Excellent."

DATA PROCESSING

Data processing involved tally sheets, and a finalized tally summary was prepared as respondents completed beta test questionnaires, with researchers using a tally sheet form for data entry.

Operation and maintenance

Following the implementation phase, the operation and maintenance phase involved distributing the application to the Google Play Store and the project's custom web domain, making the administrator panel accessible online. This facilitated user bug reporting and suggestions for enhancements. Researchers monitored application installations, uninstalls, ratings, and reviews through summary statistics on

application stores. Tracking Android versions and potential future iOS compatibility was deemed beneficial for the program's ongoing operation and maintenance.

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	Good
Neutral	3	2.61 – 3.40	Acceptable
Disagree	2	1.81 – 2.60	Marginal
Strongly Disagree	1	1.00 – 1.80	Poor

RESULTS

The results of the study's research are presented in this section. The study's objectives and the application and administrator panel's testing served as an outline for the careful analysis that produced the results shown here. This section provides a summary of the findings and considerations of their implications and overall importanc, providing an in-depth analysis of the research findings.

Testing results

The Alpha and Beta testing phases were two crucial testing stages for the system. Based on ISO 25010 standards, the researchers thoroughly evaluated the administrator interface and mobile application during the alpha test. The beta test engaged a larger audience focusing on specific criterias. These evaluations offer a comprehensive understanding of the system, laying the foundation for in-depth analyses.

Three (3) IT experts evaluated the mobile application and administrator panel during alpha testing. Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability were among the criteria that were evaluated using live demonstrations, discussions, and survey questions based on ISO 25010 standards. From the alpha test results, the administrator panel (overall mean score of 4.65) and the mobile application (overall mean score of 4.52) both performed excellently.

Table 2: Summary of Alpha and Beta Test Results (Mobile App)

ISO 25010 Criteria	Mean Score (Alpha Test)	Verbal Interpretation (Alpha Test)	Mean Score (Beta Test)	Verbal Interpretation (Beta Test)
Functional Suitability	4.72	Excellent	4.73	Excellent
Performance Efficiency	4.35	Excellent	N/A	N/A
Compatibility	4.39	Excellent	4.60	Excellent
Usability	4.81	Excellent	4.73	Excellent
Reliability	4.63	Excellent	N/A	N/A
Security	4.62	Excellent	4.75	Excellent
Maintainability	4.22	Excellent	N/A	N/A
Portability	4.39	Excellent	4.72	Excellent
Overall Mean Score	4.52	Excellent	4.70	Excellent

Excellent performance was demonstrated by the mobile application and administrator panel during the beta test, involving sixty (60) students and five (5) professors from the Institute of Hospitality and Tourism Management. Surveys were used to assess the ISO 25010 criteria, focusing primarily on Functional Suitability, Compatibility, Usability, Security, and Portability. The administrator panel received an overall mean score of 4.89, while the mobile application had a 4.70, both indicating an "Excellent" overall result.

Table 3. Summary of Alpha and Beta Test Results (Admin Panel)

ISO 25010 Criteria	Mean Score (Alpha Test)	Verbal Interpretation (Alpha Test)	Mean Score (Beta Test)	Verbal Interpretation (Beta Test)

Functional Suitability	4.94	Excellent	4.96	Excellent
Performance Efficiency	4.67	Excellent	N/A	N/A
Compatibility	4.56	Excellent	4.93	Excellent
Usability	4.78	Excellent	4.87	Excellent
Reliability	4.50	Excellent	N/A	N/A
Security	4.62	Excellent	4.85	Excellent
Maintainability	4.38	Excellent	N/A	N/A
Portability	4.78	Excellent	4.87	Excellent
Overall Mean Score	4.65	Excellent	4.89	Excellent

As demonstrated by their excellent ratings against ISO 25010 requirements, the alpha and beta test results highlight the mobile application's and the administrator panel's continuous quality improvement. The mobile application showed improvement, as presented in Table 2, from alpha (4.52) to beta (4.70). The application's user-centered design, cross-platform interoperability, user-friendly interface, security measures, and portability were among its strong points. The administrator panel also continued and exceeded its excellent performance, as presented in Table 3, with the overall mean score rising from 4.65 in alpha to 4.89 in beta, showing notable improvements in several categories. Functionality, interoperability, user-friendliness, security, and portability were all excellent aspects of the administrator panel.

DISCUSSIONS

Implementation results

With a wide variety of features and a user-friendly interface, the mobile application serves as the primary platform for the users. The mobile application encompasses features including a home screen displaying top recipes, recipes gallery for exploring various recipes, and a detailed recipe view offering in-depth information, as shown in Figure 4. Users can personalize recipes, manage ingredients through the ingredients list, create and manage shopping lists with the grocery list, and view purchased ingredients in the fridge. The personal cookbook allows users to save and share personalized recipes, while the weekly planner facilitates user-customizable meal planning. A converter tool is implemented for mass and volume measurements. The account and options section provides syncing options, profile editing, and preference management. A notification system alerts users about various events. The contact us screen facilitates support and communication. Preferences allow customization of settings such as dark mode and eco-friendly tips. Easy access to about, terms of use, and privacy policy ensures transparency.

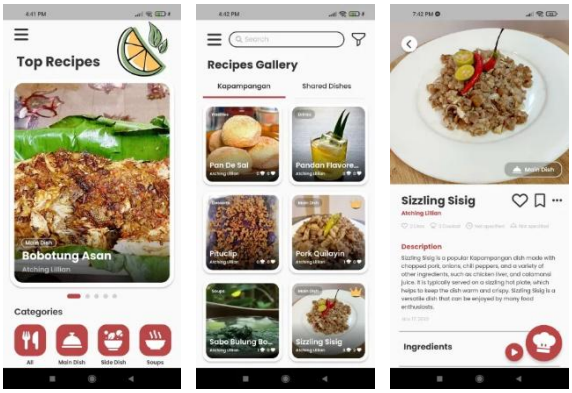

Figure 4: Home and Recipes Gallery screen of the mobile app.

Offline functionality includes accessible features such as recipe viewing, ingredient management, and limited access to the personal cookbook. Online functionality offers full access to features, including third-party links, community interactions, among others. The comparison between offline and online functionalities highlights advantages in online mode, emphasizing full-feature access and user interactions.

Figure 5: Dashboard page of the administrator panel.

The administrator panel offers efficient yet intuitive management tools and functions for managing the content in the application. The administrator panel includes a login page where administrators must enter their credentials. The dashboard, provides data analytics, including recipe metrics, user statistics, and access to various sections, as displayed in Figure 5. The recipes page offers tabs for Kapampangan recipes, shared recipes, pending submissions, and user reports, each with specific functionalities, allowing the administrator to manage the recipes displayed in the app. The ingredients page allows administrators to view, edit, delete, and add ingredients, including searching and filtering capabilities. The animations page enables the management of animation GIFs, with options for editing, deleting, and adding new animations. In the eco-tips page, administrators can view and add eco-friendly tips for users when doing specific cooking procedures. The accounts page features tabs for active and disabled accounts, allowing administrators to manage the users of the application, while providing details such as email, username, and account creation date. Administrators can manage active accounts by disabling them, but deletion is not an option, ensuring compliance with the application's policies. Disabled accounts can be re-enabled, in specific cases. The converter page allows administrators to convert measurements, categorizing them into mass and volume. The settings page enables administrators to manage their account information, change passwords, and request password resets.

The results of the implementation underscore a successful realization of both the mobile application and administrator panel. Users can expect an intuitive and engaging experience from this mobile application, which stands out as a user-friendly platform with a variety of features. The administrator panel features effective administration capabilities at the same time, guaranteeing that content management within the application is straightforward. Collectively, these results validate the effective implementation of conceptual design into a fully operational, user-focused digital environment.

Deployment

After extensive internal and external testing, the Kapam-Pamangan mobile recipe app was successfully released and is now available on the Google Play Store (See Table 6). In order to improve accessibility and management capabilities, the administrator panel is hosted on 'kapam-pamangan. Live' through Firebase.

Conclusions

The Kapam-Pamangan Application 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 project's quality, consistency, and maintainability. The researchers started on a meticulous journey distinguished by careful preparation, organization, and a thorough examination of academic materials, culinary literature, and expert consultations. Through close collaboration with culinary experts, technical advisors, and stakeholders, including Mabalacat City College's Institute of Hospitality and Tourism Management, this foundational phase guided the decision to address a critical need in preserving Kapampangan culinary heritage through the development of "Kapam-Pamangan: A Cross-Platform Application for Kapampangan Recipes." Crucial insights were gathered to develop a system that seamlessly blends tradition and culture with technological innovation.

The primary objective was to create a mobile application called "Kapam-Pamangan," which would give users an easy-to-use way to interact and discover Kapampangan recipes. The system, which aligns with Sustainable Development Goals 9, 11, and 13, substantially contributes to cultural preservation and technological accomplishments. Accomplishing the project's goals was made possible by successfully handling difficulties, such as tight deadlines and complex technological challenges. This effort marks a technical milestone and contributes significantly to the ongoing narrative of conserving cultural culinary heritages in the digital era.

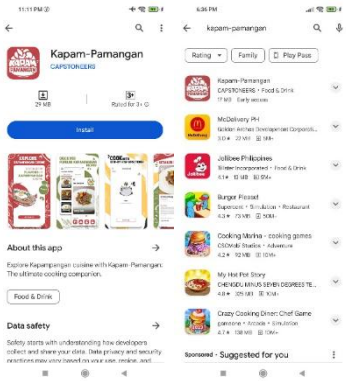

Figure 6: The Kapam-Pamangan app on Google Play Store.

The Kapam-Pamangan recipe software serves as a portable doorway to the rich culinary legacy of Pampanga, the Philippines' gastronomic capital, and extends. Available for download on the Google Play Store, it promotes the learning and preparation of Kapampangan dishes worldwide and has the potential to stimulate the local economy by creating

a greater demand for local ingredients. In terms of society, the app is essential to preserving and promoting Kapampangan food. It helps people in the area and students studying hospitality management exchange and innovate traditional recipes. Furthermore, it serves as a reference point for mobile application development and a manual for upcoming researchers and IT students, promoting a legacy of technological innovation and culinary exploration.

ACKNOWLEDGMENTS

The completion of the Capstone Project, titled "Kapam-Pamangan: A Cross-Platform Application for Kapampangan Recipes," proved challenging yet rewarding. The researchers extend sincere gratitude to individuals and institutions pivotal to the project's success.

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REFERENCES

[1] Pew Research Center. (2021, April 7). Mobile fact sheet. Pew Research Center: Internet, Science & Tech. https://www.pewresearch.org/internet/fact-sheet/mobile/.

[2] Kirschner, P. A., & Karpinski, A. C. (2010, April 17). Facebook® and academic performance. Computers in Human Behavior. https://www.sciencedirect.com/science/article/abs/pii/S0747563210000646.

[3] Bağcı, H., & Pekşen, M. F. (2022, October 31). Investigating the Smart Phone Addictions of Vocational School Students from Different Variables | Malaysian Online Journal of Educational Technology. https://mojet.net/index.php/mojet/article/view/134

[4] (2021, February 17). Technology and Innovation Report 2021. UNCTAD. https://unctad.org/system/files/official-document/tir2020_en.pdf

[5] TheExpressWire (2022, October 3). Recipe Apps Market 2022 | with COVID-19 Pandemic Analysis and Future Growth Analysis by prime Key Players and Regional Forecast -2029 | 120 Insights Report - Digital Journal. Digital Journal. https://www.digitaljournal.com/pr/recipe-apps-market-2022-with-covid-19-pandemic-analysis-and-future-growth-analysis-by-prime-key-players-and-regional-forecast-2029-120-insights-report.

[6] Medelina, V. (2021, April 26). Preserving local recipes and culinary traditions: Pampanga's burong Kapampangan. Manila Bulletin. https://mb.com.ph/2021/04/29/preserving-local-recipes-and-culinary-traditions-pampangas-burong-kapampangan/

[7] Leuterio, P., & Vargas, D. (2021, February). INTERGENERATIONAL TRANSMISSION OF FOOD CULTURES IN THE PHILIPPINES. ResearchGate. https://www.researchgate.net/publication/349353208_INTERGENERATIONAL_TRANSMISSION_OF_FOOD_CULTURES_IN_THE_PHILIPPINES

[8] (n.d.). SDG Goal 9. Department of Economic and Social Affairs. https://sdgs.un.org/goals/goal9

[9] (n.d.). SDG Goal 11. Department of Economic and Social Affairs. https://sdgs.un.org/goals/goal11

[10] (n.d.). SDG Goal 13. Department of Economic and Social Affairs. https://sdgs.un.org/goals/goal13

[11] Borromeo, L. M. (2011). Atching Lillian's heirloom recipes: Romancing the Past Through Traditional Calutung Capampangan.

[12] Gonzalez, G. (1993). Cocina sulipeña: Culinary Gems from Old Pampanga.

[13] Contributor, T. (2023, May 1). What is unit testing? definition from whatis.com. Software Quality. https://www.techtarget.com/searchsoftwarequality/definition/unit-testing

[14] Awati, R. (2022, January 13). What is integration testing (I&T)?. Software Quality. https://www.techtarget.com/searchsoftwarequality/definition/integration-testing

[15] Yasar, K., & Black, R. (2023, March 14). What is system testing? – TechTarget definition. Software Quality. https://www.techtarget.com/searchsoftwarequality/definition/system-testing

[16] Hassan, M. (2024, January 6). Purposive sampling - methods, types and examples. Research Method. https://researchmethod.net/purposive-sampling/

[17] Crossman, A. (2020, March 19). What you need to understand about purposive sampling. Understanding Purposive Sampling. https://www.thoughtco.com/purposive-sampling-3026727

[18] MasterClass. (2022, March 11). Random sampling explained: What is random sampling? - 2024. Random Sampling Explained: What Is Random Sampling? https://www.masterclass.com/articles/random-sampling

[19] ISO 25010. (n.d.). ISO/IEC 25010. ISO 25010. https://iso25000.com/index.php/en/iso-25000-standards/iso-25010

Library Management System with QR Code for Mabalacat Community High School

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ABSTRACT

The "Library Management System with QR Code for Mabalacat Community High School" is a adapted solution addressing challenges in traditional libraries by enhancing efficiency and accessibility for Grade 7 to Grade 10 students. Compatible with Windows 10 and 11, the system employs a modified waterfall model and incorporates various design elements. ISO 25010 guides evaluation, with alpha and beta testing revealing high scores for functional completeness, correctness, and appropriateness, particularly emphasizing excellence in user management and the efficacy of QR code features for book transactions. Notably, the system's outstanding usability, compatibility, and security represent a significant advancement for the Mabalacat Community High School library, promising to streamline processes and elevate the overall library experience for both students and staff.

General Terms

Library Management System

Keywords

Library Management System, QR Code, Online library web-based system, Digital Libraries, Modified waterfall model, ISO25010

INTRODUCTION

The absence of a library management system in schools often leads to disorganization, book loss, and restricted access to materials. Addressing these issues, the implementation of a system tailored for Mabalacat Community High School aims to enhance efficiency in organization, inventory tracking, and the borrowing and returning procedures for Grade 7 to Grade 10 students. The project employs a modified waterfall model and adheres to ISO 25010 standards for evaluation, with alpha and beta testing indicating high scores for functionality and correctness. The system's QR code features prove effective in book circulation, and its overall usability, compatibility, and security represent a significant advancement for the school's library. The transformative shift towards digital library management, validated through rigorous testing, promises to streamline processes, and elevate the overall library experience for both students and staff.

The implementation of the Library Management System (LMS) with QR code technology at Mabalacat Community High School represents a commendable initiative to revolutionize library operations. The LMS, designed for easy access to books using QR codes, allows students to efficiently borrow and return books while tracking transaction history. The system also provides reminders for due dates and penalties, enabling streamlined and efficient management and inventory of books for librarians. The online, web based LMS facilitates student access to the library's resources, offering a transformative solution to meet evolving technological needs and improve the overall library experience at Mabalacat Community High School.

General Objective

The general objective of the study is to develop a Library Management System with QR Code for Mabalacat Community High School.

Specific Objectives

The following are the specific objective of the study:

- To gather data for the study and the system of the library
- To identify the hardware for the development of library management system

- To identify the programming language and software for the development of the system
- To identify the framework for the development
- To design the web using the following diagrams and tools
- To develop a system that has a feature of using the following:
    - Student Account
    - Librarian Account
- To test the system using alpha and beta
- To evaluate the system using ISO25010
- To deploy and implement the system using web hosting site

Scope and Limitation of the Research

The study focuses on developing a comprehensive "Library Management System with QR Code for Mabalacat Community High School," catering to both students and library staff. The system, supporting Windows 10 and 11, aims to enhance efficiency and security through structured, configurable features. Notably, it introduces a user access level, distinguishing between student and admin accounts, with the latter having full privileges for system management. The development process utilizes a modified waterfall model and incorporates ISO 25010 for evaluation, alpha and beta testing involving students and IT experts, and various diagrams, such as Storyboard, Use Case Diagram, Visual Table of Contents, Entity-Relationship Diagram, and Data Flow Diagram.

The system's design includes automated user registration by the head librarian administrator, providing accounts with default usernames and passwords. The system features a login page for all users, directing them to the appropriate user type upon login. Librarians have access to a monitoring system, enabling them to add, delete, and update roles in the library management system. The researchers employ white box testing, survey questionnaires, and face-to-face testing to ensure functionality, gather feedback, and assess compliance with ISO25010 standards. The implementation process involves significant steps, including sorting pages by significance, GitHub repository tracking, and using the MySQL database for the web platform. The system's features encompass QR code functionalities, an inventory system, student accounts, report generation, and a versatile platform accessible via mobile and web.

The study concludes with plans for Alpha and Beta testing, involving thirty students for learner account functionalities and three IT experts for system evaluation. The researchers use statistical analysis and the Likert scale to interpret survey questionnaire results. Following testing, adjustments are made, and the system is deployed on a web hosting platform, with ongoing maintenance and support. The collaborative approach ensures the system meets the institution's evolving needs, with routine maintenance to keep it updated, secure, and performant.

METHODOLOGY

This chapter presents methods used in developing the LMS web system and illustrates the functions of the system, contains methods, design, and data that were used in the system development, it also shows the methodologies and research instruments to collect data used by the proponents. There are also different kinds of diagrams to further explain the flow and the design of the study. The proponents will use a modified waterfall of the Software Development Life Cycle model.

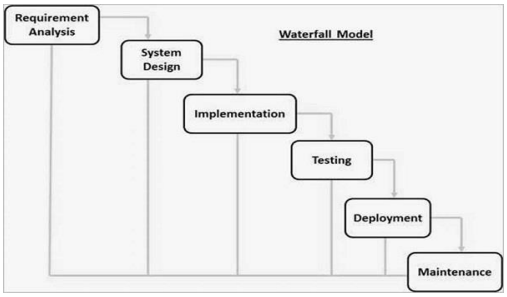

Figure 2. Phases in Modified Waterfall Model

(Source:https://www.tutorialspoint.com/sdlc/images/sdlc_waterfall_model.jpg)

Requirement Analysis

In the initial phase of developing the Library Management System, the researcher conducted a comprehensive examination of the characteristics required for efficient library management. Visits to both Mabalacat City College Library and Mabalacat Community High School Library were pivotal in understanding the technicalities and needs for system development. The researcher engaged in direct observation and interviews with the librarian, utilizing surveys to identify pain points and areas for

improvement. This hands-on approach, involving key stakeholders, laid the groundwork for creating a customized and efficient library management system tailored to meet the specific needs of Mabalacat Community High School.

Subsequently, the researcher's primary objective was to identify and comprehend the specific needs of the high school library for effective resource management. Through interviews, surveys, and direct observation, insights into existing processes, user requirements, and challenges faced by the traditional management system were gained. Roles for contributors were defined (See Table 1), and a Gantt chart (See Table 2) estimated the time needed for planning tasks. The requirement analysis served as the basis for system information diagrams, validated through comparison. Use Case Diagrams (UCDs) determined potential use cases, defining roles and access features for different users, including administrators, librarians, and students. The application's user interface and functionality were detailed, emphasizing user roles, consultations, and administrative control in the development of the Library Management System.

Table 1. Team Roles used for Learning Management System

Capstone Members	Team Roles
Engr. Robbert M. Bamba	Technical Adviser (TA)
Ocampo, Bobby S.	Project Leader and UI Designer/Document Analyst
Tabunda, Edgar P.	Front-end/Back-end Developer/Document Analyst
Mercado,Darwin	Document Analyst/System Analyst
Galang, John Michael A.	Documentation
Angeles, Edilberto Jr. V.	Documentation

Design

In the design phase, the researchers initiated the system design after completing a comprehensive Requirements Analysis of the locale. Using prototypes, particularly a Storyboard created with Canva (refer to Appendix B), the developer outlined various system features, including User Access-Level, Book Inventory, Student Management, QR Code borrow and Return functionality, Transaction Management, and Generating reports. The focal point of innovation in the design is the integration of QR code functionality within the web-based library management system. This feature aims to streamline processes such as book transactions, monitoring, and inventory management, significantly enhancing overall efficiency. The researchers emphasized the necessity and feasibility of incorporating QR code functionality for borrowing and returning library items, emphasizing the benefits of modernizing operations for both librarians and students. The system will generate QR codes for books, allowing quick tracking and reducing manual errors during transactions. Technical aspects, including algorithms for code generation and decoding, and a well- structured database, will ensure a robust system. The user interfaces will be intuitively designed, enhancing overall usability. The design tools employed include a Storyboard, created using Canva, Gantt charts (refer to Appendix N-R), and other visualization techniques to communicate the web- based capabilities and project timeline effectively.

Table 2. Gantt chart used for Library Management System

Task	Duration (weeks)	Start Date	End Date	Dependencies	Team Members
Requirements	2	Week 1	Week 2	None	Project Leader
Analysis	2	Week 3	Week 4	Requirements	System Analyst, Document
Design	3	Week 5	Week 7	Analysis	Analysis System Analyst
Coding	8	Week 8	Week 14	Design	Frontend Developer, Backend Developer
Testing	3	Week 14	Week 17	Coding	Test Engineer
Implementation	2	Week 18	Week 19	Testing	Quality Assurance Engineer
Maintenance	Indefinite	Week 20	-	Implementation	Technology Specialist

Coding

Visual Studio Code was chosen as the primary coding environment, reflecting a commitment to a robust integrated development environment for effective coding throughout the lifecycle. The development process began with the establishment of fundamental components, particularly focusing on creating a secure and role-based access control system with distinct user access levels for administrators, students, and librarians. Concurrently, the book inventory module was developed to facilitate effortless classification and organization of the library's collection. The subsequent focus was on installing the student management module, enhancing user profiles, loan data, and student records for an improved overall user experience. The transaction management module was also integrated, incorporating QR codes to streamline library transactions such as book checkouts and returns. Finally, the report creation module was developed, enabling the system to generate intelligent and configurable reports on popular books, library usage, and other pertinent metrics. Overall, the Library Management System demonstrates a methodical and user- friendly approach tailored to the specific needs of the educational environment at Mabalacat Community High School.

Testing

In evaluating the system's alpha and beta testing phases, test cases aligned with ISO25010 standards were employed, focusing on functional suitability, portability, security, and usability. The assessments involved a diverse group of students and librarians, with their demographics aiding in the formulation of a fair library policy. The respondent data proved crucial for in-depth analyses. During beta testing, user acceptability was gauged using a questionnaire to ensure the system met user needs. The evaluation encompassed content, user interaction, and technical aspects, with a grading system ranging from 1 to 5, reflecting performance from "Poor" to "Very Good". The results of both alpha and beta tests were summarized using the Likert Scale. (See Table 3):

Statistical Statement

Weighted mean used to measure the general response of the survey samples whether the respondents agree to the given statement or not.

Where: Mean

$\bar{x}$ = mean value of the set of given data f = frequency of each class

x = number of the respondents

n = total number of the respondents

$\sum fx\ \bar{x} = \sum f$

Table 3. Likert Scale

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 and Implementation

The Library Management System Using the QR Code of Mabalacat City Community High School Library project utilized Hostinger as its hosting site. Hostinger, known for its reliable and user-friendly web hosting services, particularly shared hosting, was chosen for its compatibility with Windows 10 and 11. This choice ensures smooth deployment and accessibility of the developed system, providing a stable foundation for managing student accounts, book databases, transactions, and QR Code functionalities. To refine the system and identify bugs, the researchers obtained permission from the librarian at Mabalacat Community High School for a three- month test run. This period allows for a thorough evaluation of the system's functionality and the implementation of necessary enhancements or new features, with feedback collected during the test run playing a crucial role in the continuous improvement of the system.

RESULTS

Alpha Test Result

In the alpha test phase of our Library Management System (LMS) development, the researchers employed ISO 25010 as an evaluation tool, engaging three IT experts, namely Patrick John Baylon Sicat, Edmond O. Yumang, and Marco Polo G. Sanchez, to assess the application. The face-to-face survey

yielded valuable insights from these experts. The results, as detailed in Table 4, showcase the system's commendable performance across various criteria.

The system achieved an outstanding functional suitability score of 4.30, indicating excellence in providing the necessary functions for efficient operation. Similarly, usability and portability achieved a numerical grade of 4.33 each, signifying a highly usable and secure system. The security received an excellent score of 4.17, highlighting robust data protection measures, strong authentication procedures, and an absence of security flaws.

