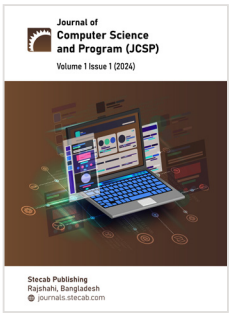

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Research Article

Development and Evaluation of a Web-Based Resident Information Management System

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About Article

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ABSTRACT

The development of a Web-Based Resident Information Management System simplifies the process of storing and accessing information of residents compared to the traditional way of information management. Having this kind of system, the barangay could easily perform its duty to the public like planning and implementing different programs and granting other document requests like residence certificates and permits. The Rapid Application Development (RAD) model was utilized as a system development method since it emphasizes the quick design development cycle and high-quality outcomes. The system was undergone testing and evaluation using six ISO 25010 criteria. An average mean result of 3.48 for functional suitability, 3.62 for performance efficiency, 3.58 for compatibility, 3.42 for usability, 3.44 for reliability, and 3.51 for security shows that the developed system met the user requirements and is ready for implementation. This will make it easier for the barangay to maintain residents' records and provide hassle-free services.

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1. INTRODUCTION

In the Philippines, the Barangay is the fundamental political unit recognized by the Local Government Code (LGC) of 1991. As stated in section 384 of the LGC, its mandate is to serve as