Table 4: Alpha Test Results

Criteria	Average	Description
Functional Suitability	4.30	Excellent
Usability	4.33	Excellent
Security	4.17	Good
Portability	4.33	Excellent

Beta Test Result

To assess the effectiveness of our Library Management System (LMS), we conducted a beta test at Mabalacat City Community High School, involving grade 7-10 students, librarians, super admin, and admin. Participants interacted with the system and provided feedback through a beta test questionnaire. The functional suitability of the LMS received an outstanding average grade of 4.51, indicating excellent performance and functionality tailored to the educational environment.

The LMS's portability scored impressively with a mean of 4.59, suggesting ease of installation and accessibility across various platforms, including desktops and mobile devices. This aligns with the findings from the usability assessment, where the system received a commendable mean score of 4.59. The LMS was deemed user-friendly and easy to navigate, with responsive design elements catering to both desktop and mobile users. Users expressed satisfaction with the overall ease of system use. Furthermore, the security assessment yielded a high mean score of 4.61, classifying the LMS as "Excellent" in terms of security. The system effectively safeguards user data, employs secure features such as OTP for user accounts, and demonstrates reliability, efficiency, and effectiveness in ensuring data confidentiality. Overall, the beta test results highlight the LMS's robust functional suitability, impressive portability, user-friendly design, and strong security measures, reinforcing its potential as an effective learning tool for educational institutions.

Table 5: Beta Test Results

Criteria	Average	Description
Functional Suitability	4.51	Excellent
Usability	4.59	Excellent
Security	4.61	Excellent
Portability	4.59	Excellent

Comparative Summary of Alpha and Beta Results

The comparative analysis of the alpha and beta test results for our Capstone project reveals a significant enhancement in various aspects of the system's performance and functionality. In the alpha test phase, which involved evaluation by IT experts, the system demonstrated commendable scores across different criteria, including functional suitability, usability, portability, and security. Notably, the functional suitability received a score of 4.30, indicating excellent provision of necessary functions.

Moving to the beta test at Mabalacat City Community High School, involving a diverse group of participants, the system exhibited remarkable improvements. The functional suitability score rose to an outstanding 4.51, highlighting enhanced performance tailored to the educational environment. Similarly, the usability and portability saw substantial improvement, with mean scores of 4.59 each, showcasing a more user-friendly design and improved accessibility across platforms. The security assessment in the beta test resulted in a high mean score of 4.61, categorizing the system as "Excellent" in terms of security. This signifies strengthened data protection measures, incorporating user feedback and implementing secure features such as OTP for user accounts. Overall, the beta test results reflect a substantial progression from the alpha test phase, with improved functional suitability, enhanced usability, increased portability, and reinforced security measures. These positive outcomes affirm the system's potential as an effective and reliable solution, aligning with user expectations and needs.

The iterative process from alpha to beta testing played a pivotal role in refining the system, incorporating valuable feedback, and ensuring its readiness for practical use.

DISCUSSIONS

The researchers conducted an evaluation and testing of the Library Management System (LMS) for Mabalacat Community High School. They collected feedback from users to assess the application's usability and overall experience. Depending on the study's goals, the application was designed and functionally adapted to meet specific requirements. The foundation and usability of the application, in terms of how users interact with its design and mechanics, enable them to understand, learn, and navigate the system.

Regarding Learnability and Operability, the library management system proves to be user-friendly and easily accessible. The system addresses the challenges users faced with the manual library management system by transitioning to an automated system with QR Code functionality. This shift enhances user convenience and satisfaction. The researchers conducted tests involving three IT experts and the local system itself to ensure its functionality and effectiveness.

Conclusion

The Library Management System with QR Code for Mabalacat Community High School was developed through a systematic process involving the creation of diagrams to guide the development. The librarian plays a crucial role in managing student accounts, books, and transactions. The website was then constructed using the outlined technologies, marking a significant improvement in the library's operational structure. Notable features include QR Code technology for book borrowing and return, efficient book management, student management, transaction tracking, and comprehensive reporting functionalities.

The implementation of QR Code technology aims to enhance user experience and expedite transactions. The book management system ensures organized accessibility to the library's collection, while the student management module provides accurate and current student records for a personalized and secure library experience. The transaction management system records all library interactions, ensuring the accuracy of book borrowings and returns. The Generate Report functionalities offer valuable analytics for informed decision-making, covering aspects such as most borrowed books, student participation, and system success. Despite facing obstacles like compatibility concerns, financial constraints, and initial slow loading speed, the system underwent thorough testing and received high scores for functional suitability, interoperability, coexistence, and usability. Security sub-criteria, including confidentiality and integrity, also received great marks, indicating a secure environment with no privacy concerns. Overall, the Library Management System demonstrates efficiency, accessibility, and security in managing the library's operations.

Recommendations

The Library Management System at Mabalacat Community High School is being enhanced to provide a more comprehensive and detailed understanding of library activities. This includes adding more reporting capabilities, such as logs for borrowed books, books borrowed and returned, student reports, and user actions. This will increase transparency, enable data-driven decision-making, and improve system efficacy.

Another enhancement is the implementation of a CSV (Comma-Separated Values) upload function for adding students to the Library Management System. This will streamline the process and eliminate the need for manual data entry. This will improve efficiency and accuracy in handling student information.

Future researchers should consider incorporating a book reservation process to ensure availability and equitable access to resources. This feature will facilitate volume reservations for users more quickly, boosting system effectiveness and satisfaction. This enhancement aligns with the goal of creating a user-friendly, efficient system that considers library users' preferences, enhancing the responsiveness and productivity of the library environment.

REFERENCES

[1] MyEdu. (2020). Challenges and Solutions of Library Automation in College Libraries. MyEdu. https://www.myeducomm.com/blog/challenges-and- solutions-of-library-automation-in-college-libraries/

[2] M. (n.d.). Library Management System: Library Automation Software. Library Management

System - Best Library Software 2023. https://www.iitms.co.in/library- management-system/

[3] P, S. A., A, R., Ganeshan, S., & S, B. (2020). Library Management System. ResearchGate. https://doi.org/10.37896/JXAT12.11/29777

[4] Singh, A. (2019) Smart Library Management System using QR code. https://portfolios.cs.earlham.edu/wp-content/uploads/2020/05/SLMS_paper_adarsh.pdf

[5] Addepalli, SL. & Addepalli, SG. (2014) Library Management System Using RFID Technology https://ijcsit.com/docs/Volume%205/vol5issue06/ijcsit20140 50610.pdf.

[6] Dani, A. (2020, June 1). QR Code based Library Management System. https://www.jetir.org/view?paper=JETIR2006271

[7] Das, Indrakshi Assistant Librarian and Das, Digbijoy Assistant Professor, "QR Code and Its Effectiveness in Library Services" (2021). Library Philosophy and Practice (e-journal). 5540. https://digitalcommons.unl.edu/libphilprac/5540

[8] Dr. Gurhan DURAK, E. Emre OZKESKIN & Dr. Murat ATAIZI (2016) QR CODES IN EDUCATION AND COMMUNICATION https://files.eric.ed.gov/fulltext/EJ1097236.pdf

[9] Din, M. M., & Fazla, A. F. (2021). Integration of Web-Based and Mobile Application with QR Code implementation for the library management system. Journal of Physics, 1860(1), 012018. https://doi.org/10.1088/1742-6596/1860/1/012018

[10] Naik, P., Kamath, R. S., Jamsandekar, S., & M.B. Patil. (2015). Enhancing the Usability of Library System at CSIBER using QR Code. ResearchGate. https://www.researchgate.net/publication/280223164_Enhan

MediSmile: A Web-based Online Appointment and Monitoring System for Pajarillaga-Castillo Dental Clinic

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ABSTRACT

There is a growing demand for better, more patient-friendly solutions regarding the growing field of healthcare. Healthcare facilities have difficulty scheduling patients and maintaining accurate records of their progress. The goal of this study is to develop a web-based online appointment and monitoring system. The researchers employed a modified waterfall methodology to move through project phases methodically. The system underwent a comprehensive evaluation process, wherein the system received an overall score of 4.32 from the alpha test and an overall rating of 4.57 from the beta test. The alpha test result is marginally enhanced in the beta phase which signifies the implementation of additional enhancement addressing potential vulnerabilities identified in the alpha testing phase. The ISO 25010 software quality standards criteria were achieved wherein the system performed all intended functions. It was ensured that the developed system aligned with and contributed towards the achievement of specific Sustainable Development Goals (SDGs). After conducting a thorough study, it has been concluded that the goals have been achieved successfully. However, to further enhance the system's performance, several improvements have been suggested. By implementing these suggestions, we can ensure the best possible system performance, which will ultimately benefit the users.

General Terms

Monitoring System, Appointment, Healthcare, Dentistry

Keywords

Information Systems, Content Management Systems

INTRODUCTION

In this modern world of technology, networking, and computer technology have made significant advancements that have changed how practitioners practice medicine and expanded treatment options. Innovations have become more diverse in various industry fields, including the medical field, specifically in dentistry [1]. Technology has been progressively integrated into the healthcare sector to enhance the patient experience, increase efficiency, and improve patient care. Gradual changes in technology have facilitated the provision of oral health solutions to individuals in need of assistance with oral complications.

In our community, the impact and duty had significant importance, especially when it relied on the power of modern technology. Professionals in this field were able to evaluate a patient's condition and perform strategic, thorough procedures and oral examinations using dental equipment and tools such as Digital X-Rays, Dental Patient Chairs, Sterilization Equipment, etc. [2].

In addition, the dentistry field in the Philippines became more influential in improving the oral experience for Filipinos as the years progressed. Technology innovation played a crucial role in shaping the reputation of dentistry in today's society. It enabled dental practitioners to maximize their potential and knowledge by using various equipment, tools, software, and more.

Looking back in history, even though there was evidence of indigenous tribes in 1178 having gold-pegged teeth, the Philippines Dental Association still considered the first real dental practice in the country to have occurred during the Spanish colonial era. During that time, anyone with the

capability and skills to extract teeth using pliers could practice dentistry.

As technology continued to evolve, it had a profound impact on dentistry. In fact, in 2016, Manila dental clinics started offering the service of 3D sculpted crowns through the use of dental machines. This development demonstrated how technology allowed practitioners in the Philippines to harness their potential and knowledge through equipment, tools, and software to enhance the lives of Filipinos.

In the Philippines, the recent events of COVID-19, and dental clinics altered the new normal in our society. The Philippine Dental Association released guidelines for dental clinics to accept walk-in patients while preventing the possibility of exposure to infectious diseases, such as the Coronavirus. Consequently, dental practitioners delved deeper into creating websites for their clinics, offering online appointments, contact information, available services, and more.

The goal of the study is to assist the dentist in maintaining the day-to-day progress and health records of the client. In addition to client-based information, it allowed clients to easily schedule appointments and access dental-related information, such as common causes of tooth decay, solutions for oral complications, and basic oral hygiene practices. Furthermore, it facilitated the Dentist in providing dental products and services to current and future customers. Through this system, the Dentist and other medical staff could record and track each patient's progress, and the client side allowed them to monitor their records and progress as well.

Background of the study

Pajarillaga-Castillo Dental Clinic was established in the year 2003 in Dau, Pampanga for twenty (20) years and just recently transferred to Mabalacat, Pampanga. Currently, it is located at 2499 Mawaque road Mabalacat City, Pampanga.

The clinic aims to provide a helping hand to individuals in need of oral healthcare services, offering quality dental treatments. There was only one (1) branch, and it was a well-known dental clinic in the area. Their primary approach to business was to ensure that the flow of their clients was organized, and their primary means of communication with clients was through text messages and phone calls. The clinic was staffed by two (2) people and could accommodate 10-15 patients per day, depending on the service required by the client. Presently, they cater both walk-ins and appointments in which they monitor their appointment with the clients through the written (book record).

Common problems that they have encountered through walk-ins were the clients who wanted to go first right after they arrived. However, it was essential for a certain firm to have a strong business rule such as FCFS or First Come First Served basis to attain an organized and coordinated business practice. In line with concerning appointments, they monitored their records exclusively through phone and written. This was the reason why most of their appointments were being stacked up resulting in a very impractical way when it comes to the systematic approach of the business.

General objective

The general objective of the study was to develop a Web-based online Appointment and Monitoring System for Pajarillaga-Castillo Dental Clinic.

Specific objectives

The study aimed to achieve the following specific objectives:

- To gather data and information through interviews and surveys, articles, scholarly published research, and library research.
- To identify hardware and software developmental tools requirements.
- To design a system using analysis tools.
    - Storyboard
    - Use Case Diagram
    - Website map
- To create a user-level access front-end and back-end system.
- To develop a system with the following features:
    - Online appointment system for clients with prior schedules and persons with special needs.
    - To provide dental health informative tips.
    - Products and service price and duration.
    - Real-time chat with the Dentist
    - Chatbot for frequently asked questions.
    - Social media hyperlink page.
    - Google Map for the location of the Dental Clinic

- To create two user accounts for admin and client.
- To test the system by using developer testing, alpha testing, and beta testing.
- To evaluate the system using ISO 25010 criteria namely: Functional Suitability, Security, Compatibility, Usability, and Portability.
- To deploy the system using Hostinger.

Scope and limitation

The scope of this study aimed to develop a Web-based Appointment and Monitoring System for the Pajarillaga-Castillo Dental Clinic. The researchers gathered research data through interviews, surveys, articles, scholarly published research, and library research.

To create the system, the researchers employed relevant tools and technologies such as web frameworks like Laravel and database management systems using XAMPP, a DBMS (MySQL), a web server (Apache), and PHP. Aside from that, third-party applications were also used such as HPanel, SMTP2GO, Pusher, and GitHub.

The researcher designed the system using a variety of analysis tools such as storyboard, use case diagram, and website map. The researcher furthered the success of the system using the Modified Waterfall Methodology since it offered a systematic progression of design phases with adaptable iterative phases. The researchers had created a user-level access front-end and back-end system.

The system provided clients with a range of features developed to enhance their experience and make it easier to schedule appointments and access important information. The client could visualize and access a variety of features from the website such as Dental Health Tips, a gallery that has an information on the products and services, chatbot and real-time chat with the dentist, google map, and etc. The system required dentist or secretary to create an account for the client. Along with this, the dentist and client were able to update their profile and personal information.

The researchers tested the system by using developer testing, alpha testing, and beta testing. The researcher used ISO 25010 to evaluate the system's functional suitability, compatibility, usability, security, and portability. The researchers used Hostinger as its domain registrar.

The development process included defining user roles and responsibilities, creating a user interface, developing backend functionality, implementing user-level access control, testing, and deploying the system to a production server. The client was able to view the available dates for the reservation of an appointment. The dentist or secretary could approve or decline the client's account upon its creation. The dentist or secretary had the authority to reschedule the approved client's appointment if the dentist had an emergency. The dentist had the authority to decide whether to accept, deny, or reschedule a client's appointment.

However, there were certain limitations to this study. First, the study focused solely on the development of the web-based system for Pajarillaga-Castillo Dental Clinic and did not cover the implementation or integration of the system into the existing workflow of the clinic. Second, the study did not encompass the development of a mobile application for the system, as it was only accessible through a web browser.

Significance of the study

The significance of the study indicates who would have the benefit of the web-based system.

The project will be beneficial to the following:

Global Context

In the global context, the ideas in this project made a valuable contribution as a reference that could help future researchers who will start new studies by providing them with valuable references. It gave a comprehensive overview of the topic, which helped researchers understand it better and gain new knowledge on a global scale.

Economic Context

In the economic context, this project would lower the operating expenses of dental clinics and, at the same time, enhance the results of the patient's treatments. This would lead to reduced costs for patients, and the entire healthcare system could benefit from this research.

Environmental context

In the environmental context, this project could help to reduce paper usage in dental clinics, which would have a positive impact on the environment. Moreover, it could also lessen the need for patients to travel to the clinic for appointments, which could help reduce carbon emissions.

Societal context

For the societal context, this project could enhance patient experience and satisfaction, minimize waiting times, and improve communication between dental clinic staff and patients. Moreover, it could help dental clinics adjust to the new normal of remote consultations and virtual appointments that became necessary due to the COVID-19 pandemic. [3].

METHODOLOGY

This chapter presents methods to be used in developing the MediSmile: A Web-based Online Appointment and Monitoring System for Pajarillaga-Castillo Dental Clinic and illustrates the functions of the system, contains methods, design, and data that were used in the system development. It also shows the methodologies and research instruments to collect data used by the researchers. There are also different kinds of diagrams to further explain the flow and the design of the study.

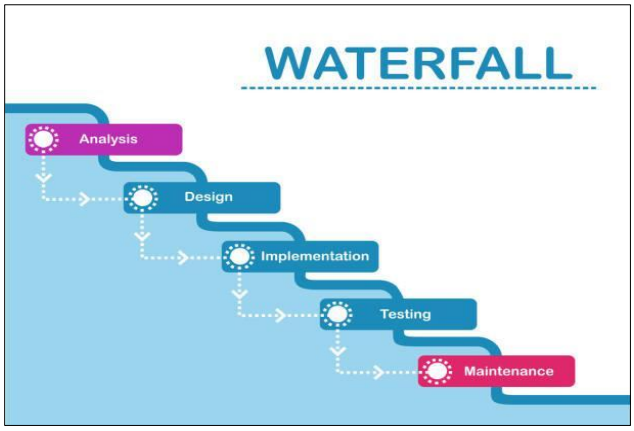

Figure 1: Modified Waterfall Model

The researchers used Modified Waterfall as their methodology because it makes early and ongoing user and stakeholder feedback possible. This feedback can be used to pinpoint problem areas and make adjustments as the product is being developed, which could lead to a higher-quality end product that more effectively satisfies consumer needs. Moreover, it can result in a more rapid and successful process of development. The likelihood of errors and faults being carried over into later phases is decreased by segmenting the software development process into phases and ensuring that each phase is finished before going on to the next.

Hence, the researchers will be reducing the need for rework and ensuring that the finished product is of excellent quality, this can ultimately save them time and resources.

Analysis

In the analysis phase, the project team examined the specifications and gathered data regarding the issue that needs to be resolved. The goals of this phase are to define the project's scope, identify the stakeholders, and comprehend the Pajarillaga-Castillo Dental Clinic's needs and objectives. The researchers conducted web research to gather data for the requirement analysis phase and ensured the data was correct and of the highest integrity. To come up with ideas for capstone projects, the researchers strategized, planned, and carried out internet and library research. The researchers started by collecting information online from academic articles, journals, governmental websites, and application store sites to define the problems and identify the fundamental requirements for the application development. To stay informed about the progress of the application development and documentation, the researchers frequently communicated with their technical and capstone advisers. Depending on the size of the study, the researchers distributed specific tasks, distributed ideas, and set activity schedules.

Figure 2: Researchers performed collaborative work and scholarly research

Design

The system's high-level design is developed by the project team. The website storyboard, use case diagrams, website map, and other diagrams that show the functionality of the system are included in this design. The storyboard was used as a guide to visualize and refine the flow of the website. The Use Case Diagram was effectively used to identify the

different actors (user and dentist) involved in the system and the functionalities they required. Lastly, the website map was used to visualize the representation of the website's content hierarchy, providing a roadmap for users to navigate the website. In this phase, the researchers developed a web-based online appointment and monitoring system for Pajarillaga-Castillo Dental Clinic to handle appointments of patients with oral complications in an organized and proper manner.

Implementation

The project team created and developed the software following the design guidelines and requirements gathered in the earlier stages. Implementing the features of the system, the researchers created a user-level access front-end and back-end system, appointment calendar and setting, and dental health tips by accessing the homepage, the client could learn about the latest treatments and procedures available to them. As well as a gallery that has information on the products and services offered by the clinic, including the duration of the specific procedure, chatbot, chat with secretary or dentist feature, and Google map for the location of the dental clinic. And lastly, a notification email to both users. The researchers used certain portions of the XAMPP which was the PHP and MYSQL together with Laravel as the framework used in developing the system. HTML 5 and CSS/Bootstrap were used by the researchers in terms of designing the user interface of the system. Canva was used in creating/editing graphics for the system, and Visual Studio Code as a text-editing software.

Testing

In this phase, system testing is done by the project team. System testing entails examining the entire piece of software to make sure it complies with specifications and is error-free. First, the researchers used simple random sampling because it can guarantee representativeness, remove biases, is straightforward, and uses statistical methods. These elements make it a useful and trustworthy sampling technique in research projects, enabling researchers to get precise information on the target population. Second, the system was tested using Developer Test, Alpha, and Beta Testing wherein Developer test would be for the developers, Alpha would be for IT Experts while Beta would be for non-IT experts. The researchers will approach three (3) IT experts as alpha testers to test the system. For Beta Testing, the researchers selected thirty (30) end-users which were the dentists, secretary, and their patients of Pajarillaga-Castillo Dental Clinic to test the functionality of the system. The system was evaluated using ISO 25010 which was Functional Suitability, Security, Compatibility, Usability, and Portability.

Questionnaire administration

The survey was conducted in Mabalacat City between November 15, 2023, and November 19, 2023. During the distribution and presentation of the questionnaire, respondents were given an overview of how to fill out the checklist based on their experience. The researchers used English for the respondents to ensure that they completely understood the instructions, which is a great way to improve their understanding and accuracy in answering the questionnaire.

Data gathering

During the testing phase of the system, the researchers administered, distributed, and collected beta questionnaires from the participants. The respondents were required to complete the questionnaire within a maximum time of ten (10) minutes after using the system. The data collection period for the beta test commenced on a specific date on November 24, 2023, and continued until a particular date on November 28, 2023.

Data analysis

This study made use of descriptive statistics. Descriptive statistics summarized the data to determine the locations around which the data is situated, as well as the spread and dispersion of the data. The following statistical treatments were used for data reduction:

Frequency distribution

The frequency distribution was utilized in the study to illustrate the number of instances at each score. The demographic profile of the respondents' scores was sorted into groups specified by step intervals, each of which comprised a set of contiguous possible scores. A variable with values indicating the order of the instances was separated into many groups. The frequency

was calculated by tabulating the number of instances in each category.

Mean

The mean is the average or computed center value of a group of numbers that is used to determine the data's central tendency. In statistics, the mean formula for a set is defined as the sum of the observations divided by the total number of observations. The mean formula for a given collection of observations is represented as, Mean = (Sum of Observations) ÷ (Total Numbers of Observations)

$\bar{x} = \Sigma fx/\Sigma f$

where,

$\bar{x}$ = the mean value of the set of given data.

f = frequency of each class

x = mid-interval value of each class

Likert scale

The Likert scale is a rating system that frequently appears in surveys to assess respondents' attitudes, views, or impressions. The researcher employed the Likert scale to translate the results into their appropriate verbal interpretations after calculating each mean score of each survey instrument sub-criteria and criteria.

Table 1. Likert Scale

Sample 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	3.21 – 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

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 will 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 developed system. The researchers will do updates by monitoring the progress, errors, and functionality of the system. With this, the researcher developed a web-based system that the users could freely access and utilize at the domain repository website address of medismile.online.

RESULTS AND OUTCOMES

The findings and conclusions based on the study's objectives are displayed in this section. The study's goals, the analysis that has been done, and the testing of the created system serve as the foundation for these discussions and conclusions. Additionally, the researchers' analysis and interpretation of the beta testing are presented. The researchers have carefully calculated the outcomes and results. The researcher's job now is to draft a written report outlining the study's findings after the data have been collected and examined. The way the research findings are presented must be well-structured, logical, and comprehensible.

Alpha testing

The results were presented using the frequency and percentage tabular presentations for the alpha testing. The researchers successfully achieved alpha testing by administering a web-based system and collecting the alpha questionnaires from three (3) IT expert respondents. The testers were namely Mr. Alexis Aldrin D. Santos Jr., Full stack web developer, Mr. Timothy Franco Calaguas, Webflow developer, and Ms. Jovillene A. Peñalosa, Web developer.

Table 2: Summary of Alpha Test Results

Evaluation	Mean	Verbal Description
Functional Suitability	4.15	Good
Compatibility	4.00	Good
Usability	4.42	Excellent
Security	4.50	Excellent
Portability	4.56	Excellent
Total	**4.32**	**Excellent**

As shown in Table 2, the system's functional suitability, which pertains to how well it met its requirements and objectives, was rated 4.15, indicating a good performance. Similarly, the system's compatibility with other related systems was rated 4.00, which is also considered good. The usability of the system, which refers to how easy it is to use and learn, was rated as excellent, with a weighted mean of 4.42. The system's security was also assessed, and it was found to be highly secure based on a weighted mean of 4.50. Lastly, the system's portability, which measures its ability to be used on different platforms and environments, was rated 4.56, indicating an excellent performance in this aspect.

Overall, the system demonstrated exceptional performance in various areas, making it a highly recommended option for its intended use.

According to the survey conducted by the researchers, the system's functional suitability, compatibility, usability, security, and portability criteria were thoroughly evaluated and found to be equally and accurately achieved with a total rating of 4.32. As a result, the overall system was deemed to be excellent, indicating that it is highly functional, compatible with different devices and platforms, user-friendly, secure, and easy to move to new environments.

Beta testing

The results were presented using the frequency and percentage tabular presentations for the beta testing. The researchers successfully achieved beta testing by administering a web-based system and collecting the beta questionnaires from the respondents.

Table 3: Summary of Beta Test Results

Evaluation	Mean	Verbal Description
Functional Suitability	4.52	Excellent
Compatibility	4.57	Excellent
Usability	4.59	Excellent
Security	4.58	Excellent
Portability	4.59	Excellent
Total	**4.57**	**Excellent**

As shown in Table 3, the thirty (30) respondents to the beta test rated the system's functional suitability weighted mean as 4.52 which had the verbal description of excellent and had the highest rating because of the completeness of the functions, the system executed every function correctly, and provides appropriate functions to facilitate the accomplishment of specified user-level tasks. The system's compatibility was rated with a weighted mean of 4.57, which falls under the "excellent" category, indicating that the system can function seamlessly with other systems and software. In terms of usability, the system scored a weighted mean of 4.59, which also falls under the "excellent" category, indicating that the system is user-friendly, easy to navigate, and efficient in performing its intended functions. The security of the system was also rated as "excellent," with a weighted mean of 4.58. This indicates that the system is secure and protected from vulnerabilities, threats, and unauthorized access. Additionally, the portability of the system scored a weighted mean of 4.59, indicating that the system can be easily transported and set up in various locations without losing its functionality.

Above all, based on the findings of the survey carried out by the researchers, the system has met all the required standards in terms of Functional Suitability, Compatibility, Usability, Security, and Portability with a total score of 4.57. The survey concluded that the system performed exceptionally well in all the aforementioned criteria, and it was deemed excellent overall.

Comparison of alpha test and beta test results

Performing a comprehensive comparative analysis of the alpha and beta test results, considering various evaluation criteria, provides detailed insights into the evolving performance of the system. The alpha test result of 4.32 is marginally enhanced in the beta phase, reaching a score of 4.57. This refinement may signify the implementation of additional security measures, addressing potential vulnerabilities identified in the alpha testing phase. This suggests a continued emphasis on ensuring the product's seamless operation across diverse platforms and environments.

The results of the alpha and beta tests reveal a well-designed and meticulously tested system, with enhancements made to improve functionality, compatibility, usability, security, and portability.

Deployment

The completion of the web-based system was accepted by the capstone adviser, technical adviser, beta testers, alpha testers, and the board of panelists was achieved. With this, the researcher developed a web-based system that would be freely accessed and utilized at the domain repository website address of medismile.online.

DISCUSSIONS

Summary of findings

The objective of the study is to develop a web-based online appointment and monitoring system for the Pajarillaga-Castillo Dental Clinic. In creating a Web-based Online Appointment and Monitoring System, the researchers commenced with planning. After planning, the researchers carefully identified the features of the system. After identifying the features of the system, the researcher then identified the software, knowledge, and hardware requirements. To make the developing process easier and efficient the researcher use analysis tools such as a storyboard, use case diagram, and Website map. After developing the system the researchers then used Hostinger to deploy the system to its intended domain which is medismile.online to undergo testing.

For the alpha test, the evaluation process was extensive and concluded that the system was highly suitable for its intended purpose. The system's functional suitability, compatibility, usability, security, and portability criteria were thoroughly assessed and found to be equally and accurately achieved with a total rating of 4.32. On the other hand, the survey results for the beta test indicated that the system performed exceptionally well in all the criteria evaluated. The system's functional suitability, compatibility, usability, security, and portability criteria were thoroughly assessed and found to be equally and accurately achieved with a total rating of 4.57.

And for the results of a comparative analysis between the alpha and beta test phases of a system are presented. According to the results, the beta test phase outperformed the alpha test phase in all aspects, indicating a focused effort to address and enhance the identified shortcomings. The enhancements could be attributed to refined functionalities, bug fixes, or additional features that contribute to a more robust and user-friendly system. The system consistently exhibits a high level of performance across all evaluation criteria, indicating meticulous debugging, optimization, and design enhancements to ensure a versatile and interoperable product.

Conclusions

The objective of the study is to develop a Web-based online Appointment and Monitoring System for the Pajarillaga-Castillo Dental Clinic. The researchers identified the hardware and software requirements required to make the system by gathering data through research, interviews, and surveys. With the use of a storyboard, use case diagram and website map, the researchers were able to visualize the design and identify the flow of the process of the system, which makes the development process efficient and minimizes the tendency of errors.

The researchers accomplished the objective of making a user-level access front-end and back-end system for the two user accounts, the admin/secretary and the client account. The system also has the following features: making appointments online, real-time chat with the secretary for inquiries, a chatbot to answer frequently asked questions, social media hyperlinks, and dental health tips to provide clients with valuable information about their dental health hygiene.

All the objectives set for the project were achieved successfully. During the development process, the prime goal was to create an environment-friendly, socially beneficial, and economically viable solution, and the system has been able to deliver on all these aspects. The project team's hard work and dedication played a crucial role in accomplishing the set objectives. The system has been effective in promoting sustainable development, as evidenced by its achievement of the goals.

The system undergoes a developer test, alpha test, and beta test. The researchers evaluated the system using ISO 25010 criteria. The system is now on a virtual private server via Hostinger.

Based on the results of the survey conducted by the researchers, the system performed exceptionally well during both the alpha and beta testing phases. The system received an impressive overall score of 4.32 from the alpha test, indicating that it met the set requirements to a satisfactory level. Additionally, the system received an outstanding overall rating of 4.57 from the beta test, which is a testament to its exceptional performance. Following these results,

the researchers concluded that the system is an excellent solution that meets all the requirements.

When developing the system, the researcher came across some limitations. The researcher only made the system solely for the Pajarillaga-Castillo Dental Clinic and did not cover the implementation or integration of the system into the existing workflow of the clinic. The study did not encompass the development of a mobile application for the system, as it was only accessible through a web browser.

By doing this, the researchers were able to provide future researchers with valuable materials that can help them in their studies. Providing the Pajarillaga-Castillo Dental Clinic with this system lowers the dental clinic's operating expenses, enhances the result of the patient treatments, and reduces the dental clinic's paper usage. In addition to reducing wait times and increasing patient satisfaction, Pajarillaga-Castillo Dental Clinic was also able to enhance staff-patient communication.

The incorporation of an online dental appointment and monitoring system is a groundbreaking advancement in oral health care. This technology is more than just an appointment scheduling convenience; it is a paradigm change toward proactive, patient-centered dentistry. It revolutionizes the patient experience, encourages preventative treatment, and plots a path toward a more technologically sophisticated and patient-empowered future in dentistry by skillfully fusing accessibility with real-time monitoring.

RECOMMENDATIONS

The web-based system development has highlighted several significant areas that require consideration and improvement based on the findings and insights gathered throughout the system's development.

One of the significant improvements that future researchers need to look forward to is developing a mobile application for the web-based system because, not every user has a computer or the ability to use a computer, developing a mobile application for the web-based application increases the usability and portability of the system. Also use monitoring tools to continuously monitor system health, user interactions, and application performance. Utilize analytics to learn from real-time data and continuously enhance the application. In addition, enhance the feature set, and keep innovating by adding new features and functionalities in response to user feedback. Give attention to features that maintain the application's simple use and simplicity while bringing significant value to users. Lastly, implement a feature that automatically sends email notifications to customers regarding any new promotions, discounts, or special offers that the business may have.

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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.

REFERENCES:

[1] D. Vaughan, “How Digital Dental Technology Benefits Our Patients | Bellaire, TX,” Contemporary Dental, Mar. 29, 2021. https://contemporary-dental.com/2021/03/how-digital-dental-technology-benefits-our-patients (accessed Mar. 26, 2023).

[2] “Dental Equipment | Dentalcompare.com,” Dentalcompare.com, 2017. https://www.dentalcompare.com/Dental-Equipment/ (accessed Mar. 26, 2023).

[3] F. Bagheri, F. Behnam, Z. Galavi, and L. Ahmadian, “The use of various appointment systems among patients visiting academic outpatient centers in Kerman and the evaluation of patients’ perspective and satisfaction,” BMC Health Services Research, vol. 22, no. 1, Nov. 2022, doi: https://doi.org/10.1186/s12913-022-08635-6.

SanRafael: A Web-Based Appointment and Payment System of San Rafael Arkanghel Parish

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ABSTRACT

The capstone project, "SanRafael: A Web-Based Appointment and Payment System of San Rafael Arkangel Parish," aims to improve church services by creating an online appointment and payment system. This system streamlines transactions, simplifies payment processes, and reduces time and effort for Parishioners and staff. Aligned with Sustainable Development Goals 8, 9, and 10, it focuses on economic growth, industry innovation, and reduced inequalities. Following the Modified Waterfall Methodology, the researchers iteratively developed the system, emphasizing continuous improvement through feedback loops. Alpha and beta evaluations showcased exceptional performance in Functional Suitability, Compatibility, Usability, Security, and Portability, with consistently high scores across all dimensions. In conclusion, both evaluations highlight the system's effectiveness in meeting functional requirements, ensuring security measures, offering easy portability, and demonstrating good compatibility and usability. The project contributes to church efficiency, productivity, and positive user experience, emphasizing the importance of technology in enhancing traditional service processes.

Keywords
San Rafael Arkanghel Parish, Church Services, Appointment System, Payment Processing, Church Efficiency, Modified Waterfall Method, Sustainable Development Goals (SDGs), ISO25010

INTRODUCTION

Online appointment systems, also known as schedulers or accessible software, provide a convenient way for users to make appointments, reducing wait times and enhancing efficiency for organizations, governments, retail, and small businesses. Accessible through various devices, these systems enable secure reservations and requests, contributing to the widespread impact of technology, with 72.1% of the Philippines' population using technology and the internet in 2023 [1]. The printing press revolutionized information dissemination, increasing literacy and access to religious studies. Radio connected remote Americans to country and religion, transitioning to television. Today, the internet and gadgets facilitate knowledge transmission, but also challenge traditional beliefs, reducing religious adherence. New interpretations have diversified and individualized religions, and as technology evolves, so will the ways believers express their faith [2].

Modern technology has significantly influenced how people acquire religious knowledge, practice their faith, and engage with others of different beliefs. Religious organizations offer online services and prayer groups, fostering connectivity. Social media serves as a platform for religious expression and debate. The majority of organizations utilize websites or applications for advertising and enhanced client accessibility. Web-based scheduling has shown positive impacts on parameters like decreased staff labor, shorter wait times, and increased satisfaction, despite challenges related to cost, flexibility, safety, and integrityThe researchers developed a web-based appointment and payment system for San Rafael Arkanghel Parish, streamlining church services. This system simplifies online transactions, reducing effort and time for both Parishioners and staff. By eliminating the need for cash or checks, it speeds up payment processes, enhancing overall efficiency and capacity. Automation of appointment and payment processing boosts church service efficiency, enabling staff to focus on essential tasks [3].

Background of the study

San Rafael Arkanghel Parish was founded on May 24, 1993, in Mabiga, Mabalacat City, Pampanga. Father Rolando Q. Lopez currently leads San Rafael Arkanghel Parish with Mr. Dennis Urbano, the

secretary of the church office, San Rafael Arkanghel Parish is one of Pampanga's catholic churches. It provides various services, including weddings, baptisms, funeral masses, and mass intentions, the church currently relies on a manual appointment system, requiring parishioners to visit the office during specific hours. The process is time-consuming, leading to confusion and waiting times. To address these challenges, the researchers developed an online appointment and payment system for the church, allowing parishioners to schedule and pay for services, enhancing organization and efficiency. Citing a study by Onyefulu et al., satisfaction with online scheduling systems is evident. The study aims to tackle challenges faced by church staff, including long wait times and miscommunications. Implementing an appointment system can alleviate these issues, benefiting both staff and parishioners. The research highlights the potential advantages, such as improved time management and member satisfaction [4]. This study provides valuable insights into the use of appointment and payment systems in a Catholic community, emphasizing improved satisfaction and church efficiency. It demonstrates how technology can enhance traditional processes and foster dialogue and cooperation within religious contexts.

General objective

The general objective of this study is to develop an effective appointment and payment system for the church's services that allows parishioners to easily plan the desired masses and assists parish administration in managing requests and scheduling masses in a timely and orderly way.

Specific objectives

Specifically, the website aims the following:

- To gather information and rules of the church services from:
    - San Rafael Arkhanghel Parish;
    - Journals;
    - Books;
    - Related system; and
    - Related studies;
- To develop a system using the following software and tools.
    - Visual Studio Code;
    - XAMPP;
    - MySQL; and
    - Adobe Photoshop;
- To develop a system that has the following specific features;
    - Direct Bubble Chat
    - LiveStream
    - Appointment of Parish services
    - Payment through PayPay and GCash
- To evaluate the mobile application using the following ISO 25010 criteria:
    - Functional Suitability;
    - Compatibility;
    - Usability;
    - Security; and
    - Portability.

Scope and limitation of the study

The study aims to create a web-based appointment and payment system for San Rafael Arkanghel Parish, streamlining services like weddings and baptisms. Using a desktop computer with specified tools, the researchers employed the modified waterfall method, including alpha and beta testing for functionality, compatibility, and security. The system caters to the Catholic community in Mabalacat City, Pampanga, providing a convenient solution for scheduling and payments.

Appointment process - Parishioners log in to the church website to access the 'Services' tab for appointment scheduling. They select the desired service, provide necessary information, choose a date and time, and proceed to payment through PayPal or GCash. After payment, the church secretary reviews and approves the appointment, notifying the Parishioner via email. Only PayPal and GCash are accepted; bank transfers are not available. Declined appointments prompt immediate email notification to Parishioners. The website mandates administrative login for overseeing user that is being requested appointments, validating information, and managing payments. The administrator verifies appointment details, enforces limits, and has authority over website content updates, including 'About Us,' service limits, and online masses information [5].

Significance of the study

The significance of the study of the study indicates who would have the benefit of developed application. The following beneficiary are:

Global Context

Parishioners favor the church's online system for its speed and efficiency, reflecting the broader acknowledgment that technology enhances accessibility globally. This highlights the need for institutions to adapt and innovate to meet evolving community expectations in a global context.

Economic Context

The system boosts the local economy by simplifying Mass intention scheduling, attracting more attendees to religious services. This increased support fosters positive social and economic impacts

in the community and contributes to the growth of religious institutions, enhancing overall well-being.

Environmental Context
The system positively impacts the environment by digitizing transactions, eliminating manual reports for admin, and reducing paper usage in interactions between users and parish officials.

Societal Context
The system boosts community access to religious services, fostering involvement and social connections. It aids organizations in optimizing scheduling and improving client services.

Data Dictionary
Religious Services – These are all the activities of the church including the baptism, requesting a baptismal certificate, wedding, special blessing, funeral mass, and mass intentions such as the soul, special intention, thanksgiving, birthday and others [6].
Payment System - Both non-cash and cash money are used by customers, businesses, and governments. The payment system of the church such as the GCash to pay on desired payment [7].
Parishioners - Parishioners who attend the church in catholic and book services on the Catholic Church at San Rafael Arkanghel Parish.
Web-based system - As long as it has a browser and an internet connection, it may be used on any platform and open the system. Because of this, it is often known as browser based [8].

Conceptual framework

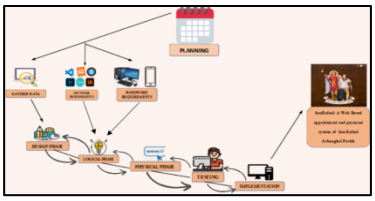

Figure 1: Conceptual Framework

The Conceptual Framework outlines the researchers' method for building the project. In the planning stage, community concerns were gathered, and a roadmap for developing a religiously based appointment and payment system was created. The data-gathering phase involved visiting San Rafael Arkanghel Parish, using questionnaires, interviews, and observations. Software requirements include XAMPP and MySQL for the database, visual studio code for the framework, and design tools like Adobe Photoshop. Hardware requirements include a computer and a smartphone for testing.
The process phase includes design, logical, physical, and implementation stages. Design uses gathered data as a blueprint, the logical phase focuses on system functionality, the physical phase implements the user interface, and implementation ensures the system functions, integrates, and undergoes testing and debugging.
In the final phase, a fully operational system is produced. Parishioners can access the website for services and appointments, enhancing convenience, transparency, and efficiency. The system, accepting PayPal and GCash, features automated reminders and facilitates reporting and data analysis, offering cost savings and adaptability. The website outcome facilitates consumer convenience, simplify processes, and boost efficiency. With automated reminders, it guarantees financial transparency, provides secure transactions. In addition to being adaptable, the system facilitates reporting and data analysis and enhances the user experience. Its benefits—which include cost savings, system integration, and flexibility to accommodate changes—highlight its modern and effective approach to appointment scheduling and payment

METHODOLOGY

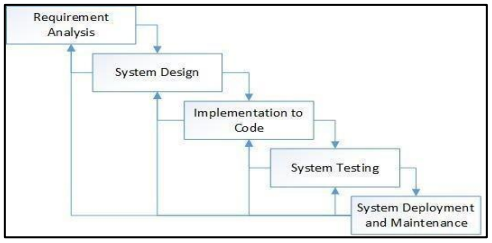

Figure 2: Modified Waterfall Method

This methodology explains the technique and design that was used to construct the study parameters and development process. There are also different kinds of diagrams to further explain the flow and the design of web-Based appointment and payment system of San Rafael Arkanghel Parish throughout the process of the system from planning to implementation. The researchers used a method called the Modified Waterfall Method. The traditional waterfall model is improved by using the modified one instead. This model incorporates feedback loops between each step of the software development process. Iterations are used for each phase of development in this model, with the primary focus of each iteration being on creating a specific feature or capability. Before moving on to the next iteration, the results of each iteration's work are analyzed and assessed. This step makes it possible for feedback and improvements to be included in the development process.

Requirement Analysis
The researchers gathered ideas for the church's appointment and payment system by conducting internet and library research. They collaborated with advisers, Ms. Dessa Lyn J. De Castro and Mr. Dennis Tacadena, for guidance. Information was collected online from academic sources and governmental websites to define problems and system requirements. Additionally, the researchers visited San Rafael Arkanghel Parish to understand the church's needs and gathered information on services and prices. Interaction with the church secretary, Mr. Dennis Urbano, provided insights into the concerns of the staff and Catholic community.

Table 1. Development Software and Hardware Specification during development and testing system.

Hardware Requirements	**Software Requirements**
Computer	Visual Studio Code
Ryzen 5 2600 16 GB Memory	XAMPP
4 GB Video Ram	MySQL
500 GB Hard Disk or the SSD of the Computer	PHP/JavaScript and Adobe Photoshop/Illustrator

System Design
The researchers used the following analysis tools and diagrams: Use Case diagram, ERD, data flow diagram, visual table of contents, and storyboard diagram.

Implementation
The researchers developed the web-based appointment and payment system for San Rafael Arkanghel Parish, utilizing tools like Adobe Photoshop, Illustrator, and sketchbooks for design. Visual Studio Code, XAMPP, MySQL, HTML, CSS, and PHP were used for front-end and back-end programming to ensure the system's overall functionality.
The website features online masses accessible on the home page, a direct bubble chat for inquiries, and an appointment system requiring user registration. Users can choose services, provide necessary details, and select a date based on the church's schedule. Payment options include PayPal and GCash, with users receiving payment receipts. Once the process is complete, Parishioners can physically attend the scheduled service on the chosen date.

System Testing and Evaluate
The method for gathering the data is purposive sampling method The study utilizes non-probability sampling to choose 30 participants exclusively from the Catholic community of San Rafael Arkanghel Parish in Mabiga, Mabalacat City, Pampanga. In the testing phase, the researchers adopted a questionnaire based on ISO25010.
Alpha testing, conducted by IT experts Mr. Edmond O. Yumang, Mr. Jave Ryan Reyes, and Mr. Louis Jannero R. Baclao, ensured the website's functionality, security, and user experience before its public launch. Beta testing, conducted after alpha testing, involves evaluating the website's functionality, compatibility, usability, security, portability, and performance by a diverse group of users. Testers follow specific instructions, providing feedback to developers for further improvements before the public release.
The data to be collected would be compiled and analyzed so conclusions can be derived. Frequency Count would be utilized to determine the number of responses. The results from the Likert's Scale would be used to find out the overall assessment of the respondents (see Table 2).

Table 2: Likert's Scale

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

System Deployment and Maintenance
The web-based appointment and payment system is deployed on the client's server for live evaluation which is the web hosting site is the Hostinger. Once implemented, end users can access it through web browsers on various devices. Real-time user training is conducted to highlight system advantages and report bugs or areas for improvement. Ongoing support and maintenance are provided to address any issues encountered by clients and users during product use.

RESULTS
This chapter thoroughly examines the study's results, detailing the comprehensive procedure used to achieve the main objective. Examination of functionality, design, development, and testing phases of the proposed web-based system.

Alpha Test Results
ISO 25010 was used for evaluation. Face-to-face survey questionnaires gathered feedback from 3 alpha testers, ensuring the system met set criteria.

The collected alpha tester feedback was tallied to evaluate the outcomes of the overall results:

Table 3. Summary of Alpha Test Results

Criteria	Weighted mean	Interpretation
Functional Sustainability	4.93	Excellent
Compatibility	4.81	Excellent
Usability	4.88	Excellent
Security	4.91	Excellent
Portability	4.94	Excellent
TOTAL MEAN	4.55	Excellent

Table 3 summarizes the system's performance evaluation in Functional Suitability, Compatibility, Usability, Security, and Portability. Verbal feedback consistently rates the system as 'Excellent' in all areas, with outstanding mean scores: 4.93 for Functional Suitability, and high scores of 4.81, 4.88, 4.91, and 4.94 for Compatibility, Usability, Security, and Portability, respectively. These results highlight the system's strong performance in meeting functional requirements, seamless cross-platform operation, user-friendliness, enhanced security, and easy portability.

Administrator Test Result

The researchers worked closely with the church secretary, addressing system administrator needs for church operations. Feedback from alpha testers was actively incorporated, refining the system iteratively. Before beta testing, the system was presented to the church secretary, ensuring alignment with specific administrative needs and emphasizing a commitment to a seamlessly integrated system. This pre-beta phase served as a vital checkpoint for adjustments and refinements before broader testing.

Table 4: Administrator Testing Results

Criteria	Weighted mean	Interpretation
Functional Sustainability	5	Excellent
Compatibility	5	Excellent
Usability	4.8	Excellent
Security	5	Excellent
Portability	5	Excellent
TOTAL MEAN	**4.96**	**Excellent**

Table 4 affirms the system's exceptional performance, receiving the highest rating of 'Excellent' in all areas, with outstanding scores in functionality suitability, security, and portability. The high overall mean score highlights the system's ability to meet functional requirements, ensure robust security, and maintain excellent compatibility and user-friendly design across diverse platforms.

Beta Test Results

The researchers used ISO 25010 for evaluation. Face-to-face survey questionnaires gathered feedback from 30 respondents, ensuring the system met set criteria. Collated respondent feedback was tallied for the evaluation of beta test outcomes, yielding the following results:

Table 5: Beta Test Results

Criteria	Weighted mean	Interpretation
Functional Sustainability	4.63	Excellent
Compatibility	4.06	Good
Usability	4.08	Good
Security	4.54	Excellent
Portability	4.39	Excellent
TOTAL MEAN	4.34	Excellent

Table 5 provides a comprehensive overview of the system's performance in Functionality Suitability, Compatibility, Usability, Security, and Portability. Verbal feedback consistently rates the system as 'Excellent' in all areas, with Functionality Suitability leading with a mean score of 4.63. Security and Portability follow closely with scores of 4.54 and 4.39, both categorized as 'Excellent.' Compatibility and Usability receive 'Good' ratings with scores of 4.06 and 4.08, respectively. These results collectively highlight the system's ability to meet functional requirements, provide robust security, offer easy portability, and maintain good compatibility and usability across various platforms.

Comparison and summary of alpha and beta results

Comparing alpha and beta evaluations reveals that the system consistently excels across Functional Suitability, Compatibility, Usability, Security, and Portability. While both assessments indicate 'Excellent' ratings, the alpha evaluation tends to score slightly higher, particularly in Functional Suitability, Security, and Portability. The system's outstanding mean score of 4.93 in Functional Suitability during the alpha assessment is noteworthy. Overall, both evaluations reinforce the system's effectiveness in meeting requirements, ensuring security, offering easy portability, and demonstrating good compatibility and usability across platforms.

System Implementation Result

Home Page

Figure 3: Home Page

Live Stream

Figure 4: Live Stream

Past LiveStream's

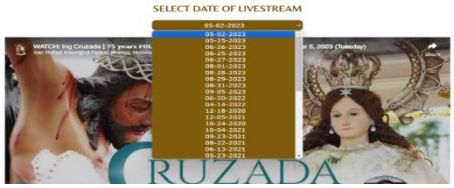

Figure 5: Archive of Past Live Stream

Services Tab

Figure 6: Services Tab

Services Request Form

Payment processing

Figure8: Payment Tab

E-bibble

Figure 9: E-Bibble

Chat Bubble

Figure 10: Chat Bubble Message

Admin Dashboard and Side Menu

Figure 11: Admin Dashboard

DISCUSSIONS

Summary of findings

The researchers evaluated the web-based appointment and payment system for San Rafael Arkanghel Parish, aiming to enhance online engagement with church services. Alpha testing with 30 Catholic respondents showed consistently high ratings in Functional Suitability (4.93), Compatibility (4.81), Usability (4.88), Security (4.91), and Portability (4.94). Pre-beta testing aligned the system with administrative needs, resulting in an excellent rating (4.96). Beta results maintained high scores in Functionality Suitability (4.63), Security (4.54), and Portability (4.39), with slightly lower scores in Compatibility (4.06) and Usability (4.08). Overall, the system earned an excellent rating (4.34), confirming

its efficacy in fulfilling requirements and improving church efficiency.

Conclusion

The capstone project began with comprehensive research and planning, involving the exploration of academic articles and collaboration with San Rafael Arkanghel Parish. The team identified the need to improve church services and decided to develop a web-based appointment and payment system. The primary objective was to enhance efficiency by automating processes, reducing reliance on physical currency, and introducing features like online transactions, a bubble chat for parishioners, and a live stream Mass option. Despite challenges in integration and time constraints, the team successfully addressed these issues, delivering an effective web-based system. The project's success highlights the commitment to innovation and problem-solving, emphasizing the importance of understanding community needs. The implemented solution not only streamlines payment processing but also contributes to the overall improvement of church services for the San Rafael Arkanghel Parish community.

REFERENCES

[1] Kemp, S. (2023, February 8). Digital 2023: The Philippines - datareportal – global digital insights. DataReportal. Retrieved May 1, 2023, from https://datareportal.com/reports/digital-2023-philippines?fbclid=IwAR2XCGhGHiHlT6AvwmerxCVpLaAS50GCWl_-s77YkQBV7nypKaNevHcJstA#:~:text=Internet%20use%20in%20the%20Philippines%20in%202023&text=The%20Philippines's%20internet%20penetration%20rate,at%20the%20start%20of%202023

[2] Frederica, S. (2011, April). Index navigation. Brescia University. Retrieved May 8, 2023, from https://www.brescia.edu/2013/08/how-technology-is-transforming-religion/

[3] Zhao, P., Yoo, I., Lavoie, J., Lavoie, B. J., & Simoes, E. (2017, April 26). Web-based medical appointment systems: A systematic review. Journal of medical Internet research. Retrieved May 1, 2023, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5425771/?fbclid=IwAR373nuDX3lJZjiEnD_R68dmQKkxm24fnCCKGnGOK5mHKnldaof8ofe0LAQ

[4] Vatican. (2021, March 22). The holy see. Vatican.va. Retrieved May 7, 2023, from https://www.vatican.va/content/vatican/en.html?fbclid=IwAR0fsYdiBGIGfG3_jfljbGPstvbS1f9wbyzlDWLk2ABuAnPRH7nrABTd5Xg

[5] Collins. (2023). Parishioner definition and meaning: Collins english dictionary. Parishioner definition and meaning | Collins English Dictionary. Retrieved May 1, 2023, from https://www.collinsdictionary.com/dictionary/english/parishioner

[6] Thamrin, D. (2020, June 3). Appointment scheduling system: What you need to know. appointment-scheduling-solution-what-how-and-why. Retrieved May 1, 2023, from https://www.qmatic.com/blog/appointment-scheduling-solution-what-how-and-why

[7] Denetherlandschebank. (2023, May 1). How do payment systems work? De Nederlandsche Bank de centrale bank van Nederland. Retrieved May 1, 2023, from https://www.dnb.nl/en/payments/how-do-payment-systems-work/

[8] Laura, A. (2023, March 23). What is a web-based application, software, app, and System. What is a Web-Based Application, Software, App, and System. Retrieved May 1, 2023, from https://mockitt.wondershare.com/app-design/web-based-application.html

VOUPRO: Mabalacat City's Accounting Office Voucher Processing and Monitoring System

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ABSTRACT

The Mabalacat City Accounting Office is struggling with the processing and monitoring of vouchers, which require credibility and careful processing. Google Sheets is currently used as the main logbook and storage for data in all processed vouchers. This study aims to provide a web-based system that addresses the deficiency of Google Sheets. The researchers used a modified waterfall model in the software development life cycle (SDLC) to develop VOUPRO: Processing and Monitoring system, a web-based system that allows users to process and monitor vouchers. VOUPRO also protects user data and information through a time password (OTP), with two types for verifying emails and forgetting passwords. The system has high results in Functional Suitability, Portability, Security, and Usability. However, future researchers suggest that the VOUPRO web-based system needs a centralized approach to enhance efficiency and coordination. The VOUPRO system serves as a new platform for the Mabalacat City accounting office in effectively processing and monitoring

General Terms

Voucher, VOUPRO, Web-based System, Monitoring System

INTRODUCTION

A voucher system is a valuable tool for government or non-profit organizations to implement social welfare programs, offering benefits such as increased income, consumption, expenditure, asset accumulation, and improved health outcomes. Vouchers are redeemable documents that can be used in various sectors, including airlines, hotels, restaurants, companies, and governments. The voucher system requires approval from certain businesses and is designed to cater to the needs of individuals who will benefit the most, such as those living in isolated areas, rural areas, or poverty.

The voucher system's management and administration should be recorded to expand the repository of knowledge supporting efficient methods. It is essential to consider the community's environment when designing, implementing, and evaluating voucher systems based on specific objectives. Community service online vouchers are an example of a government platform that pays online vouchers to customers and provides them with the option of services.

A voucher system is an internal accounting control method that ensures all transactions involving disbursements are appropriately documented and accompanied by sufficient supporting evidence. It includes various documents and controls to oversee and regulate organizational procedures. By adopting a voucher system, an organization can ensure complete control and peace of mind regarding cash disbursements due to its sequential procedure and clear division of work.

The digital voucher process offers several advantages for providing efficient work in an accounting office, automating the voucher creation process, streamlining user distribution, and providing fast, easy access to auditors by bringing all documentation into one secure online location with access controls and a reliable audit trail.

The person in charge of preparing the voucher must print its full name, date it was made, and signature. The signed voucher and accompanying documents

are sent for inspection and approval. The owner, treasurer, or other authorized person reviews the voucher and accompanying documentation for legitimacy and completeness before returning the voucher to the preparer for payment and any supporting documentation.

The Government Disbursement Voucher serves as a crucial financial instrument facilitating transactions related to voucher services and company expenditures. To streamline this process, individuals seeking reimbursement must obtain prior approval from the accounting department of the Municipality of Mabalacat City.

The integration of the VOUPRO: Processing & Monitoring System optimizes the efficiency of voucher management, enabling stakeholders to seamlessly navigate through the voucher lifecycle from submission to approval. The Mabalacat City Accounting Office's Pre-Audit Section plays a pivotal role in expediting the approval process, providing a transparent

General Objective

The general objective of the study is to develop the system entitled "VouPro: Mabalacat City's Accounting Office Voucher Processing and Monitoring System." a web-based system that manage vouchers for accounting office of the Mabalacat City Municipal Hall.

Specific Objectives

The following are the specific objectives of the study:

- To gather data through online and physical interview, online research of articles, and using books.
- To identify the software and hardware requirements.
- To design the system using using the following tools:
    - Use Case Diagram
    - Entity Relationship Diagram
    - Data Flow Diagram
    - Visual Table of Contents
    - Storyboard
- To develop Front-end and Back-end interface of the system using the following
    - Front-End
        - Visual Studio (VS) Coduim
        - Vite.js
        - JavaScript
        - CSS3
        - HTML5
        - Github
    - Back-End
        - Laravel 10
        - Identity and Access Management
- To test the system using the created test cases that have criteria based on ISO 25010.
- To deploy the system using web hosting site and turn over the system to Accounting office of the Mabalcat City Municipal Hall.

Scope and Limitation

The study aimed to create a dedicated system called "VOUPRO: Mabalacat City's Accounting Office Voucher Processing and Monitoring System" for the Pre-Audit, Encoder, Document Representative, Post-Audit, and Releasing Sections of Pre-Audit in Mabalacat City Municipal Hall of Pampanga. The system was developed using trusted data and software, including Visual Studio, JavaScript, My SQL, Node JS, Adobe Dreamweaver, and Adobe Photoshop. The system was designed using UCD, Data Flow Diagram, Entity-relationship Diagram, and Visual Table of Contents. The admin can register users, manage accounts and sections, and manage the roles of each section.

The admin can register users, manage accounts and sections, and manage the roles of each section. Unit tests were conducted to verify the system's functionality, and feedback from pre-audit users was collected. The system was implemented using a MySQL database and features such as consultation Dashboard, login and home pages, and a forum page. The system's functionality, security, and user experience are crucial for its success.

METHODOLOGY

Chapter III details the system design, software development methods, testing procedures, implementation strategy, outcomes, and requirements for the system's creation. It also includes the Modified Waterfall Model as the study methodology, showcasing the necessary steps for the system's creation.

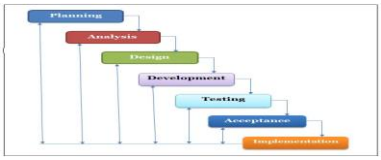

Figure 3. Shows the Modified Waterfall Model of the Voucher Processing and Monitoring System according to Bishal Napit.

SDLC

The Systems Development Life Cycle (SDLC) is a project management framework that outlines the phases of an information system development project, from feasibility study to ongoing maintenance. Researchers used the Modified Waterfall Model for system development, which incorporates validation or verification between phases for prompt correction and customer satisfaction. The SDLC includes planning, analysis, design, development, testing, and implementation, with input at each level. This approach is considered the best strategy for the Software Development Life Cycle.

Requirements

The requirement analysis phase involved defining the system's functions and boundaries, assigning responsibilities to each feature, and creating a Gantt chart for planning. System information diagrams were validated against requirements. The requirement analysis phase involved defining the system's functions and boundaries, assigning responsibilities to each feature, and creating a Gantt chart for planning. System information diagrams were validated against requirements. The UCD identified potential use cases, including face-to-face interactions between researchers and employees.

System information diagrams were validated against requirements. The UCD identified potential use cases, including face-to-face interactions between researchers and employees. The head department approved all users, while admins and service heads managed approved users. A VTOC was created to show the initial layout of pages, allowing users to log in, add employees or students, initiate consultations, and update fields. Admins, service heads, and deans managed users, roles, and departments.

Design

The development team will utilize tools like the Gantt chart, Storyboard, and game menu tree to showcase Web-based functionality throughout the design process. The Storyboard serves as a roadmap for users, while the Web menu tree and Storyboard provide guidelines for initial iterations. Adobe Dreamweaver will be used to build website prototypes for images from the login page. The Gantt chart will display the system development tasks completed by each team member, ensuring a clear understanding of the system's functionality and flow.

Development

The VouPro: Mabalacat City's Accounting Office Voucher Processing and Monitoring System was developed through several phases, including planning, requirements analysis, design, development, testing, acceptance, and implementation. The system was developed in close collaboration with software engineers and underwent frequent testing and quality assurance checks. The system has several components to enhance effectiveness and precision, including an interface for data entry, automatic error-prevention validation checks, and the ability to produce reports as needed. It also has the ability to trace changes to data over time and strong security measures to protect critical voucher information.

The VouPro system has been a valuable tool for the Pre-Audit Section of the Mabalacat City Accounting Office, increasing productivity and reducing mistakes by simplifying the recording and tracking of voucher documents. It has also simplified the process of producing reports on demand, providing key details about the Pre-Audit Section. The accuracy and openness of voucher reporting have improved overall with the VouPro system.

Testing

The system's alpha testing was conducted using scenarios based on advocates and ISO25010. The system's suitability, usability, and portability were assessed by various team members and staff. The demographics of respondents were used to create a fair department policy. During the beta testing phase, the system's supporters used a user acceptance questionnaire to determine if it met the needs of department heads. The system was reviewed by end users using a questionnaire provided by the researchers. The grading system used ranged from 1 to 5, with 5 indicating "Excellent," 4 "Very Good," 3 "Good," 2 "Fair," and 1 "Poor."

The pre-audit division of Mabalacat City's accounting office implemented a voucher processing system, which improved the handling of voucher data.

The technology made it easier to store and access documents, allowing for faster audits. Employees accepted the system, showing encouraging results in reducing errors and enhancing the voucher processing system. The system technology has positively impacted both employees and users, allowing the office to enhance its services and provide better public accountability after adopting the method.

Implementation

The implementation stage involves the researcher's development team turning the intended diagrams into functional apps. Review the characteristics of the system.

Data Analysis

Data Analysis is employed with descriptive statistics. To determine the places where the data are placed as well as the spread and dispersion of the data, descriptive statistics summarized the data.

The following statistical procedures were employed to reduce the amount of data:

The study utilized the frequency distribution to show how many instances fell into each score range. The results of the respondents' demographic profile were categorized into step intervals, each of which comprised a collection of contiguous potential results. Many categories are assigned to a variable with values that represent the cases' order. The frequency was determined by counting the cases under each group.

The mean, also known as the average or estimated center value of a group of numbers, is used to determine the data's central tendency. The statistician's definition of the mean formula for a set is the sum of the observations divided by the total number of observations. The mean formula may be written as Mean = (Sum of data) (Total Numbers of Observations) for a collection of provided data.

$$\bar{x} = \Sigma fx / \Sigma f$$

where,

$\bar{x}$ = the mean value of the set of given data.

f = frequency of each class

x = mid-interval value of each class

The Likert scale is a rating system employed in surveys intended to gauge respondents' attitudes, views, or impressions. The researchers used the Likert scale to translate the results into the respondent's appropriate verbal interpretations following the computation of each mean score for each survey instrument, sub-criteria, and criteria.

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

Table 4. 5-point Likert Scale - level of agreement

Maintenance

Verification is completed before moving on to maintenance. In maintenance stage are involved with deploying and publishing the web-based application onto the Web market repository site. Maintenance stage would serve as a channel for customers or staff members to report errors or areas that require improvement to improve the produced web application. Potential users can browse the repository hosting website during project deployment and mark the Web-based as exclusively available for Desktop devices, which would allow user to download it. With the help of the repository hosting website, the Web-based application has been promoted and distributed for deployment. A summary statistic on the website that hosts the repository might help the researcher's maintenance team determine the exact figures relating to Web-based application installs and ratings. The researchers may also find it beneficial to keep track of the different Web platforms that the Web application supports.

RESULTS

Software Requirements

During the development process, the developer utilized several software development tools that are open source and compatible with the system and the developer used Laravel framework as version 10. The developer also used other software to develop the system (as seen in APENDIX X, APENDIX X, APENDIX X). The developer utilized designing tools such as ADOBE DREAM WEAVER and ADOBE PHOTOSHOP. It requires Microsoft Windows 7, 10, and 11. To view the details, see APENDIX X.

Hardware Requirements

Figure 4. Hardware Requirements.

The hardware requirements for developing and for deploying the system are Intel(R) Core (TM) i5-7400 CPU @ 3.00GHz for processor, 8.00 GB for memory, 256 GB for Solid State Drive or SSD, 64-bit operating system that also includes x64-based processor in System Type of the Desktop.

Testing Result Prototype

The web-based system was tested using a questionnaire based on ISO25010 criteria, creating a fair policy for future analysis. The Alpha Tester assesses the system's functionality, portability, usability, and security, identifying and reporting errors and bugs.

The Beta Tester tests before deployment, ensuring the system is suitable and user-friendly. After testing, the Beta Tester conducts questionnaires to assist developers in fixing errors and bugs. This comprehensive testing process ensures the system meets ISO 25010 requirements.

Table 2. Composition of Respondents by Gender

Gender	Percentage of Respondents
Male	48%
Female	52%
LGBTQIA+	0%

The table displays the gender composition of the respondents, with 12 males and 13 females, totaling 25 respondents who answered the questionnaire.

Table 3. Composition of Respondents by Job Position

Job Position	Percentage of Respondents
ENCODER	4%
DOCUMENT REPRESENTATIVE	40%
PRE-AUDIT	20%
POST-AUDIT	20%
RELEASING	8%
ADMIN	8 %

Table 4. Composition of Respondents by Age

Age	Percentage of Respondents
20 - 30	56%
31 - 60	44%

The table above shows the composition of respondents by Age. Fourteen (14) of the respondents are age between 20-30 and eleven (11) are age between 31-60.

Functional Suitability

Table 5. Results for Functional Suitability in Beta Testing

Test cases	Results
Functional Suitability	4.62%

The average score is 4.62

The system scored 4.62 on the Likert scale for Functional Suitability, indicating excellent suitability, with most functions executed accurately and producing suitable results.

Usability

Table 6. Results for Usability in Beta Testing

Test cases	Results
Usability	4.64

The average score is 4.64

The system scored 4.64 on the Likert scale, indicating excellent usability. It is user-friendly, simple, and easy to navigate, with ample error alerts to protect users from potential issues.

Table 7. Results for Portability in Beta Testing

Test cases	Results
Portability	4.62%

The average score is 4.62

The system scored 4.62 on the Likert scale, indicating excellent portability, making it adaptable to any web hosting environment and matching server and client-side situations.

Security

Table 8. Results for Security in Beta Testing

Test cases	Results
Security	4.69%

The average score is 4.69

The system scored 4.69 on the Likert scale, indicating excellent security. It performs most safety functions accurately and provides suitable outcomes, ensuring excellent safety and protection.

Table 9. Overall Average of the Beta Testing

Test cases	Results
Functional Suitability	4.62%
Usability	4.64%
Portability	4.62%
Security	4.69%
TOTAL	4.64%

The overall average of the system is 4.64.

The system scored 4.64 in beta testing, earning a Likert scale rating of "Excellent" due to its compatibility in functional suitability, portability, usability, and security.

Functional Suitability

Table 10. Results for Functional suitability in Alpha Testing

Test cases	Result
Functional Completeness	4.67
User-Level Entry	4.5
Functional Correctness	4.34
Functional Appropriateness	4.33

The average score is 4.42.

The system scored 4.45 on the Functional Suitability Likert scale, indicating excellent functionality, with most operations carried out and all functions providing precise and appropriate outcomes.

Compatibility

Table 11. Results for Compatibility in Alpha Testing

Test cases	Result
Integration	4.33
Compatibility	4.67

The average score is 4.42.

The system achieved an average compatibility score of 4.5, indicating excellent performance across multiple operating systems on internet-capable devices, indicating successful interactions with web browser apps.

Usability

Table 12. Results for Usability in Alpha Testing

Test cases	Result
Suitable and identity	4
Obtainability	4.17
Availability	4.45

The average score is 4.21.

The system scored 4.21 in usability, earning an "Excellent" rating for accessibility and learnability, demonstrating its ease of use, legibility, and clear error warnings.

Portability

Table 16. Results for Portability in Alpha Testing

Test cases	Result
Flexibility	5
Integrity	4.67

The average score is 4.84.

The system's portability score of 4.84 indicates its excellent performance, matching both server and client-side conditions and adapting to any web hosting environment.

Security

Table 17. Results for Security in Alpha Testing

Test cases	Result
Security	4.33

The average score is 4.33.

The system scored 4.33 on the Likert scale, indicating excellent security, with accurate and fitting results, demonstrating commendable safety and protection.

Test cases	Results
Functional Suitability	4.45
Compatibility	4.5
Usability	4.21
Portability	4.84
Security	4.33
TOTAL	4.47

The overall average of the system is 4.47.

The system achieved an overall average of 4.47 in alpha testing, earning a Likert scale rating of "Excellent" due to its functional suitability, compatibility, portability, usability, and security.

The system's Functional Suitability score in alpha testing was 4.45, while in beta it was 4.62. The system's Usability score increased slightly from 4.21 in alpha to 4.64 in beta. Portability improved from 4.33 in alpha to 4.69 in beta, and security improved from 4.33 to 4.69 in beta. Overall, the system's overall score was 4.47 in alpha and 4.64 in beta.

Comparison of Alpha and Beta testing overall result

Alpha testing	
Test cases	Results
Functional Suitability	4.45
Compatibility	4.5
Usability	4.21
Portability	4.84
Security	4.33
TOTAL	4.47
Beta testing	
Test cases	**Result**
Functional Suitability	4.62
Usability	4.64
Portability	4.62
Security	4.69
TOTAL	4.64

DISCUSSIONS

Conclusions

The researchers developed a web-based system for the accounting office, using diagrams to guide the development stage. The system includes admin and encoder roles for voucher input and modification, and pre-audit, post-audit, releasing, and document representative roles. The system was tested for functionality and compatibility with the accounting office. The system scored higher on Functional Suitability, Security, and Portability and Usability, with most respondents agreeing and rating it as "Excellent" based on the Likert Scale. The system was adaptable to any web hosting and easy to use, reducing the accounting office's workload.

Recommendation

The study suggests using voucher processing solutions to optimize workflow and improve decision-making. It recommends real-time monitoring capabilities and further research to minimize errors and shorten processing times. Implementation should prioritize user-friendly interfaces and system efficacy, taking feedback and practical testing into account. This aims to advance effective voucher procedures in accounting offices.

REFERENCES

[1] Hsu, C. S., Tu, S. F., & Huang, Z. J. (2020). Design of an E-voucher system for supporting social welfare using blockchain technology. *Sustainability*, *12*(8), 3362. [Online] Available:

https://www.mdpi.com/2071-1050/12/8/3362?ref=internetfreedom.in.

[2] Hager, T. G. (2022). *The Influence of Affordability and Affordable Care Act on Patients' and Veterans' Healthcare-Seeking Behaviors and Access to Healthcare*. University of Wisconsin-Whitewater. [Online] Available: https://minds.wisconsin.edu/bitstream/handle/1793/83826/TGHager_Dissertation_2022.pdf?sequence=1&isAllowed=y.

[3] Sharma, M., Batra, K., Batra, R., Dai, C. L., Hayes, T., Ickes, M. J., & Singh, T. P. (2022). Assessing the Testability of the Multi-Theory Model (MTM) in Predicting Vaping Quitting Behavior among Young Adults in the United States: A Cross-Sectional Survey. International Journal of Environmental Research and Public Health, 19(19), 12139. [Online] Available: https://www.mdpi.com/1660-4601/19/19/12139.

[4] Ali, M., Farron, M., Azmat, S. K., & Hameed, W. (2018). The logistics of voucher management: the underreported component in family planning voucher discussions. *Journal of multidisciplinary healthcare*, 683-690. [Online] Available: https://www.tandfonline.com/doi/full/10.2147/JMDH.S155205.

[5] Eo, G., & Nam, T. (2020). Activating Public Service Delivery Platforms: A Case of Social Service e-Voucher. *Journal of Digital Convergence*, *18*(7), 21-29. [Online] Available: https://koreascience.kr/article/JAKO202021741260887.page.

[6] *Smartsheet recipe | Dataprovider.com*. (n.d.). [Online] Available: https://www.dataprovider.com/recipes/smartsheet/.

[7] Gregersen, R., Maule, C. F., Bak-Jensen, H. H., Linneberg, A., Nielsen, O. W., Thomsen, S. F., Meyhoff, C. S., Dalhoff, K., Krogsgaard, M., Palm, H., Christensen, H., Porsbjerg, C., Antonsen, K., Rungby, J., Haugaard, S. B., Petersen, J., & Nielsen, F. E. (2022b). Profiling Bispebjerg Acute Cohort: database formation, acute contact characteristics of a metropolitan hospital, and comparisons to urban and rural hospitals in Denmark. *Clinical Epidemiology*, *Volume 14*, 409–424. [Online] Available: https://doi.org/10.2147/clep.s338149.

[8] Moore, L. (2018, July 31). *MySQL*. SearchOracle. [Online] Available: https://www.techtarget.com/searchoracle/definition/MySQL.

[9] Delcev, S., & Draskovic, D. (2018, May). Modern javascript frameworks: A survey study. In *2018 Zooming Innovation in Consumer Technologies Conference (ZINC)* (pp. 106-109). IEEE. [Online] Available: https://ieeexplore.ieee.org/abstract/document/8448444.

[10] White, E. (2023, May 2). *Why should you use PHP frameworks for web development?* Stackify. [Online] Available: https://stackify.com/why-should-you-use-php-frameworks-for-web-development/.

[11] Gillis, A. S., & Casey, K. (2022, June 30). *DigitalOcean*. Cloud Computing. [Online] Available: https://www.techtarget.com/searchcloudcomputing/definition/DigitalOcean.

[12] S, A. (2023, August 25). *What is HTML? Hypertext Markup Language Basics explained*. Hostinger Tutorials. [Online] Available: https://www.hostinger.ph/tutorials/what-is-html.

[13] Juviler, J. (2022, October 31). What Is GitHub? (And What Is It Used For?). *What Is GitHub? (and What Is It Used For?)*. [Online] Available: https://blog.hubspot.com/website/what-is-github-used-for.

[14] Heller, M. (2022, July 8). *What is Visual Studio Code? Microsoft's extensible code editor*. InfoWorld. [Online] Available: https://www.infoworld.com/article/3666488/what-is-visual-studio-code-microsofts-extensible-code-editor.html.

[15] *Introduction to ViTE - next generation frontend tooling - This Dot Labs - This Dot Labs*. (n.d.). This Dot Labs. [Online] Available: https://www.thisdot.co/blog/introduction-to-vite-next-generation-frontend-tooling/.

[16] Mittal, T. (2021, December 14). CSS: Cascading Style Sheets - EduCipher - Medium. *Medium*. [Online] Available: https://medium.com/educipher/css-cascading-style-sheets-b9706e77224.

[17] Northover, M., Kourie, D. G., Boake, A., Grüner, S., & Northover, A. (2008). Towards a Philosophy of Software Development: 40 Years after the Birth of Software Engineering. *Journal for General Philosophy of Science*, *39*(1), 85–113. [Online] Available: https://doi.org/10.1007/s10838-008-9068-7.

[18] Robert.Wickramatunga. (n.d.). *Sustainable Development Goal 9: Industry, Innovation and infrastructure*. [Online] Available: https://www.unoosa.org/oosa/en/ourwork/space4sdgs/sdg9.html.

[19] Egbe, V. (2023, October 10). Hostinger Web Hosting Review - Victoria Egbe - Medium. Medium. [Online] Available: https://medium.com/@victoriaegbe02/hostinger-web-hosting-review-33419f08a41d.

WRS: Water Refilling Management System for Far East Water Station

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ABSTRACT

The Philippines faces challenges in accessing clean water, leading to a growing demand for water refilling stations. This surge in popularity has intensified competition, prompting business owners to employ various strategies for success. Recognizing the need for effective management systems in this era, researchers developed a water refilling management system to assist businesses, focusing on Far East Water Station owned by Ma'am Emma Mercado in Madpdap, Mabalacat City, Pampanga. Selected for its prominence and clientele, including major companies like SMDC and Tipco, this water station posed as a representative case. The Modified Waterfall Model methodology guided the application development, executed using PC and software tools such as Visual Basic, MySQL Workbench, Crystal Report, and Photoshop. Design and analysis tools included ERD, VTOC, and Use Case Diagrams, while Likert Scale, based on ISO 25010 criteria, serve as the statistical formula in the survey questionnaires. Alpha and beta tests resulted in scores of 3.76 and 4.2, respectively, with an overall mean score of 4, indicating positive reception and effectiveness. The developed management system offers a solution for water refilling stations to streamline operations, manage data efficiently, and thrive in a competitive market.

General Terms

Desktop Application

Keywords

Water Station, Management System, Desktop Applicatiojn

INTRODUCTION

The water refilling industry is a vital service provider providing safe drinking water to households and businesses. According to the article in Business Diary Philippines [1], the demand for cleaner water has grown, and the cost of that was conducted in the Philippines, customers who bought water from the water refilling stations equipped with management systems reported improved levels of effectiveness, precision, convenience, quality control, and loyalty programs. The results indicate that a management system for water refilling stations can improve the customer experience and foster greater customer happiness and loyalty.

The household water purifiers and bottled water has become prohibitively expensive. Water refilling stations run by private entrepreneurs provide a less costly and more convenient solution to the public's drinking water needs than bottled water or household filters. As time passed, Water Refilling Station still uses a manual system in managing the business; according to the study of C. Basavaraddi et al. [2], the problem of using the manual system is one of the reasons why the efficiency in availing services of the clients is not satisfying and keeping of records is often misplaced and not secure.

The mission of WRS is to provide comprehensive benefits for water refilling stations, including the use of streamlined order management, which helps minimize costs, lower the possibility of errors, and improve customer satisfaction [3]. Efficient inventory control using an inventory system, according to Indeed Editorial Team [4], helps businesses organize and keep track of their stock by providing accurate records of new and returning goods as users enter or

leave the establishment. Efficient content management through a Content Management System is a program that allows users to create, modify, collaborate on, publish, and save digital material without using any codes [5]. Reliable monitoring through the use of a Monitoring System that guarantees that the business owners are always informed of how the company is doing. Depending on the user's needs, the system can display reports of business monitoring findings daily, weekly, monthly, or annually Indeed Editorial Team [6] and provide sales reports to the station by the use of the Report Generation System, which is a piece of software that enables the user to quickly access any data required from a database, spreadsheet, XML stream, or another source. The user then examines the data online or exports it to several document types, including Excel, PDF, and CSV, each catering to different readerships [7]. The WRS water-refilling stations can automate the order management process, reduce manual errors, and provide a user-friendly interface for owners to place orders, track history orders, and set the data when the charges have already been picked up or delivered. The use of a Water Refilling Station Management System by the Water Station affects the customer's experience because, according to the study by Mercado, J. R., & Gopez, M. D. [8]

Water refilling management systems, according to recent studies highlighting their importance and benefits. Developed an automated water refilling station management system to streamline the order management process, reduce manual errors, and improve operational efficiency. The study found that the system effectively made business efficient, improved order accuracy, and enhanced customer satisfaction [9].

In the Philippines, a third-world country with large populations, clean water is still a problem, especially when there is little access to safe drinking water and low water quality. As stated in the article of ABS-CBN News [10], the report notes that since more people choose to stay at home and put health and safety first, the COVID-19 pandemic has raised the need for home-based water replenishment services. The article also mentions how water refilling stations have changed to accommodate the market's shifting needs by introducing new goods and services, including alkaline water and delivery services. The article also discusses the water refilling market's potential for expansion, citing a survey that projects a 7.6% compound annual growth rate for the Philippine water refilling market from 2021 to 2026.

The researchers have developed a stand-alone water refilling management system that can help water refilling stations optimize their operations, increase efficiency, and provide quality experience for the user. The WRS provides a comprehensive solution that streamlines the water refilling management process, reduces manual errors, and improves user satisfaction. The success of Far East Water Station with the WRS underscores the benefits of investing in a water refilling management system.

General Objective

The general objective of the study is to develop a water refilling management station for Far East Water Station in a form of desktop application.

Specific Objectives

The following are the specific objective of the study:

- To gather data through brainstorming, observation, interview, and internet research.
- To identify hardware and software developmental tools
- To design a System that has the following analysis tools: a Visual Table of Contents, Entity Relationship Diagram, and Use Case Diagram
- To Create a water refilling management system using VB (Recursive acronym for VB: Visual Basic) as the primary programming language, Crystal Report for releasing physical records, and Mysql workbench for the database.
    - Water Refilling Management System that can generate the needed reports and records and can assign an accession number generated by the system to all the reports and records.
    - A water refilling management system that has two level of user access which are the users and an admin;
    - The admin is the owner of the water station who has the full access to the feature of the system.
    - The users on the other hand are the staff of the stations who have a limited access to the system

features that will be elaborate in the studies' scope and limitations.

- To test and evaluate the system's quality in terms of Functional Suitability, Usability, and Portability using ISO 25010 as a tool for the study.

Scope and Limitation of the Research

This section encompasses the scope of the study and presents the limitations which are not covered by the developed application.

The research team collaborated to develop a comprehensive water-refilling management system through brainstorming, group discussions, and interviews with local water station operators. The researchers utilized a desktop PC with Microsoft's operating system, employing Visual Basic, MySQL Workbench, Crystal Report, and Adobe Photoshop for development. The system, designed for the Far East Water Refilling Station, functions offline, allowing users and admins to manage station operations. The login process involves security measures, with password reset options. Upon successful login, users access a control dashboard with modules for POS, Customer, Delivery, History, and Task Calendar. The POS module facilitates automated sales using a QR code scanner. Customer and Delivery modules enable managing customer information, orders, and deliveries. The Inventory

module tracks stock using QR codes. The system also features a Task Calendar displaying events. Admins access an additional Admin Panel with modules for Items Lists, Cash Management, Credit Logs, and History Logs. The Items Lists module manages stocks and QR code generation. Cash Management tracks sales and expenses, while Credit Logs monitor customer credit. The Admin Panel allows admin control over delivery information, including printing receipts. History Logs provide transaction details. The system emphasizes event/task management and allows the admin to manipulate history logs, calendar events, and credit information.

There are still factors that limit the study. While the Water Refilling Management System (WRS) for Far East Water Station is a promising solution to the challenges of managing a water refilling station, it has its limitations. These are some limitations of this study, although the scope of this study is limited to Far East Water Station, and the WRS system may not apply to other water refilling stations with different business models and operations. The WRS is explicitly designed for the needs and processes of Far East Water Station and may not be suitable for other businesses. The development of the WRS is limited to the stand-alone computer-based platform. This study excludes other components, such as hardware and infrastructure. The business owner also instated in the researchers that the system should not be a web-based application.

METHODOLOGY

The section outlines the methods and activities employed to achieve system objectives, emphasizing the use of the System Development Methodology (SDM) as formal documentation for the system development life cycle (SDLC) phases. SDM delineates specific objectives for each phase, detailing the necessary results before proceeding to the next phase. The researchers adopted the Modified Waterfall Model, a variant of the SDLC, as depicted in Figure 1, to guide the systematic development of the water-refilling management system.

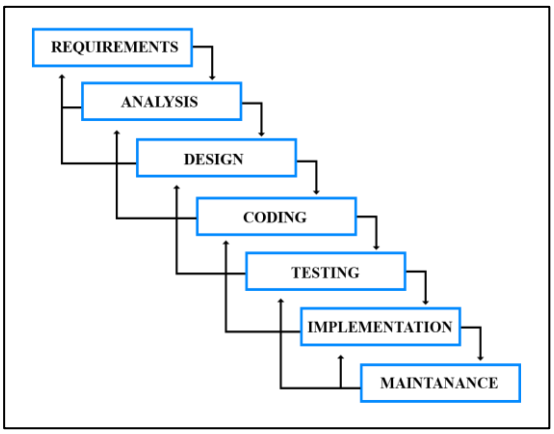

Figure 3: The Modified Waterfall Model

Source: unyscape.com/software-development

Requirements

In the Requirements phase within the waterfall method, involved parties should understand what have developed. The researchers conducted an observational interview, asking different questions and gathered data with the business owner of Far East Water Station. The traditional way of managing the water station because managing a water refilling station can be challenging, especially when dealing with multiple

customers, orders, and inventory. Like other water refilling stations, Far East Water Station faces several operational challenges, such as manual order processing, inventory management, and customer communication. After the interview and data gathering, the researchers have also read various books and articles and checked the internet to come up with the idea concerning the proposed system.

Analysis

In the Analysis Phase, the researchers have developed the system with a logical flow designed based on the locale requirements and what interface best suits the system for the environment of the water station. It was evaluated and structured to address the requirements needed for the system proposal. In this phase, that fulfills the conditions determined in the analysis phase. In short, it creates a "how" that provides the "what" from the requirement phase—creating appropriate designs for the system. The researchers used a Gantt chart (See Table 2). That would visually display the timeline and progress of the project, including all the tasks involved and the duration. It would help the project leader and the team track the project's progress, identify any potential delays or issues, and adjust the schedule as needed. This table lists the team members responsible for each task in the last column. The team members are grouped by their roles (See Table 1). The duration, start date, end date, and dependencies of each task are the same as in the previous table.

Table 1. Team Roles used for WRS Management System

Researcher	Role
Arcilla, John Adrian Yanco	Graphics Artist & Technology Specialist
Asis, Joshua Eli	Document Analyst & Graphics Artist
Galang, Kenneth Garcia	Systems Analyst & Document Analyst
Layug, Faocci Ghaize Olmedo	Project Leader, Hardware Engineer & Quality Assurance Engineer
Santiago, Carl Daniel Grande	Back-end, Front-end programmer & Test Engineer

Table 2. Gantt chart used for WRS Management System

Task	Duration (weeks)	Start Date	End Date	Dependencies	Team Members
Requirements	2	Week 1	Week 2	None	Project Leader
Analysis	2	Week 3	Week 4	Requirements	System Analyst, Document Analysis
Design	3	Week 5	Week 7	Analysis	Graphic Artist
Coding	6	Week 8	Week 13	Design	Frontend Developer, Backend Developer
Testing	3	Week 14	Week 16	Coding	Test Engineer
Implementation	1	Week 17	Week 18	Testing	Quality Assurance Engineer
Maintenance	Indefinite	Week 18	-	Implementation	Technology Specialist

Design

In the design phase, the researchers used design tools to illustrate the system's function and process. Visual Table of Contents (VTOC): A hierarchy chart represents the system's top-down structure. It shows the different modules that the system has. The Visual Table of Contents for the Water Refilling Management System illustrates the modules and sub-modules for each user to familiarize with each system function. This can make them use the system efficiently and reliably. The Visual Table of Contents in Appendix A is the visual table of contents used in designing the various contents of the Water Refilling Management System. Entity Relationship Diagram. Presents the graphical representation of entities and their relationships to each other. It also shows how the data is shared between entities in the database. This may help the users know the relationships between entities in the system. This also shows a generic idea of the tables used and the design. Use Case Diagram—a graphical representation of the user's interaction with the system. The use case diagram in this study shows the different types of users and the various ways they interact with the system.

Coding

The provided passage describes the coding phase of a Water Refilling Station (WRS) management system. In this phase, the system was implemented based on the design from the previous phase. The WRS system is standalone and can operate offline. Users, including staff and the owner, access the system through a login page with a username and password. Security measures include a limited number of login attempts and a waiting period for unsuccessful attempts. Once logged in, users can navigate through a main screen with options for managing point of sales, customers, deliveries, inventory, task calendar, and transaction history. In the point of sales section, there was a QR code scanner to track sales automatically. The customer's list displays information and borrowed items. Users can manage customer data and view transaction details. The delivery section ensures timely delivery, and the inventory tab allows checking stocks and item quantities. The task calendar and borrowers tab manage events and borrower lists. The history tab provides a view of past transactions for accurate inventory management. Admins log in using designated credentials with similar security measures. The admin panel includes options to manage item lists, sales and expenses, credit logs, deliveryman information, and customer credit information. Admins can add, delete, and edit item information, manage stocks, and view sales and expenses within a specified timeframe. Credit logs enable the viewing and changing of payment status, and history logs show past activities. Admins can also add, delete, and update calendar events and tasks and view delivery details in the delivery section.

Testing

After the system developed in the Testing Phase, it shall undergo the testing phase. The researchers have used the ISO 25010 to test and evaluate the system. This testing tool used to know if the Water Refilling Management System was working, executing, and performing without errors, with accuracy and response to the expected output. The researchers have conducted the Alpha and Beta Testing to check if the system works accurately. The researchers asked the right and selected person to evaluate the system using the ISO 25010 tool so that it can provide the necessary information needed for the system to complete and to make the research study successful. Three I.T. Experts have performed the Alpha Testing of the system. The experts can suggest, comment on, and recommend the system to make it more efficient and effective. The user have performed the Beta Testing within the locale. The water station Owner, Mrs. Emma M. Mercado, and her son, Mr. Raphael Christian Mercado, are the hired users. Each respondent on the Alpha and Beta Tests gave a grade from 1-5 based on the executed test. The summary of the alpha and Beta Tests rated through the Likert Scale (See Table 3):

Table 3: Likert Scale

LIMIT OF INDEX	VERBAL DESCRIPTION
4.20-5.00	Excellent
3.40-4.19	Very Good
2.60-3.39	Good
1.80-2.59	Fair
1.00-1.79	Poor

Statistical Treatment

Weighted mean used to measure the general response of the survey samples whether the respondents agree to the given statement or not.

Where:
Mean

$$\bar{x} = \frac{\sum fx}{n}$$

$\bar{x}$ = weighted mean

f = weight given to each respondent

x = number of the respondents

n = total number of the respondents

The t-test offers various advantages, including the capacity to assess if a difference in means between two groups is statistically significant. It is a parametric test of difference, which means it bases its conclusions on the same set of data assumptions as other parametric tests. The t-test presupposes that the data are independent, roughly normally distributed and that each group being compared has a comparable level of variation. Additionally, it

is a time- and money-saving method of analyzing tiny sample volume.

Implementation

In the Implementation Phase, the production system installed, initial user training is completed, user documentation delivered, and the implementation review meeting is held. Once the system is developed and installed, it reviewed to ensure that the researchers meet all of the goals in the project plan for a satisfactory result. Upon installing the system, the researchers have clearly explained to the user the functions of the system's cache modules.

Maintenance

In Maintenance, the researchers repair, upgrade, and renovate the system as necessary. After the initial installation of the system, the researchers should keep the design effective and productive. The maintenance phase involves changing hardware, software, and documentation to support its operational effectiveness. It includes making changes to improve a system's performance, correct problems, enhance security, or address user requirements.

RESULTS

This chapter discusses how the study's main objective was to provide a desktop application for the Far East Water Refilling Station that helps the owner manage the station more efficiently. It also includes a discussion of the requirements gathering, design and development, and testing results in this chapter. The study covered primarily the design, development, and testing of the desktop application entitled "(WRS) Water Refilling Management System for Far East Water Station." The system focused on managing the inventory, point of sales, stocks, expenses, and accounts of the staff of the water refilling station.

Alpha Test Result

Completing all the panelists' criteria, the researchers administered an alpha test using ISO 25010 as an evaluation tool for developing a desktop application. The researchers approached three (3) experts to test the application. The survey conducted virtually using Microsoft Teams, which was composed of three (3) IT experts. The alpha test respondent was Ms. Olive Daza, who has ten (10) years of experience as a software engineer and is currently a software engineer 2 in an IT company specializing in full-stack. Ms. Joanna Marie Bautista, with expertise of nine (9) years in Information Technology and is currently an application support in an IT company specializing in UNIX SQL, and Mr. Arrold Calma, with experience of seven (7) years as a senior software developer in IRipple Incorporation

The summary of the alpha test shown in Table 4. The functional suitability of the system has an average grade of 4.3, which is an excellent grade. This means the system is well equipped with functions the water station needs to operate more efficiently. In terms of performance efficiency, the system has a numerical grade of 3.7, which means it has a very good performance as a system, same as the usability and security, which has a numerical grade of 3.6, which means it has a very good grade, or the system was well secure and perfectly usable. The portability and maintainability of the system both have very good grades. The portability has a numerical grade of 3.8, which means it is easy to install, and the numerical grade of maintainability of the system is 3.6, which means the system is easy to maintain once deployed in the water station.

Table 4: Alpha Test Results

Criteria	Average	Description
Functional Suitability	4.3	Excellent
Performance Efficiency	3.7	Very Good
Usability	3.6	Very Good
Security	3.6	Very Good
Portability	3.8	Very Good
Maintainability	3.6	Very Good

Beta Test Results

To complete the study, the researchers approached the owner of the water station, Mrs. Emma Mercado, which is the Far East Water Station in Barangay Madapdap, Mabalacat City, Pampanga. We have explained to her how the system works, what things to remember, and how to maintain the system, and we gave her the beta test questionnaire that she will answer after she interacts with the system.

The summary of the beta test shown in Table 5. The functional suitability of the system has an average grade of 4.3, which is an excellent grade. This means the system is well equipped with functions the water station needs to operate more efficiently. In terms of performance efficiency, the system has a numerical grade of 4.3, which means it performs well as a system. The usability and security have a numerical grade of 4.15, which means it has a very good grade or the system was well secure and perfectly usable. Portability and the system's maintainability both had great results, wherein the portability has a numerical grade of 4, which means it is easy to install. The numerical grade of maintainability of the system is 4.3, which means that the system is easy to maintain once deployed in the water station.

Table 5: Beta Test Results

Criteria	Average	Description
Functional Suitability	4.3	Excellent
Performance Efficiency	4.3	Excellent
Usability	4.15	Very Good
Security	4.15	Very Good
Portability	4	Very Good
Maintainability	4.3	Excellent

Comparative Summary of Alpha and Beta Results

The comparative summary of the alpha and beta test results, wherein the results in the beta testing were much better than the result we got from the alpha test. In terms of the functional suitability of the system, it shows the same results, with a numerical grade of 4.3, which means it has an excellent rating. With the performance efficiency, the researchers get a sensational result, going from getting 3.7 to getting 4.3 in beta testing. In terms of usability, security, portability, and maintainability, the beta test has improvements to the results the researchers acquire in the alpha test. The usability and security have improved from 3.6 to 4.15, which means the researchers somehow applied the suggestions of the alpha testers. The system's portability also improved from 3.8 in the alpha test to 4 in the beta test, which means that the system improved, and in terms of the system's maintainability, it improved from 3.6 in the alpha test to 4.3 in the beta test. Overall, the proposed system of the researchers made a sensational improvement from the time of the alpha testing with an IT expert to the beta testing with the owner of the water refilling station.

DISCUSSIONS

The researchers have evaluated and tested the application (WRS) Water Refilling Management System for the Far East Water Station. The researchers have gathered respondents' feedback on the application's usability and the player experience during the evaluation and testing phases. Depending on the study's aims, these characteristics have different design and functionality requirements for the application. The foundation and usability of the application in the context of the user's interaction with the system design and application mechanics allow the user to comprehend, learn, and run the application. The graphics and user interface aesthetics of the application design attract users. Users are familiar with the text, font, and colors. In terms of Learnability and Operability, the system's mechanics, rules, and instructions are easy to comprehend and follow. The application's Accessibility contains pictures that show the various system features. The user experience decided by the user's engagement with the application, mainly how the user engages with or likes the application. The system application is challenging for users; it used to be manual before, and now they are trying to be digitally adaptive, which grabs and satisfies the user's interest. The researchers tested the app on three I.T. Experts and the system local itself to ensure that its functionality and design achieved.

Conclusion

These conclusions based on the objectives of the study, complete analysis, and testing and evaluation of the developed system. The researchers have successfully developed and designed the system application in accordance with the study's objectives. The application development tools can develop the Far East Water Station's water refilling management system (WRS). The application's user interface was a well-designed and operated efficiently on the screens of the different computer devices. Users were capable of understanding and using the application. Visual Basic, MySQL workbench, and Crystal Reports are the primary system-developing tools used by the researchers to visualize the final stand-alone application output.

As a result of achieving the study's objectives, the evidence required to evaluate the application is provided. One of the objectives of the study is to develop a Water Refilling Management System for Far East Water Station that can help water-refilling stations optimize their operations, increase efficiency, and provide a quality experience for the user. The researchers successfully developed a WRS Management System with a better user experience, as stated in the objectives.

The researchers have identified all of the hardware and software specifications and requirements to develop a desktop application using design tools such as a use case diagram, visual table of contents, and entity-relationship diagram. The researchers have created and developed a desktop application with POS, a task scheduler, and all the features needed for the water station. The desktop application test cases have tested using test cases in terms of functional suitability, performance efficiency, usability, security, portability, and maintainability. As for the summary of alpha and beta testing, the total mean for the alpha testing is 3.76 with a verbal description of "Very Good," and the total mean for the beta testing is 4.2 with a verbal description of "Excellent." These results conclude that the researchers put a lot of effort into improving the desktop application from alpha to beta testing. The results also show that all the requirements in the system meet the features and the standards that the water station needs to operate more efficiently. Therefore, with all the evidence, the researchers concluded the overall objective of the study and application acceptance achieved.

Recommendations

The goal of the researchers' recommendation was to provide future academics with different ideas that might be used to improve the desktop application for succeeding researchers with the same interest. One of the recommendations is to turn this stand-alone application into a local area network point of sales, a web-based point of sales, and the use of RFID instead of the QR code that the system is currently using.

REFERENCES

[1] Business Diary Philippines (2021). Water Refilling Station Stud

[2] Basavaraddi, C., Basavaraddi, S., Shashidhara, S., Kashyap, P., & Sudeep, P. (2023), A Project Work on Water Refilling Management System. https://ijarcce.com/wp-content/uploads/2023/02/IJARCCE.2023.12134.pdf

[3] E-Store Logistics (2020), 6 Ways to Streamlined Order Fulfillment Process. https://www.estorelogistics.com.au/6-ways-to-streamline-order-fulfillment-process/

[4] Indeed Editorial Team (2022), What is an Inventory System? (With Definitions and Benefits) https://www.indeed.com/career-advice/career-development/inventory-system

[5] S. Amsler & F. Churchville (2021), Content Management System. https://www.techtarget.com/searchcontentmanagement/definition/content-management-system-CMS

[6] Indeed Editorial Team (2022), What is Business Monitoring and Why it is Important? https://www.indeed.com/career-advice/career-development/importance-of-business-monitoring

[7] G. Baltusevičius, (2020) What is a Report Generator https://whatagraph.com/blog/articles/report-generator

[8] Mercado, J. R., & Gopez, M. D.(2021) The Impact of Water Refilling Station Management System on Customer Experience: A Study in the Philippines. Journal of Water Supply: Research and Technology-Aqua, 70(5), 389-400.

[9] Alkayal and Ibrahim, (2021), Implementation of Inventory Management System in Water Refilling Station in the Philippines. Journal of Applied Science and Engineering Innovation, 5(2), 27-32.

[10] ABS-CBN News (2022), Why water refilling stations remain a lucrative business in the Philippines https://news.abs-cbn.com/specialpages/search?q=Why+water+refilling+stations+remain+a+lucrative+business+in+the+Philippines#gsc.tab=0&gsc.q=Why%20water%20refilling%20stations%20remain%20a%20lucrative%20business%20in%20the%20Philippines&gsc.page=3

[11] Alcaide, J., Díaz, G., & Gómez, A. (2020). Offline-based inventory management system for small and medium-sized water refilling businesses. Journal of Environmental Management, 271, 111034. https://doi.org/10.1016/j.jenvman.2020.111034

[12] Valdeavilla, V., dela Cruz, J., Mendoza, J., & Regalado, R. (2021). Computerized inventory management system for water refilling station. International Journal of Innovative Science and Research Technology, 6(4), 35-43. https://doi.org/10.38124/IJISRT21APR330

[13] Eletta, A. P., & Wilfred, I. A. (2020). Automatic management system for water refilling stations: A case study. Journal of Water Process Engineering, 35, 101313. https://doi.org/10.1016/j.jwpe.2020.101313

[14] Pata, L. A., Florea, L., Badea, A., & Acatrinei, D. (2021). Impact of implementing an automated billing and inventory management system in a water refilling business. Journal of Cleaner Production, 294, 126268. https://doi.org/10.1016/j.jclepro.2021.126268

[15] Youssef, M. A., & Abou-Zeid, E. S. (2020). Impact of point of sale (POS) system on sales performance

of small retail businesses. Journal of Business and Retail Management Research, 12(3), 79-87.

[16] Rehman, Z. U., Zeb, A., Amin, H., Saeed, M., & Ullah, Z. (2019). Impact of content management system on customer engagement and brand loyalty in small business: Evidence from developing country. Journal of Retailing and Consumer Services, 51, 219-226.

[17] Shaikh, M. K., Alqahtani, A. A., Khurshid, Z., & Alshahrani, A. (2021). Impact of inventory system on supply chain performance: Evidence from the manufacturing industry. Journal of Manufacturing Technology Management, ahead-of-print(ahead-of-print).

[18] Selamat, M. H., Abdul Aziz, A. R., & Osman, I. H. (2020). Effects of payment system on sales revenue and payment processing time of small business. Journal of Retailing and Consumer Services, 55, 102128.

[19] Microsoft. (2023). Support for Visual Basic in Windows 11. Retrieved from https://docs.microsoft.com/en-us/dotnet/framework/migration-guide/compatibility/windows-11-support-visual-basic.

[20] Zhang, Y., Hu, L., & Jiang, P. (2023). An Effective Quality Control Report Generation System Based on Crystal Reports. IEEE Access, 11, 38312-38320.

[21] Oracle Corporation. (2023). MySQL Workbench Manual. https://dev.mysql.com/doc/workbench/en/

[22] Al-Emran, M., & AbuShawar, M. A. (2020). The role of Adobe Photoshop as a user interface design tool: A study of Jordanian web designers. International Journal of Information Management, 50, 366-374.

[23] Williams, E., & Thompson, L. (2022). Enhancing Project Planning and Implementation of Water Refilling Management Systems through Gantt chart Utilization. Journal of Water Resource Management, 27(3), 123-137.

[24] Natividad, J. E., & Alcantara, J. A. (2020). Development of Water Refilling Management System using Agile Approach. International Journal of Advanced Science and Technology, 29(6), 1429-1438.

[25] Fadli, M. & Hariri, R. (2021). Using the VTOC Diagram in Designing a Quality Management System. Journal of Engineering and Applied Sciences, 16(5), 1232-1238.

[26] Zhou, Y., Wu, Q., & Liu, W. (2019). Effectiveness of using entity-relationship diagrams in the development of an inventory management system. Journal of Industrial Engineering and Management, 12(2), 322-341.

[27] Asaduzzaman, M., & Rahman, M. (2019). Development of a Student Management System Using Use Case Diagrams and Implementation of Its Prototype. Journal of Information Technology and Software Engineering, 9(1), 1-7.

[28] Awotunde, A., Adeyemo, A., Odeyemi, T., & Adetunmbi, A. (2020). Evaluation of performance efficiency of a system developed as a capstone project using ISO 25010. In International Conference on Innovative Trends in Computer Engineering (pp. 60-73). Springer, Cham.

[29] Nazeer, I., Khan, W. A., & Javaid, M. (2019). Evaluating maintainability of a management application using ISO/IEC 25010: A case study. In 2019 2nd International Conference on Computer Applications & Information Security (ICCAIS) (pp. 1-6). IEEE.

[30] Sadek, A., El-Kassas, S., & El-Fattah, M. A. (2020). Evaluating the effectiveness of modified waterfall model for developing a management information system. Ain Shams Engineering Journal, 8(1), 87-97.

[31] Citation: Ahmad, N., & Muhammad, A. (2019). Management System: A Case Study of Public Sector in Khyber Pakhtunkhwa. Journal of Informatics in Developing Countries, 13(2), 83-99.

[32] Adedokun, M. O., Akintoye, I. R., Oluwole, O. A., Olatunji, A. O., & Adeyemo, A. B. (2021). The effect of sampling techniques on research outcomes: A review of selected works. Journal of Economics and Behavioral Studies, 13(2), 26-34.

[33] Jang, H. W., & Lee, Y. J. (2019). An empirical study on the effect of management information system use in the public sector: Focusing on user satisfaction and organizational performance. Sustainability, 11(19), 5227. doi: 10.3390/su11195227

[34] Ye, X., Ma, Y., & Zhang, Y. (2019). Research on Quality Control of ERP System Based on Alpha and Beta Testing. International Journal of Online Engineering, 15(8), 1-9. https://doi.org/10.3991/ijoe.v15i08.10438

[35] Malik, A. Q., Raza, S. A., Naeem, M. A., & Ahmad, M. (2019). Evaluating the Quality of Management System Using Weighted Mean Method. Journal of Business and Management, 20(1), 12-24.

[36] Kostandyan, R., & Toneyan, S. (2020). User Satisfaction Assessment of a Management System Based on the Likert Scale. In 2020 International Conference on Artificial Intelligence in Information and Communication (ICAIIC) (pp. 393-396). IEEE.

[37] Espina, R. L., Dayrit, F. M., & Estrellado, J. C. (2019). Development of a Standalone-Based Water Refilling Station Management System. Journal of Physics: Conference Series, 1368(1), 012041.

[38] Nhiar (2023). Water Refilling Station POS. Retrieved from https://www.sourcecodester.com/microsoft-access/10849/water-refilling-station-pos.html

[39] Shah, N., & Hussain, R. (2021). Customized software vs off-the-shelf software: An exploratory study. International Journal of Information Management, 56, 102227.

Xev-Curity: A Mobile Community Reporting App for Xevera Subdivision

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ABSTRACT

The development of the Xev-Curity app marks a significant stride in leveraging technology to enhance community safety and communication. Situated within the unique landscape of Xevera in Mabalacat, Pampanga, this mobile application addresses the specific needs of residents by offering features such as incident reporting, lost and found services, and interactive discussion platforms. Guided by the ISO 25010 Software Product Quality standards, the app underwent rigorous evaluation, showcasing strengths in Functional Suitability, Performance Efficiency, and Usability. However, the study also identified areas for improvement, particularly in Security and Accessibility. The research underscores the iterative nature of app development, emphasizing continual refinement to align with the dynamic requirements of the Xevera community. This project stands as a testament to collaborative efforts, drawing from the invaluable insights of residents, the expertise of instructors, and the support of friends and family.

Keyword

Mobile Application, Security, Community

INTRODUCTION

Mobile applications have a significant impact on every aspect of our lives in the current digital era. People are utilizing mobile apps for a variety of reasons, including communication, entertainment, and even work, as smartphone usage increases. However, there is a rising need for mobile applications that put security and safety first, particularly in areas with high crime rates [1]. Maintaining the safety and wellbeing of residents in a subdivision depends on security, which is an essential aspect. It is essential to have sufficient security measures in place to guarantee the protection of residents and their property due to the rising rate of criminal activity and other security concerns. Using the Xev-Curity app, which enables users to report occurrences such as suspicious activity, accidents, and hazards as well as communicate concerns within the community, residents can keep themselves safe and secure. The app also has a volunteer program that encourages young people to organize activities and projects aimed at enhancing safety in their areas [2]. With community security and safety in mind, Xev-Curity was created. Instead of making time-consuming phone calls or making in-person visits to the authorities' offices, it enables locals to report occurrences immediately to the security personnel. Quick response to emergencies is ensured by the app's user-friendliness, simplicity of navigation, quick and effective method of incident reporting. Overall, the Xev-Curity app strives to encourage a safer and more secure community in the Xevera Subdivision by giving residents access to vital safety information and encouraging users to actively participate in reporting security issues.

Background of the Study

Xevera Mabalacat Community was built on 2009 under Globe Asiatique Realty Holdings Corp (GARHC) that provides housing units, Church, School, Commercial Center to the low to middle income demographic people. Westchester Realty Corp. (WRC) recently acquired three land titles from PAG-IBIG including Xevera Mabalacat. Maintaining a big community with over 6,400+ Housing Unit is a tedious task and must not be taken lightly, administration have to take account the safety and

well-being of its homeowners including but not limited to Clean Water, Electricity, Safe environment and Security of each Families. When entering the Xevera community, there will be 2 Gates, one for entering and one for exiting, walk a bit forward and there will be a building called Clubhouse. Inside the clubhouse residents can process their home papers, pay the monthly dues, or file a resident complain regarding the communities' shortcomings or a rowdy neighbor. When filing an Incident report to ask for help, resident talk it out with the people in charge, fill up some paper works and if available, take action immediately after reporting. Residents can also go to the Gate to ask for help, but will not act without the supervisors go signal, but that takes a long time.

General objective

The General objective of the study is to develop "Xev-Curity: A Mobile Community Reporting App for Xevera Subdivision" to improve the communities Reporting situation and easily action.

Specific objectives

The following are the specific objectives of the study:

- To gather relevant information using:
    - Libraries;
    - Related Articles;
    - Online Journals;
    - Similar Applications;
- To identify the required specifications and requirements of Software and Hardware:
    - Personal Computer;
    - Android Studio;
    - Adobe Illustrator;
    - Figma;
    - Flutter;
- To Design the Mobile Application using designing tools:
    - Storyboard;
    - Flowchart;
    - Use Case Diagram;
    - Visual Table of Contents;
- 1.2.4 To create and develop the mobile application that would help residents in Xevera with the following Features:
    - Incident Report:
        - Emergency Report;
        - Hazard Report;
        - Crime Report;
        - Discussions;
    - View Bulletin Board
        - Events;
        - News;
        - Announcement;
    - Lost and Found
        - Post Lost Item/Pet
        - Claim Lost Item/Pet
    - Discussions
        - Write a Comment
    - Chat
        - Chat with an Admin
    - Settings
        - Edit Profile
        - Delete All Report
        - Delete All Comment
        - Delete Account
    - Help & FAQ
        - Change Profile
        - Change Password
- To evaluate the mobile application using ISO 25010 Software products Quality Standards in terms of :
    - Function Suitability
    - Performance Efficiency
    - Compatibility
- Usability
- Reliability
- Security
- Portability

Scope and Limitations of the Study

This project aims to help lessen the problems/issues and speed up the security response around Xevera. The scope of this study is to develop and evaluate the effectiveness of the Xev-Curity app in improving security, safety, and crime prevention within the Xevera community only. The researchers had designed the application using a storyboard, flowchart, use case diagram and visual table of contents. Storyboards help visualize the user interface and interaction flow of the mobile app, providing a clear representation of how users navigate through different screens and features. A use case diagram aids in understanding the various scenarios or interactions between users and the system, ensuring that the app captures and address key functionalities and user goals in our mobile app. Flowcharts assist in mapping out the logic and sequence of processes within the mobile app, facilitating a visual understanding of the app's workflow, decision points, and potential areas for optimization. A visual table of contents helps organize and structure the content and features within our mobile app, providing users with an

intuitive navigation system and aiding in the design of a user-friendly and accessible interface. The study had targeted the xevera thirty (30) residents as Beta Testers located at Tabun Xevera Subdivision Mabalacat Pampanga and three (3) IT Experts as Alpha Testers to gather data and help improve the researcher's application.

In the Incident Report Feature, the researchers classified three diverse types of report to better filter and respond accordingly based on the type of report, Users Identification are automatically filled to hasten the filing report. Auto filled form includes, the name, Address of the user, contact no and the date on which the report was filled. The three main categories under Incident Report are; Emergency Report, Hazard Report, Crime Report. Each category is similar but differentiates depending on what type the user reports. Crime there are 6 checkboxes, they are; Safety Hazards, Workload Hazards, Ergonomic Hazards, Physical Hazards, Chemical Hazards, and Biological Hazards. Under Crime Report there are Robbery, Murder, Homicide, Theft, Car Theft and Sexual Violence.

The "Bulletin Board" feature provides users with a centralized space to view important community events, news, and announcements. Unlike other interactive features of the app, users are restricted from posting or commenting in this area, maintaining a one-way flow of information. This limitation is intentional, as only the admin possesses the authority to upload content to the Bulletin Board. By implementing this structure, the app ensures that critical information is disseminated in a controlled and official manner. The decision to restrict user posts and comments aims to uphold the accuracy, reliability, and consistency of the information displayed, as it is directly administered by authorized personnel. This feature offers residents a convenient and reliable source for staying updated on community-related events and announcements while maintaining a secure and well-managed communication channel.

The "Post a Lost and Found Report" feature empowers users to actively contribute to community well-being by providing a platform to report lost or found items through the app. This functionality enhances community collaboration, allowing residents to efficiently communicate and coordinate efforts to recover lost belongings or assist in reuniting owners with found items. By offering real-time updates and fostering a culture of mutual support, the feature not only streamlines communication within the community but also contributes to overall community safety. Residents are encouraged to take proactive steps, actively participating in the creation of a secure and closely knit neighborhood where individuals can rely on each other for assistance and the swift resolution of Lost and Found situations.

The "Home" feature of the app serves as a centralized information hub, promoting community transparency and collaboration by displaying real-time reports and updates submitted by residents. This feature enhances user engagement, allowing residents to stay informed about incidents, hazards, and events within the community. By displaying what other residents have reported, the app fosters a sense of shared responsibility, timely awareness, and community building. Empowering residents with knowledge about the current situation, the "Home" feature encourages a collective approach to community safety and well-being, creating a dynamic and interactive space for residents to interact, share experiences, and contribute to a secure and connected living environment.

On the Profile Menu, displaying sensitive information such as the full name, home address, email address, phone number, and password on the Profile Menu raises significant privacy and security concerns. It is considered a risky practice to show the password, as it poses a potential security threat. Passwords should always be stored securely using encryption methods, and they should never be displayed in plaintext for users or anyone else to see.

The study is limited to the community of Xevera only and the findings may not be generalizable to other communities due to differences in demographic, socio-economic, and geographic factors. Additionally, there is a possibility of bias in the data collected from residents and community guards, as those who choose to use the app may have distinctive characteristics or experiences than those who do not. The study had only included data from a limited number of residents and community guards, which may limit the representativeness of the findings.

METHODOLOGY

This chapter contains the methodology and design that explains the study development process and parameters. This section introduces the software lifecycle methodology, analysis charts, and data

collection research tools used by the researcher in developing the game application.

The researchers used Modified Waterfall model to develop the mobile application. This method uses the SDLC.

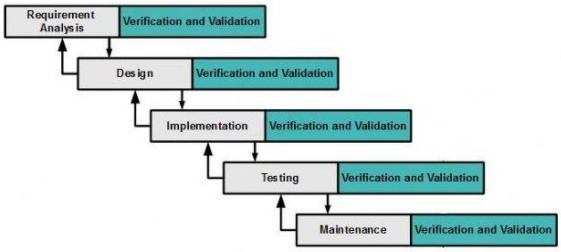

Figure 1. Modified Waterfall Methodology

2.1 The System Design

The researchers have used the following analysis tools and diagrams: Storyboard, Use Case Diagram, Visual Table of Contents.

A storyboard is a graphic representation of how your video have been unfolded frame by frame. It consists of many boxes with illustrations or images representing each shot, with notes about what happens in the scene and what was said in the script during that shot (see Appendix F)

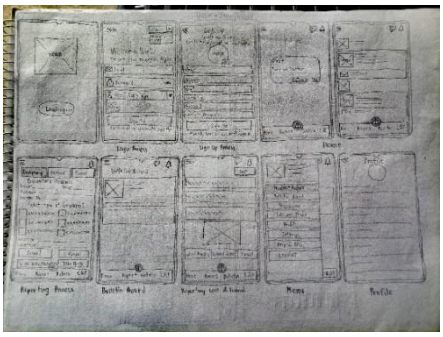

Figure 2. Storyboard

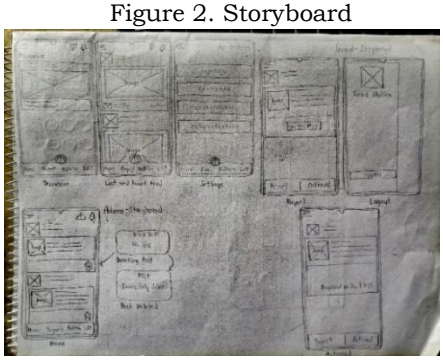

Figure 3. Storyboard Continuation

A use case diagram is a visual depiction illustrating the numerous ways a user can interact with a system. It serves as a key tool for outlining the system/software requirements of a new software program that is currently in the development phase (see Appendix C.)

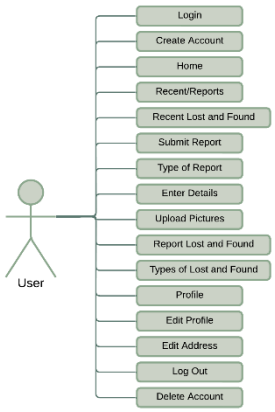

Figure 4. Use Case Diagram

The Visual Table of Contents is a widget featured on the course homepage that presents interactive tiles corresponding to the content available within the course. If the course has no modules and is empty, the Visual Table of Contents have also been devoid of any content (see Appendix D.)

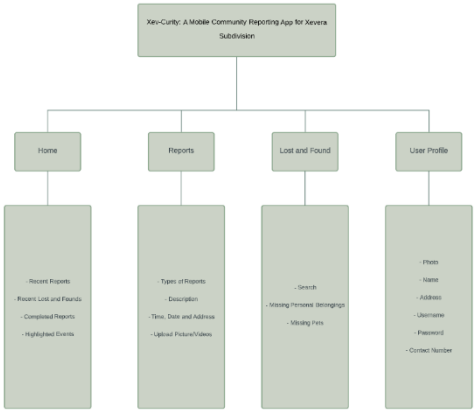

Figure 5. Visual Table of Contents

Implementation

The System have been built on windows desktop computer with AMD Ryzen 3 2200g 3.5GHz, 16GB of memory, 4GB of RAM, 120GB of HDD and 500GB of SSD. The researchers have developed the Xev-Curity: A Mobile Community Reporting App for

Xevera Subdivision. And the specific features of the mobile application. Adobe photoshop and adobe illustrator had been used to create the hand signs of the sign language app, the logo, the welcome sign, icons, and some buttons. For the database and back-end of the mobile application the researchers had used MySQL and node.js

System Testing

During the testing phase, the researchers have intricately assessed the validity of the questionnaires before they are deployed. The gathering of data, the analysis, and processing have been presented.

Data Analysis

This study had used descriptive statistics to summarize and analyze the data. Descriptive statistics help us understand where the data points are located and how they are spread out. It provides a clear picture of the data's characteristics and patterns.

The following statistical treatments were used for data reduction:

Frequency Distributions

Frequency distribution was used in the study to indicate the number of cases at each score. The scores of the demographic profile of the respondents were grouped in categories defined by step intervals, each of which was a set of contiguous scores. A variable with values that indicate the order of the cases was divided into several categories. The number of cases tabulated in any category was the frequency.

Mean

The mean is the average or a calculated central value of a set of numbers and is used to measure the central tendency of the data. The mean formula in statistics for a set is defined as the sum of the observations divided by the total number of observations. The mean formula for a set of given observations can be expressed as, Mean = (Sum of Observations) ÷ (Total Numbers of Observations)

$\bar{x} = \Sigma fx/\Sigma f$

$\bar{x}$ = the mean value of the set of given data.

f = frequency of each class

x = mid-interval value of each class

Likert Scale

The Likert scale is a rating system used in questionnaires and designed to measure respondent's attitudes, opinions, or perceptions. After the calculations of 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. Likert Scale

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

Maintenance

The maintenance phase is done after the verification phase. In this phase, the mobile application has been deployed and released into the game industry market repository site. This will be an avenue where users may and will be able to report glitch or needs improvement for the betterment of the developed application. During project deployment, the potential users can be able to download the applications by accessing the repository hosting site and marking as it is available for mobile devices. The game application was advertised and disseminated for deployment with the repository hosting website. A summary statistic on the website hosting the repository could assist the researcher's maintenance team in figuring out the precise numbers related to application installations, uninstalls, and ratings. Additionally, tracking the various Android versions that the application is compatible with can be useful to the researchers.

RESULTS

This chapter contains the results and outcomes based on the objectives of the study. It also shows the analysis and interpretation results of the survey conducted, alpha and beta and the mobile application system. The results and outcomes have been computed carefully by the researchers.

Software and Hardware Requirements

For the development of the mobile application's interfaces, the researchers used Adobe Illustrator for the icons. Additionally, Figma and Balsamiq were used for stoyboarding and diagram creation for the organization of ideas.

For the Coding, the researchers used Visual Studio Code and Android Studio as the integrated development environment, employing Dart and C++ to develop the ideas.

To manage the database, XAMPP with MySQL was used for data storage and retrieval of the system for seamless user interactions.

For the development of the mobile application, the researchers used a desktop PC running in Windows 10 Enterprise sixty-four (64) bit with a processor of AMD Ryzen 3 2200G with Radeon Vega Graphics and a 16GB of RAM, 4GB of VRAM and a 500GB of hard drive storage.

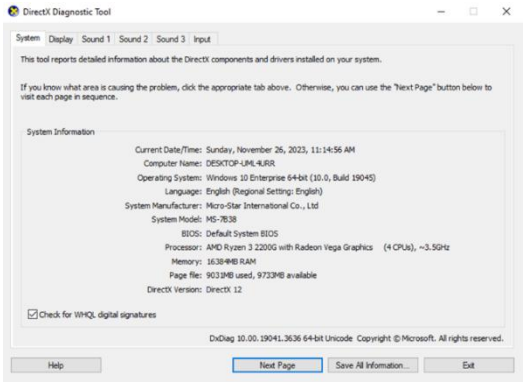

Figure 6. PC Information

Developmental Tools

In the development of the Mobile Application system, various diagrams were employed to offer a comprehensive insight into its functionalities. A Use Case Diagram, detailed in Appendix C, was carefully crafted to delineate users and the application system, enhancing the understanding of their interactions. Additionally, the Visual Table of Contents (VTOC) presented in Appendix D played a pivotal role in shaping the application's layout. This visual representation served as a valuable guide in determining the organization of the application's content. In the development of the mobile application for the research project, the researchers utilized Visual Studio Code as the primary coding tool. Leveraging its versatile features and streamlined interface, Visual Studio Code provided an efficient environment for coding, debugging, and version control. This choice significantly contributed to the seamless implementation of the application's functionalities, ensuring a robust and well-structured codebase.

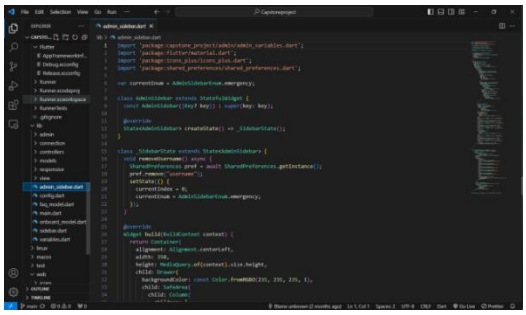

Figure 7. Visual Studio Code

Testing Result

This system was evaluated using the ISO 25010 Software Product Quality. Different Xevera Residents and Guards, Head Guards evaluated the Functional Suitability, Compatibility, and Usability of the system. Composition of the respondents are also provided below.

Table 2. Alpha Test Result

Criteria	Mean	Interpretation
Functional Suitability	3.96	Good
Performance Efficiency	4.06	Good
Compatibility	3.95	Good
Usability	4.2	Excellent
Reliability	3.8	Good
Security	3.7	Good
Portability	3.96	Good
Total Mean	3.94	Good

The table 2 above shows summary of the test results evaluated by three (3) I.T Experts as the Alpha Testers of the system. The highest among the criteria is Usability with a weighted mean score of 4.2 and a verbal interpretation of "Excellent". This means that the system is appropriate, easy to navigate and visually appealing. The lowest weighted mean score on the criteria has a 3.7 with a verbal interpretation of "Good". This means that there is still improvement in terms of confidentiality and security in the system so that users will feel comfortable using the application and entrusting their private information. The overall weighted mean score is 3.94 with a verbal interpretation of "Good". This means that the system substantially met all the developer's expectations and criteria based on the survey questionnaires. All sub-Criteria needs improvements have been addressed before the system undergo beta testing.

Table 3. Beta Test Result

Criteria	**Mean**	**Verbal Interpretation**
Functional Suitability	3.9	Good
Compatibility	4.56	Excellent
Usability	3.96	Good
Total Mean	3.98	Good

The table above shows the overall summary of the beta test result and an overview of its effectiveness in Functional Suitability, Compatibility and Usability. The highest result for the acquired beta test result is Compatibility with a weighted mean of 4.56 with a verbal interpretation of "Excellent" followed by Usability with a weighted mean of 3.96 with a verbal interpretation of 3.96 and a verbal interpretation of "Good" and lastly, Functional Suitability with a weighted mean of 3.9 and a verbal interpretation of "Good". These results show the systems capability to reach the required criteria of its functional Suitability and its strong compatibility across devices and its Usability.

Alpha and Beta Test Comparison

The system's performance in alpha and beta evaluations showed significant differences. Alpha testers rated the system highest in Usability, with a mean score of 4.2 and a verbal interpretation of 'Excellent,' while beta testers scored it lowest at 3.7, with a verbal interpretation of 'Good,' indicating improvements in privacy and security. The overall score was 3.94, with a verbal interpretation of 'Good,' indicating the system met all developer expectations, with all sub-criteria needs addressed before beta testing. On the other hand, in the beta evaluation, the system continues to excel, with Functional Suitability leading with a commendable mean score of 4.56. Compatibility and Usability receive 'Good' ratings with scores of 4.03 and 3.98, respectively. While both assessments highlight the system's strong performance. However, the alpha evaluation rated the system slightly higher in terms of Usability.

In conclusion, the system has received consistent high marks for Functional Suitability, Compatibility, Usability, Security, and Portability in both alpha and beta evaluations. 'Good' according to the alpha evaluation, with a mean Usability score of 4.2, emphasizes how well it satisfies functional needs, upholds security, provides convenient portability, and exhibits compatibility. All in all, these assessments support the system's excellent performance and satisfying user experience.

DISCUSSIONS

These discussion and conclusions are based on the objectives of the study, completed analysis, and testing and evaluation of the developed game. It also covers the recommendations of the developers to further improve the game for future researchers.

Summary of Findings

The researchers have developed the Xev-curity mobile application that's exclusively made for Xevera Community security needs. The researchers used MySQL and XAMPP for database management, Visual Studio Code and Android Studio for the front-end and back-end programming. Graphic Design and Storyboarding were achieve using Adobe Photoshop, Illustrator, Figma and Balsamiq.

For the alpha testing the researchers reached out to 3 I.T experts for their opinion and was asked for a survey to critic the mobile application software regarding its for all category encompassing the ISO 25010. The result for Functional Suitability achieved the weighted mean of 3.96 followed by Performance Efficiency (4.06), Compatibility (3.95), the highest mean Usability (4.2), followed by Reliability (3.8), Security (3.7), Portability (3.96).

The Beta testing phase consists of 30 residents from xevera mabalacat community, Functional Suitability have a weighted mean of 3.9 with a verbal interpretation of “Good” followed by the highest achieved weighted mean of 4.56 for Compatibility and a verbal interpretation of “Excellent” and last but not the least is the Usability with a weighted mean of 3.96 and a verbal interpretation of Good. The overall rating is 3.98 with a verbal interpretation of “Good”

Conclusions

The culmination of the Xev-Curity app development project reflects a multifaceted journey. In achieving the primary objective of crafting a Mobile Community Reporting App for Xevera, the study embarked on a comprehensive information-gathering process, leveraging diverse sources like the internet, libraries, articles, journals, and analogous applications. The meticulous identification of software and hardware specifications, including tools like Personal Computer, Android Studio, Adobe Illustrator, Figma, and Flutter, laid a robust foundation. The design phase saw the application take shape through Storyboarding, Flowcharting, Use Case Diagrams, and a Visual Table of Contents.

The subsequent creation and development phase brought forth an application equipped with user-centric features, addressing varied needs within the community. From incident reporting categorized into Emergency, Hazard, and Crime, to Lost and Found functionalities spanning both items and pets, the app offered a comprehensive solution. Additional features included Bulletin Board viewing for events, news, and announcements, a discussion platform, and chat functionality with administrators. The Settings menu provided options for profile editing, report and comment deletion, and account removal, while a dedicated Help & FAQ section aimed to guide users effectively.

Recommendations

To better optimize the application, future researchers are advised to consider implementing user authentication during login to add a sense of user protection on their account, Establishing a routine schedule for regular security audits to proactively identify and address potential vulnerabilities. Regular audits help maintain the app's resilience against evolving security threats and ensure ongoing protection of user data. Review and enhance access controls to ensure that users have appropriate permissions based on their roles. Restrict access to sensitive features and information to authorized personnel only, reducing the risk of misuse or unauthorized actions.

Continuously optimize the user interface to improve user experience. Gather user feedback on the app's interface, and implement changes that enhance intuitiveness, navigation, and overall usability. A user-friendly interface contributes to higher user satisfaction and engagement. Implement a robust feedback mechanism within the app to gather user opinions and suggestions.

Regularly review user feedback to identify areas for improvement, address concerns, and ensure the app evolves in line with user expectations. Explore opportunities to broaden location integration capabilities. This could include incorporating additional location-based services, such as geofencing or real-time location sharing, to enhance the app's effectiveness in community reporting and emergency response. Test the app across a diverse range of mobile phones to ensure compatibility. Considerations should be made for various screen sizes, resolutions, and hardware specifications to guarantee a consistent and optimal user experience across different devices.

REFERENCES

[1] Turner, B. A., H., & Turner, A. (2018, July 10). 3.86 Billion More Phones Than People In The World! BankMyCell. https://www.bankmycell.com/blog/how-many-phones-are-in-the-world

[2] Panganiban, A.V. (2019) *Right to regulate passage in subdivisions*, *INQUIRER.net*. Retrieved from: https://opinion.inquirer.net/124424/right-to-regulate-passage-in-subdivisions?fbclid=IwAR3yYbl6itqrdA942eU07H5tshSR19xXv34EOHXfVZVetWzP3qJK3X8yTls (Accessed: 16 May 2023).

International Research Conference on Information Technology Education (IRCITE 2024)

COMMISSION ON HIGHER EDUCATION

REGIONAL OFFICE III

RELEASED
DEC 12 2023
CHEDRO III

CHEDRO-III MEMORANDUM
No. 229 s. 2023

For : **ALL PRESIDENTS/HEADS OF HIGHER EDUCATION INSTITUTIONS IN REGION III**

Subject : **INTERNATIONAL RESEARCH CONFERENCE ON INFORMATION TECHNOLOGY EDUCATION (IRCITE) 2024**

Date : **December 12, 2023**

This Office endorses the subject undertaking **INTERNATIONAL RESEARCH CONFERENCE ON INFORMATION TECHNOLOGY EDUCATION (IRCITE) 2024** with the theme, ***"Breaking Barriers and Empowering Change through Global Innovation, Knowledge Engineering, and Diversity-centered Research"*** to be held on **Friday, March 8, 2024** from 08:00am-05:00pm at the **Campus Gym, Nueva Ecija University of Science and Technology, Sumacab Este, Cabanatuan City**.

The conference is organized by the Philippine Society of Information Technology Educators (PSITE) Central Luzon and aims to provide the opportunity for students in the graduate and undergraduate IT Education programs and IT Educators to converge in one research platform, to innovate and commercialize ideas.

Target participants are the Information Technology Education Heads, Faculty and Graduate/Undergraduate Students of the higher education institutions.

For registration fees/details and confirmation, interested participants are advised to directly contact the Focal Persons through the information provided below:

DR. ROLAIDA L. SONZA
Conference Chair
Mobile: 0915-423-8863
Email: rolaidasonza@yahoo.com

MS. EVELYN A. VILLANUEVA
Conference Co-chair
Mobile: 0998-858-6659
Email: evelynvillanueva@clsu.edu.ph

For the voluntary participation of all concerned.

Wide dissemination of this memorandum is desired.

MS. LORA L. YUSI
Officer-in-Charge, Office of the Director IV

INTERNATIONAL RESEARCH CONFERENCE ON INFORMATION TECHNOLOGY EDUCATION (IRCITE 2024)

"Breaking Barriers and Empowering Change through Global Innovation, Knowledge Engineering, and Diversity-centered Research"

March 8, 2024

BREAK OUT ROOM (Auditorium)
INFORMATION TECHNOLOGY

Session Chair: Dr. Jet C. Aquino
Judges: Engr. Lester Phil Cruz
Moderator: Mr. Jordan L. Salenga

(Reminder: The researcher can have a 7-minute presentation and 3 minutes allotted for question and answer)

TIME/PRESENTER #		TITLE	AUTHORS/INSTITUTION
8:05– 8:10		PRAYER	
8:10 - 8:25	P1	Project Quedia: Delivering an Incentivized Platform for a Media Consumption Tracker	Axl Louis Coronel, John Carlo Gonzales, Justine James Medina, Allan Iverson Reyes, Bob Myron Reyes and Jayson Batoon Bulacan State University-Main Campus
8:25 - 8:40	P2	Clinic Care: A Smart Health Care System	Mary Ann Valentino, Ken Lordian Derla, Kristine Cruz,Adrian Labao, Jefferson Magat, Kerry Brionne Ramos and Jan Raphael Tansiongco National University, Philippines
8:40 -8:55	P3	COMPSIMU: A 3d Assembly And Disassembly Simulator	Laines Alimurung, Vincent Jay Guiao, Kenji Hidaka, Dominic Jubinal, Danniele Sarmiento, Jannela Mae Subido, Robhert Bamba and Dennis Tacadena Mabalacat City College
8:55 - 9:10	P4	DENCARE: A Comprehensive Web-Based Dental Management System For Managing Records And Scheduling Appointments With Sms And Email Notification	Franchesca Culalic, John Kenneth Arellano, Russel Dela Cruz, Jeneses Galang, Alessandra Juan, Nicole Santos and Jayson Batoon Bulacan State University-Main Campus
9:10 - 9:25	P5	STEMJuander: An E-Learning Portal for At-Risk Grade 12 Learners at Angeles City Science High School	Gabriel Rhobert Dy, Stephanie Basilio and Bobby Marcko Cruz Angeles University Foundation
9:25 - 9:40	P6	ITRADE	Christine M. Sugui, Frederic Santos and Ernie Lee Pineda

BREAK OUT ROOM (Auditorium)
INFORMATION TECHNOLOGY

Session Chair: Dr. Jet C. Aquino
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TIME/PRESENTER #		TITLE	AUTHORS/INSTITUTION
			Mabalacat City College
9:40 - 9:55	**P7**	PLANTERA: Web Based Horticulture Guide and Gardening Supplies in Bataan	Marc Jacob Oira, Ceazar John Porgatorio, Jerome Pantig and Vincent Josh Conrad Isip Bataan Peninsula State University
9:55 - 10:10	**P8**	Compawnion: A Profile Management System with Geo-Location System for Noah's Ark Dog and Cat Shelter, Mabalacat, Pampanga	Aileen de Leon, Bea Donasco, Maan Isabel Due, Dan Joseph Haban, Cyrille Magdaluyo, Zheman Manaloto and Genasky Jr. Pinlac Don Honorio Ventura State University
10:10 - 10:25	**P9**	YSMO: A Web-Based Visitor Monitoring System for Campus Security and Visitor Management	Kathlyn May Pineda, Christopher Jay Manubay, Jan Alexandrei Macario, Junel Alcantara, Jodell Bulaclac, Ruth Luciano, and Josh Mclyde Rojo Nueva Ecija University of Science and Technology
10:25 - 10:40	**P10**	Empowering Student Well-Being: A Holistic Approach through an Online Social Platform and Mental Health Tracking System at NEUST	Almer Bondoc, Angelo Julius Taruc, Jefferson Diaz, Joshua Ulic-Ulic, Jodell Bulaclac and Emilsa Bantug Nueva Ecija University of Science and Technology
10:40 - 10:55	**P11**	VAXTRACK: A Web Application For Rabies Vaccination Tracking And Management	Jasmin Bundalian, Mariela Cia, Angelica Rodriguez, Julieta Umali and Jemuel Bernaldo Don Honorio Ventura State University
10:55 - 11:10	**P12**	University Medical Records Management System	Jonel David, Westly Juco, Mario Lord Luna, Ruel Reyes and Laude Dworcel Blythe Espiritu Angeles University Foundation
11:10 - 11:25	**P13**	XPress: A Progressive Web Social Media Application for Mental Health Support	Svet Leighann Señeres, Nathaniel Ribada and Kim Padua

BREAK OUT ROOM (Auditorium)
INFORMATION TECHNOLOGY

Session Chair: Dr. Jet C. Aquino
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Moderator: Mr. Jordan L. Salenga

(Reminder: The researcher can have a 7-minute presentation and 3 minutes allotted for question and answer)

TIME/PRESENTER #		TITLE	AUTHORS/INSTITUTION
		Services Using the Laravel Framework	Gordon College
11:25 - 11:40	**P14**	Automated LED Lights Motion Detection In Bulacan State University Sarmiento Campus	Jerecho Ambasa, Jocebel Balbuena, Rhaven Jhay Taraje, Ronnel Tolentino, Emmanuel Valdez and Jennifer Anne Repaso Bulacan State University Sarmiento Campus
11:40 - 11:55	**P15**	BulSU Connect: Alumni Management Information System for Bulacan State University Alumni Relations Office	Elia Margarete De Guia, Isagani Lapira Jr., Wilhelm Jan Miranda, Michaella Shylle Ong, Patrick Joseph Pronuevo, Teresita Mangahas and Jayson Batoon Bulacan State University
11:55 – 12:25		---------- B R E A K ----------	
12:25 - 12:40	**P16**	Stockpile Navigator- An Efficient and Effective Monitoring and Fast Purchasing Order	John David Bautista, Monica Luzon, Reynaldo Maisa Jr., John Andrew Oxima, Jhane Salaysay and Mary Rose Columbres Bulacan State University - Sarmiento Campus
12:40- 12:55	**P17**	Lakbay Hiwaga: Using Philippine Mythology in Developing Interactive Storytelling Game	Diana Claire Ambat, Dominic Zachary Torres, Froilan De Guzman and Alejandro Ortega CIIT College of Arts and Technology
12:55- 1:10	**P18**	Reverie: A Web-Based Art Gallery Platform for Aspiring Artists	Froilan De Guzman, Chino Tigre Morales and Justine Luis Salem Nueva Ecija University of Science and Technology
1:10- 1:25	**P19**	The Development And Evaluation Of Guidance Counseling Management System With Email And Sms Notification	Darren Celzo Acuña, Pamela Elaine Dela Cruz, Mary Geraldine Matillano, Monica San Juan, Ronaldin Bauat and Melgine Bauat Nueva Ecija University of Science and Technology

BREAK OUT ROOM (Auditorium)
INFORMATION TECHNOLOGY

Session Chair: Dr. Jet C. Aquino
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(Reminder: The researcher can have a 7-minute presentation and 3 minutes allotted for question and answer)

TIME/PRESENTER #		TITLE	AUTHORS/INSTITUTION
1:25- 1:40	**P20**	GTG(GarageToGo): A hyperlocal cross-platform Personal Garage Renting Platform for Sustainable Urban Mobility using Ionic Framework	John Ulysses Paruginog, Justin Louise Ferdes and Enrique Raymond Lumbang Gordon College
1:40- 1:55	**P21**	Paws Pro: A Web-based Appointment and Content Management System for Happy Paws Pet Care Services Using Progressive Web Application Framework	James Roward Paneza, John Patrick Mata and John Harvey Agrabio Gordon College
1:55- 2:10	**P22**	SPORTEE: A Digital Web-Based Reservation and Availability Tracking System for Sport Court Facilities Using Laravel	Bernadeth De Jesus, Anne Claire Racela and Jericho Falsario Gordon College
2:10- 2:25	**P23**	REMEDIO: A Gamified Cross-Platform Informative And Reminding System For Medication Adherence Using Ionic Framework	Mark Janeil Villasis, John Carlo Ramos and Kanji Takahashi Gordon College
2:25- 2:40	**P24**	READEFINE: Enhancing Elementary Students' Comprehension Skills In English Language Through Gamification	Rein Miguel Buenaventura, Rolfe Matthew Alipio, Ma. Christine Dela Cruz, Meryll Lynch Joaquin, Sophia Rhyzelle Beloro, Laurence Paul Advincula and Christelle Zamora La Consolacion University Philippines
2:40- 2:55	**P25**	SPCFind: A Smart AR-Based Navigation System	Lara Joy Cuison, Jayson Talaguit, Charles Andre Sarmiento, Tristan Hashley Lazaga and Ralph Cadalzo System Plus College Foundation
2:55- 3:10	**P26**	AQUARIZZ: An E-commerce Community Web Application for Fish Enthusiasts in Olongapo City using ReactJS Framework	Ryan Kevin Bascon, James Patrick Tsung and Joseph Gideon Simbre Gordon College
3:10- 3:25	**P27**	PRMSU ID Processing System i-Request for Students	Criel Glean Anao, Daniel Joseph Dizon, Daryl John Ragadio, Nathaniel Baluyot and Michael Robles

BREAK OUT ROOM (Auditorium)
INFORMATION TECHNOLOGY

Session Chair: Dr. Jet C. Aquino
Judges: Engr. Lester Phil Cruz
Moderator: Mr. Jordan L. Salenga

(Reminder: The researcher can have a 7-minute presentation and 3 minutes allotted for question and answer)

TIME/PRESENTER #		TITLE	AUTHORS/INSTITUTION
			President Ramon Magsaysay State University
3:25- 3:40	**P28**	UPAHANMOTO: Web-Based Housing And Commercial Spaces Rental Using Google Map Global Positioning System (Gps) Application Programming Interface (Api) And Notification	Allen Marc Bautista Dalubhasaang Politekniko ng Lungsod ng Baliwag

INTERNATIONAL RESEARCH CONFERENCE ON INFORMATION TECHNOLOGY EDUCATION (IRCITE 2024)

"Breaking Barriers and Empowering Change through Global Innovation, Knowledge Engineering, and Diversity-centered Research"

March 8, 2024

BREAK OUT ROOM # 301
INFORMATION TECHNOLOGY

Session Chair: Dr. Rachel Alegado
Judges: Ms. Aileen P. De Leon
Moderator: Ms. Myka A. Cruz

(Reminder: The researcher can have a 7-minute presentation and 3 minutes allotted for question and answer)

TIME/PRESENTER #		TITLE	AUTHORS/INSTITUTION
8:05– 8:10		PRAYER	
8:10 - 8:25	P1	SkillHub: A Mobile Application Linking Communities with Residential Services	Jhon Michael Ramos, Donna Princess Valonda, Earish Ann Paguio, Rozel Avila, Florentino Casuco Jr, Erick Campano and Mary Ann Valentino. National University, Philippines
8:25 - 8:40	P2	TRIKETOGO: Innovative Tricycle Ride-Hailing Mobile Application	Xymon Harold Darcen, Arabella Dennise Flores, Justine Diane Santos, Ken Lordian Derla, Rozel Avila, Mary Ann Valentino and Erick Campano. National University, Philippines
8:40 -8:55	P3	NU VENTURE: A Mobile Application for Streamlining University Processes for Event Management at NU Baliwag	Brenley Ian Robles, Jhon Mark Santos, Nichole Joyce Santos, Rozel Avila, Paul John Cabance, Erick Campano and Mary Ann Valentino. National University, Philippines
8:55 - 9:10	P4	BlooDrive: A Mobile Application for Blood Donation Drive	Bryan Jay Mallare, Caryl Rociel Santiago, Christian Gazzingan, Rozel Avila, Samuel Espino Jr., Erick Campano and Mary Ann Valentino. National University, Philippines
9:10 - 9:25	P5	CritterCare: A Next-Generation Hybrid Application for Pet Adoption and Analytics	Calvin Kent Pamandanan, Ron Russelle Bangsil and Jesel Aurvic De Jesus.

BREAK OUT ROOM # 301
INFORMATION TECHNOLOGY

Session Chair: Dr. Rachel Alegado
Judges: Ms. Aileen P. De Leon
Moderator: Ms. Myka A. Cruz

(Reminder: The researcher can have a 7-minute presentation and 3 minutes allotted for question and answer)

TIME/PRESENTER #		TITLE	AUTHORS/INSTITUTION
			Angeles University Foundation
9:25 - 9:40	**P6**	LegalAid Ph: Enhancing Lawyer-Citizen Connections through an Innovative Mobile Application	Simone Jehrome Chico, Rovic Yuri Abiol, Jeanherline Santiago, Rozel Avila, Urek Pondare, Mary Ann Valentino and Erick Campano. National University, Philippines
9:40 - 9:55	**P7**	COMMUNIVERSE: Barangay Information Systems Through A Mobile Application	Lex Andrew Torres, Caressa Mae Edrada, Angel Grace Villas, Rozel Avila, Paul John Cabance, Mary Ann Valentino and Erick Campano. National University, Philippines
9:55 - 10:10	**P8**	A Mobile App for Aquatic Companions: Online Ordering System for Live Fish as Pets	Franz Dainell Valones, Jonas Vasallo, Jasper James Paragas, Rozel Avila, Julius Yves Battung, Mary Ann Valentino and Erick Campano. National University, Philippines
10:10 - 10:25	**P9**	BarnBuddy: An Agricultural Extension Services Management System for Farm Animals using Android Technology	Archie Joseph Cayabyab, Junieben Dela Fuente, Joebert Deldoc and Gene Paul Fernandez Bataan Peninsula State University-Main Campus
10:25 - 10:40	**P10**	RapidResponse: An Application to Improve Vehicular Services in Angeles City	Joseph Andrew Garcia, Dan Isidrei Musni, Jeremiah Quiambao and Killian Jarel Vitug Angeles University Foundation
10:40 - 10:55	**P11**	BulSU Alert: Enhancing University Emergency Response through Mobile Applications	Franz Rainier Adriano, John Lloyd Russuel Tengco, Justine Kate Tubanza, Mckyla Faith Valenzuela,

BREAK OUT ROOM # 301
INFORMATION TECHNOLOGY

Session Chair: Dr. Rachel Alegado
Judges: Ms. Aileen P. De Leon
Moderator: Ms. Myka A. Cruz

(Reminder: The researcher can have a 7-minute presentation and 3 minutes allotted for question and answer)

TIME/PRESENTER #		TITLE	AUTHORS/INSTITUTION
			Jeffrey Zamora, Jayson Batoon and Raquel Adriano Bulacan State University
10:55 - 11:10	**P12**	IOT (FIRE ALARM) Surveillance Camera With Motion-Based Sensor At Clirdec Using Arduino	Romeo Lapurga, Hurry Puntawi, William Sabado and Cenon Divina.
11:10 - 11:25	**P13**	TALKEASY: Customizable Communication Buttons For Non-Speaking Individuals	Bea Dianne Tolentino, Nikki Ann H. Triguero
11:25 - 11:40	**P14**	Kapam-Pamangan: A Cross-Platform Application for Kapampangan Recipes	Clarence Carl Canlas, Robelynne Dela Fuente, Eric Davidson Mercado, Eric Jacobson A. Mercado, Marvin Pamintuan, Ron Van Santos, Aeriane Charmaine Dizon and Jaypee Patdu
11:40 - 11:55	**P15**	AquaEasy : Water Contamination Security System with Warning Signal for All Fish Farming	Jeffrey Caraga, Joshua Darap and David Paul Ramos.
11:55 – 12:25		---------- B R E A K ----------	
12:25 - 12:40	**P16**	Android-Based Renewable Energy Powered Smart Curtain with Automatic Light and Temperature Sensor	Jericho Llanes, Mark Christian Aringo, Leah Sansano, John Paul Abasolo, Harold James Galve and John Philip Paranis Bulacan State University - Sarmiento Campus
12:40- 12:55	**P17**	Rice Field Monitoring With IoT	Mary Ann Valentino, Ken Lordian Derla, Kian Harvey Pastrana Bemaldo, Enjenricmarie Cadawan, King Christian Monte, Erman Bryant Pagtalunan and Mark Vincent Mark Vincent Raymundo National University, Philippines
12:55- 1:10	**P18**	StreetLight: Connecting Advocates for Community Welfare	Ted Bryan Agon, Yuridiz Kyle Gonzales, JohnBennidict Blanco, Rozel Avila, Erick Campano, Mary Ann

BREAK OUT ROOM # 301
INFORMATION TECHNOLOGY

Session Chair: Dr. Rachel Alegado
Judges: Ms. Aileen P. De Leon
Moderator: Ms. Myka A. Cruz

(Reminder: The researcher can have a 7-minute presentation and 3 minutes allotted for question and answer)

TIME/PRESENTER #		TITLE	AUTHORS/INSTITUTION
			Valentino and Jenalyn Columna National University, Philippines
1:10- 1:25	**P19**	CYBERESCAPE: A MOBILE EDUCATIONAL ESCAPE ROOM APPLICATION FOR NETWORKING FUNDAMENTALS	Christian Mallari, Myka Cruz, Ma. Dannylene Dindin, Jen Rose Jimenez, Joshua Garcia, John Kenshin Martin, John Dale Quiambao and Romar Salenga. Don Honorio Ventura State University
1:25- 1:40	**P20**	Habilin: A Quest to Uncover the Rich Heritage of Philippine Heroes in 2D Mobile Game	Jastine Zaplan, Jomar Navarro, John Barleta, Ayra Villamor, Marcus Sanchez, Christian Castro and Edwin Garcia Bulacan State University
1:40- 1:55	**P21**	MIAW: Multi-Paramater Internet-of-Things-based Analysis of Water Quality	Rexine Joy Roxas, Maya Isabel Feliciano, Ryumi Miakka Therese Dizon, Mary Ann F. Quioc, Jona P. Tibay Philippine Science High School
1:55- 2:10	**P22**	Location Based Mobile Crime and Complaint Report management System for San Clemente, Tarlac	Danmark Joshua Dela Peña, Janren Tayag and Dave Manzano Tarlac State University
2:10- 2:25	**P23**	Revitalizing Philippine Heritage Through Gaming: "Taya" an Android Platformer Game for Educating Filipino Games	Jean Lemuelle Bagay, Kyryll Joy Tiru, John Carlo Balisi and Rogine Alamo Tarlac State University
2:25- 2:40	**P24**	DrivED: A 3d Virtual Reality Mobile Educational Game	Ernie Lee Pineda, John Kevin Dizon, Fernando Jose Dungca, Johndhel Igaya, Jestoni Estardo, Justin Josh Resada and Dennis Tacadena Mabalacat City College
2:40- 2:55	**P25**	SAFEHOME: A Cross-Platform Home Automation For Detecting And Monitoring Emergency Situations	Nicko Jopson, Allister Ross Sandoval, Chrisden Ann Pizarro, Sofia Marie Baguio,

BREAK OUT ROOM # 301
INFORMATION TECHNOLOGY

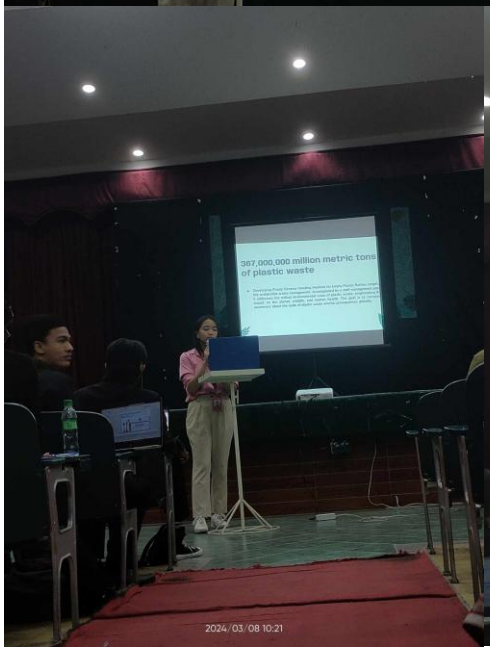
Session Chair: Dr. Rachel Alegado
Judges: Ms. Aileen P. De Leon
Moderator: Ms. Myka A. Cruz

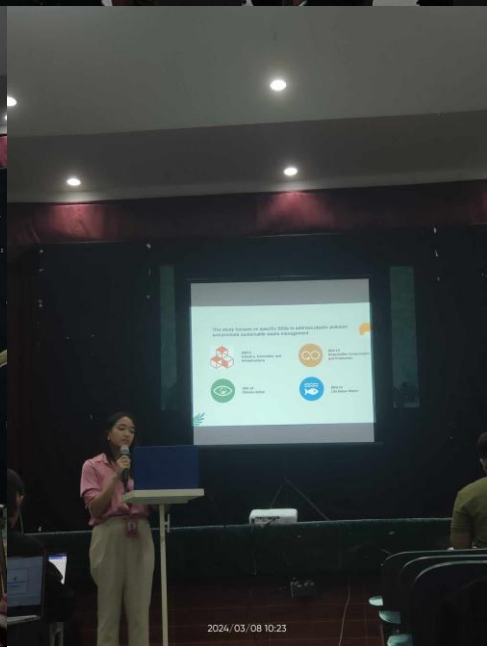
(Reminder: The researcher can have a 7-minute presentation and 3 minutes allotted for question and answer)

TIME/PRESENTER #		TITLE	AUTHORS/INSTITUTION
		Involving Smoke, Gas, And Water	Andrew Caezar Villegas and Cris Norman Olipas Nueva Ecija University of Science and Technology
2:55- 3:10	**P26**	UGH Studio Mobile App Prototype: StreamliningK-PopMerchandise Orders	Juan Miguel De Jesus, Frances Nicolle Alejandro, Khen Lawrence Santos, Rozel Avila, Mary Ann Valentino, Erick Campano and Paul John Cabance National University, Philippines
3:10- 3:25	**P27**	BEEBAYIN: A Mobile Application Game To Rekindle Baybayin At Baliuag University	Ana Lizel Del Poso, Rowell Santos, Cedrick Ann Emmanuelle Santos, Alexza Justine Dela Peña,Arianna Louise Tumangday and Johnmar Pangan Baliuag University, Bustos, Bulacan


COMPSIMU
INTRODUCTION
INTRODUCTION
2024/03/08 09:53


Trade
Reverse Vending
Machine for Empty
Plastic Bottles
TRADE
2024/03/08 10:21


367,000,000 million metric tons
of plastic waste
2024/03/08 10:21


2024/03/08 10:23


KAPAM
PAMANGAN
SS-PLATFORM APPLICATION FOR
KAPAMPANGAN RECIPES


THE PRELIMINARY SURVEY RESULTS


THE CONCLUSION
DIGITAL BRIDGE
CULINARY COMMITMENT
EXCEPTIONAL QU
AVAILABLE NO


DrivED: 3D VR Mobile Educational Game

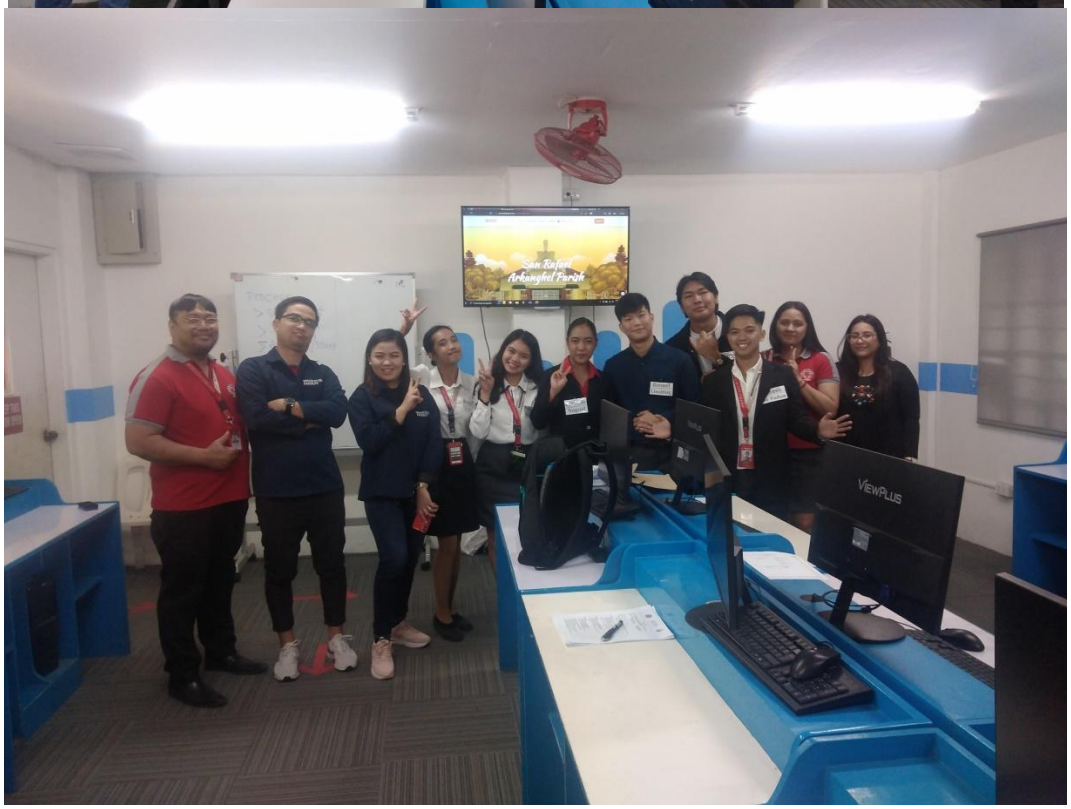

RESULTS AND DISCUSSION


MABALACAT CITY COLLEGE
2008
PAMPANGA
MABALACAT CITY COLLEGE
2008
PAMPANGA
VISION
VALUES

BSIT

ORAL DEFENSE


KAPAM
PAMANGAN
A CROSS-PLATFORM APPLICATION FOR
KAPAMPANGAN RECIPES
ViewPlus


San Rafael
Arkanghel Parish
ViewPlus


DrivED: A 3D VIRTUAL REALITY MOBILE EDUCATIONAL GAME
ViewPlus


iTrade
Reverse Vending Machine for Empty Plastic Bottles
iTRADE
ViewPlus


iVenTaMo: An IoT Vending, Tracking, & Monitoring System
ViewPlus


Pajarillaga-Castillo Dental Clinic
MediSmile: A Web-Based Online Appointment And Monitoring System for Pajarillaga-Castillo Dental Clinic
ViewPlus


(WRS) Water Refilling
Management System for
Far East Water Station
ARCI
ViewPlus


Course Evaluation and
Enlistment for
BSIT program of
Mabalacat City College


I-CDRRMO-MO:
A Public Emergency and Response System for Mabalacat City


Educventures:
DISCOVERING MADAPDAP COMMUNITY SCHOOLS IN A 3D VIRTUAL TOUR SIMULATOR FOR PERSONAL COMPUTERS
VeinPlus


Xev-Curity :
A Mobile
Community
Reporting App for
Xevera Subdivision
ViewPlus


VOUPRO: MABALACAT
CITY'S ACCOUNTING OFFICE
VOUCHER PROCESSING
AND MONITORING SYSTEM
ViewPlus

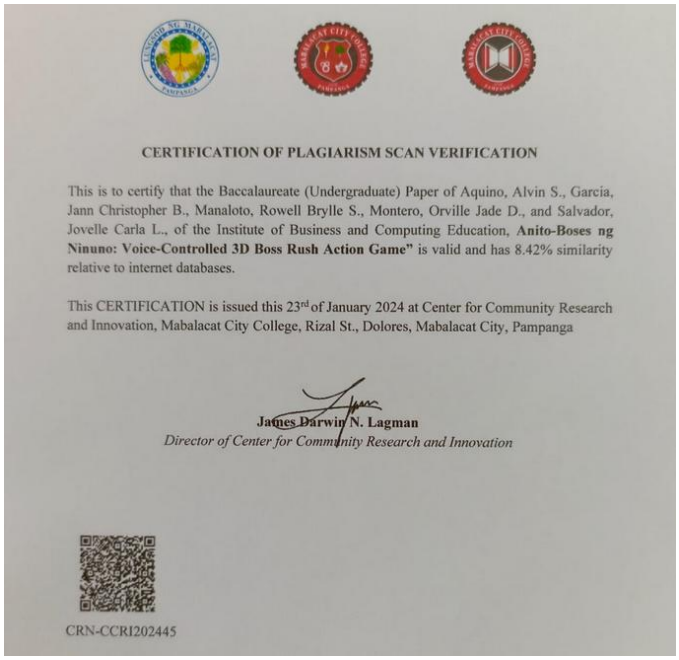

Library Management
System with QR Code for
Mabalacat Community
High School
BERT
EDGAR
DADA
BOB
JM


COMPSIMU


BRGY. CAMACHILES
MANAGEMENT
SYSTEM
EDGIE
ViewPlus


ANITO : BOSES NG NINUNO
ViewPlus

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION AND CERTIFICATION OF ENGLISH CRITIC



CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Aquino, Alvin S., Garcia, Jann Christopher B., Manaloto, Rowell Brylle S., Montero, Orville Jade D., and Salvador, Jovelle Carla L., of the Institute of Business and Computing Education, **Anito-Boses ng Ninuno: Voice-Controlled 3D Boss Rush Action Game"** is valid and has 8.42% similarity relative to internet databases.

This CERTIFICATION is issued this 23rd of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

James Darwin N. Lagman
Director of Center for Community Research and Innovation

CRN-CCRI202445

Appendix K: Grammarian Certification

January 25, 2024

CERTIFICATE OF EDITING

This is to certify that I have edited the thesis/research entitled "Anito-Boses ng Ninuno: Voice-Controlled 3D Boss Rush Action Game", and found it thorough and acceptable with respect to English grammar and composition.

Gladys Grace S. Farolan, LPT, MAED English
Grammarian/Language Editor
+639608315906
ggsfarolan23@gmail.com

Name of Researchers:

Aquino, Alvin S.
Garcia, Jann Christopher B.
Manaloto, Rowell Brylle S.
Montero, Orville Jade D.
Salvador, Jovelle Carla L.

Bachelor of Science in Information and Technology
Mabalacat City College

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Rodney C. Gonzales, Edgie Simon M. Garcia, Cjay D. Wage, William P. Antonio Jr., Aaron Clyde L. Garcia and Lexys S. Salvador., of the Institute of Business and Computing Education, **"Barangay Camachilles Management System"** is valid and has 6.37% similarity relative to internet databases.

This CERTIFICATION is issued this 31st of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

James Darwin N. Lagman
Director of Center for Community Research and Innovation

CRN-CCRI202457

GRAMMARIAN
CERTIFICATION

This certifies that this CAPSTONE RESEARCH MANUSCRIPT entitled, **"BARANGAY CAMACHILES MANAGEMENT SYSTEM (CLOUD HOSTING AND INFRASTRUCTURE SETUP)"**, prepared and submitted by **Antonio, William P. Jr., Gonzales, Rodney C., Garcia, Edgie Simon M., Garcia, Aaron Clyde L., Salvador, Lexys S.,** and **Wage, C Jay D.,** has been duly edited and scrutinized by the English critic whose signature is affixed below.

RUBY BAYLON SICAT, LPT
ENGLISH CRITIC / EDITOR
Lic.No. - 1336599

JANUARY 26, 2024
Date Signed

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Alimurung, Laines Y., Guiao, Vincent Jay R., Hidaka, Kenji B., Jubinal, Dominic M., Sarmiento, Danniele R., and Subido, Jannela Mae P., of the Institute of Business and Computing Education, **"CompSimu: A 3D Based PC Assembly and Disassembly Simulator"** is valid and has 4.5% similarity relative to internet databases.

This CERTIFICATION is issued this 25th of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

James Darwin N. Lagman
Director of Center for Community Research and Innovation

CRN-CCRI202451

Grammarian Certification

Republic of the Philippines
MABALACAT CITY COLLEGE
Mabalacat City, Pampanga
A.Y. 2023-2024

CERTIFICATE OF ENGLISH EDITING

January 28, 2024

This certificate confirms that the capstone paper listed below has been checked/edited for language by yours truly **Mrs. Sheena A. Sibug**. The following issues were corrected: grammar, spelling, punctuation, sentence structure, and phrasing.

Capstone Title:

COMPSIMU: A 3D BASED PC ASSEMBLY AND DISASSEMBLY SIMULATOR

Researchers:

Alimurung, Laines Y. Hidaka, Kenji B. Sarmiento, Danniele R.

Guiao, Vincent Jay R. Jubinal, Dominic M. Subido, Jannela Mae P.

Mrs. Sheena A. Sibug
Name and Signature of English Expert/Grammarian

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Ariston, Sophia Kate D., Matias, Paula Bianca M., Rosauro, Princess Rea T., Sobrevilla, Roy Jr. P., Viado, Victor Alystyr C., and Yutuc, Edille Marie D., of the Institute of Business and Computing Education, "**Course Evaluation and Enlistment for BSIT Program of MCC (MabalacatCity College)**" is valid and has 6.43% similarity relative to internet databases.

This CERTIFICATION is issued this 3rd of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

James Darwin N. Lagman
Director of Center for Community Research and Innovation

CRN-CCRI202437

Republic of the Philippines
MABALACAT CITY COLLEGE
Mabalacat City, Pampanga

CERTIFICATE OF ENGLISH EDITING

This certificate confirms that the capstone paper listed below has been checked/edited for language by yours truly ***Felita C. Tobias, LPT. BSED, Major in English***. The following issues were corrected: grammar, spelling, punctuation, sentence structure and phrasing.

Capstone Title:

Course Evaluation and Enlistment for BSIT program of MCC (Mabalacat City College)

Researchers:

Ariston, Sophia Kate D.

Matias, Paula Bianca M.

Rosauro, Princess Rea T.

Sobrevilla, Roy Jr. P.

Viado, Victor Alystyr C.

Yutuc, Edille Marie D.

Date Issued:

Jan 30, 2024

Felita C. Tobias, LPT.

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Dizon, John Kevin Q., Dungca, Fernando Jose D., Estardo, Jestoni D., Igaya, Johndhel M., and Resada, Justin Josh B., of the Institute of Business and Computing Education, **DrivED: A 3D VIRTUAL REALITY MOBILE EDUCATIONAL GAME"** is valid and has 7.45% similarity relative to internet databases.

This CERTIFICATION is issued this 24th of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

James Darwin N. Lagman
Director of Center for Community Research and Innovation

CRN-CCRI202449

Mabalacat City College
Institute of Business and Computing Education
A.Y. 2023 - 2024

CERTIFICATE OF ENGLISH EDITING

This certificate confirms that the capstone paper listed below has been checked/edited for language by yours truly **Marnie Anthonette F. Montillon, Bachelor of Secondary Education Major in English.** The following issues were corrected: grammar, spelling, punctuation, sentence structure and phrasing.

Capstone Title:

DrivED: A 3D VIRTUAL REALITY MOBILE EDUCATIONAL GAME

Researchers:

Dizon, John Kevin Q.
Dungca, Fernando Jose D.
Estardo, Jestoni D.
Igaya, Johndhel M.
Resada, Justin Josh B.

Date Issued:

January 22, 2024

Marnie Anthonette F. Montillon
Name of the English Expert/Grammarian

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Cruz, Darryl O., Payabyab, John Winther R., Quizon, Tyrone Mhar G., Silva, Jeremy R., and Zabala, Gerald V., of the Institute of Business and Computing Education, **"I-CDRRMO-MO: A Public Emergency and Response System for Mabalacat City"** is valid and has 7.5% similarity relative to internet databases.

This CERTIFICATION is issued this 9th of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

James Darwin N. Lagman
Director of Center for Community Research and Innovation

CRN-CCRI202439

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Cillo, Izellah L. Manuel, Joelyn H. Manuel, Justin H. Pascua, Marc D. Raymundo, Vyete A. and Sugui, Christine M. of the Institute of Business and Computing Education, **"iTrade: Reverse Vending Machine for Empty Plastic Bottles"** is valid and has 7.04% similarity relative to internet databases.

This CERTIFICATION is issued this 19th of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

James Darwin N. Lagman
Director of Center for Community Research and Innovation

CRN-CCRI202441

Grammarian Certification

Republic of the Philippines
MABALACAT CITY COLLEGE
Mabalacat City, Pampanga
A.Y. 2023-2024

CERTIFICATE OF ENGLISH EDITING

January 18, 2024

This certificate confirms that the capstone paper listed below has been checked/edited for language by yours truly **Mrs. Sheena A. Sibug.** The following issues were corrected: grammar, spelling, punctuation, sentence structure, and phrasing.

Capstone Title:

ITRADE: REVERSE VENDING MACHINE FOR EMPTY PLASTIC BOTTLES

Researchers:

Cillo. Izellah L. Manuel, Joelyn H. Raymundo, Vyete A.
Sugui, Christine M. Manuel, Justin H. Pascua, Marc D.

Mrs. Sheena A. Sibug
Name and Signature of English Expert/Grammarian

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Bulaon, Albert S., Jocson, Vincent John F., Miranda, Ryan G., Munoz, Rose Ann L., Samson, Matthew C., and Tobias, Kevin Raizean C., of the Institute of Business and Computing Education, **"iVenTaMo: An IoT Vending, Tracking and Monitoring System"** is valid and has 10% similarity relative to internet databases.

This CERTIFICATION is issued this 31st of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

James Darwin N. Lagman
Director of Center for Community Research and Innovation

CRN-CCRI202447

Grammarian Certificate

Republic of the Philippines
MABALACAT CITY COLLEGE
Mabalacat City, Pampanga

CERTIFICATE OF ENGLISH EDITING

This certificate confirms that the capstone paper listed below has been checked/edited for language by yours truly ***Felita C. Tobias, LPT, BSED, Major in English***. The following issues were corrected: grammar, spelling, punctuation, sentence structure and phrasing.

Capstone Title:

IVenTaMo: An IoT Vending, Tracking and Monitoring System

Researchers:

Bulaun, Albert S.

Jocson, Vincent John F.

Miranda, Ryan G.

Muñoz, Rose Ann L.

Samson, Matthew C.

Tobias, Kevin Raizean C.

Date Issued:

Jan 30, 2024

Felita C. Tobias, LPT.

Undergraduate Research Form No.9

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Canlas, Clarence Carl R., Dela Fuente, Robelynne D., Mercado, Eric Davidson A., Mercado, Eric Jacobson A., Pamintuan, Marvin H. and Santos, Ron Van F. of the Institute of Business and Computing Education, **"Kapam-Pamangan: A Cross-Platform Application for Kapampangan Recipe"** is valid and has 9.44% similarity relative to internet databases.

This CERTIFICATION is issued this 19th of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

James Darwin N. Lagman
Director of Center for Community Research and Innovation

CRN-CCRI202444

CERTIFICATE OF ENGLISH CRITIC

GRAMMARIAN
CERTIFICATION

This certifies that this CAPSTONE RESEARCH MANUSCRIPT entitled, **"Kapam-Pamangan: A Cross-Platform Application for Kapampangan Recipes,"** prepared and submitted by **Canlas, Clarence Carl R., Dela Fuente, Robelynne D., Mercado, Eric Davidson A., Mercado, Eric Jacobson A., Pamintuan, Marvin H.,** and **Santos, Ron Van F.,** has been duly edited and scrutinized by the English critic whose signature is affixed below.

RUBY BAYLON SICAT, LPT
ENGLISH CRITIC / EDITOR
Lic.No. - 1336599

JANUARY 14, 2024
Date Signed

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Tabunda, Edgar P., Ocampo, Bobby S., Mercado, Darwin B., Galang, John Michael A., and Angeles, Edilberto Jr. V., of the Institute of Business and Computing Education, **"Library Management System with QR Code for Mabalacat Community High School"** is valid and has 5.43% similarity relative to internet databases.

This CERTIFICATION is issued this 25th of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

James Darwin N. Lagman
Director of Center for Community Research and Innovation

CRN-CCRI202450

CERTIFICATION FOR PAPER GRAMMAR REVIEW

This is to certify that the undersigned has reviewed each page of the capstone paper entitled **LIBRARY MANAGEMENT SYSTEM WITH QR CODE FOR MABALACAT COMMUNITY HIGH SCHOOL** by the researchers namely **Tabunda, Edgar P., Ocampo, Bobby S., Mercado, Darwin B., Galang, John Michael A., and Angeles, Edilberto Jr. V.** The said paper was reviewed aligned with the set structural rules of grammar, spelling, punctuation, sentence structure and phrasing in the English language.

Signed this 27th day of 2024 at Mabalacat Community High School, Dolores, Mabalacat City.

JEMIMA S. DADULLA, LPT
BSEd-English
Units, M.A. Speech Communications

Plagiarism Checker X - Report

Originality Assessment

9%

Overall Similarity

Date: Jan 19, 2024
Matches: 1863 / 20376 words
Sources: 84

Remarks: Low similarity detected, check with your supervisor if changes are required.

Verify Report:
Scan this QR Code

GRAMMARIAN
CERTIFICATION

This certifies that this CAPSTONE RESEARCH MANUSCRIPT entitled, **"MediSmile: A Web-based Online Appointment and Monitoring System for Pajarillaga-Castillo Dental Clinic"**, prepared and submitted by **Cabotage Jr. Ruben A., Hipolito, Alfer B., Liwag, Antonio Victor P., Miclat, Julius P., Sanchez, Kyla Jazmine F., and Sanguyu, John Russel B.**, has been duly edited and scrutinized by the English critic whose signature is affixed below.

RUBY BAYLON SICAT, LPT
ENGLISH CRITIC / EDITOR
Lic.No. - 1336599

JANUARY 18, 2024
Date Signed

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Aquino, Bolen, Roxette B., Cunanan, Francis Dominic D., De Padua, Genesis A., Liwanag, Ronnel C., Mabala, Princess Grace M., and Nuguid, Chriselle D., of the Institute of Business and Computing Education, **"SanRafael: A Web-Based Appointment and Payment System of San Rafael Arkanghel Parish"** is valid and has 4.44% similarity relative to internet databases.

This CERTIFICATION is issued this 22nd of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

James Darwin N. Lagman
Director of Center for Community Research and Innovation

CRN-CCRI202446

Mabalacat City College
Institute of Business and Computing Education
A.Y. 2023-2024

GRAMMARIAN CERTIFICATION

This certificate acknowledges that the Capstone paper entitled **"SanRafael: A Web-Based Appointment and Payment System of San Rafael Arkanghel Parish,"** prepared and submitted by **Bolen, Roxette B., Cunanan, Francis Dominic D., De Padua, Genesis A., Liwanag, Ronnel C., Mabala, Princess Grace M., and Nuguid, Chriselle D.**, has undergone thorough examination and editing by **Ms. Jean Claire B. Bolen, LPT.**

The document was meticulously examined, focusing on various linguistic elements, including grammar, spelling, punctuation, sentence structure, and phrasing. The rigorous editorial process ensures that the written content adheres to the highest standards of clarity, coherence, and correctness.

Date Issued:

January 19, 2024

Jean Claire B. Bolen, LPT
English Critic/Editor

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Anunciacion, Julian S., Calventos, Jonathan R., Dalas, Joshua A., Del Prado, Jansen A., Mercado, Reinier D., and Sarmiento, John Christoper J., of the Institute of Business and Computing Education, **"VOUPRO: MABALACAT CITY'S ACCOUNTING OFFICE VOUCHER PROCESSING AND MONITORING SYSTEM"** is valid and has 0% similarity relative to internet databases.

This CERTIFICATION is issued this 19th of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

James Darwin N. Lagman
Director of Center for Community Research and Innovation

CRN-CCRI202442

Republic of the Philippines
MABALACAT CITY COLLEGE
Mabalacat City, Pampanga
A.Y. 2023-2024

CERTIFICATE OF ENGLISH EDITING

December 8, 2023

This certificate confirms that the capstone paper listed below has been checked/edited for language by yours truly **Mrs. Sheena A. Sibug**. The following issues were corrected: grammar, spelling, punctuation, sentence structure, and phrasing.

Capstone Title:

VOUPRO: MABALACAT CITY'S ACCOUNTING OFFICE VOUCHER PROCESSING AND MONITORING SYSTEM

Researchers:

Anunciacion, Julian S. **Calventos, Jonathan R.** **Dalas, Joshua A.**
Del Prado, Jansen A. **Mercado, Reinier D.** **Sarmiento, John Christoper J.**

Mrs. Sheena A. Sibug
Name and Signature of English Expert/Grammarian

CERTIFICATION OF PLAGIARISM SCAN VERIFICATION

This is to certify that the Baccalaureate (Undergraduate) Paper of Arcilla, John Adrian Yanco, Asis, Joshua Eli, Galang, Kenneth Garcia, Layug, Faocci Ghaize Olmedo, Santiago, Carl Daniel Grande., of the Institute of Business and Computing Education, **"(WRS) Water Refilling Management System for Far East Water Station"** is valid and has 6.5% similarity relative to internet databases.

This CERTIFICATION is issued this 24th of January 2024 at Center for Community Research and Innovation, Mabalacat City College, Rizal St., Dolores, Mabalacat City, Pampanga

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This certificate confirms that the capstone paper listed below has been checked edited for language by Yours truly **JEMIMA S. DADULLA (Units- M.A.Speech Communication)** The following issues were Corrected: grammar, spelling , punctuation, sentence structure and phrasing.

Capstone Title:
Water Refilling Management System for Far East Water Station

Researchers
John Arcilla
Joshua Eli Asis
Kenneth Galang
Faocci Layug
Carl Santiago

Date Issued:
JANUARY 25, 2024

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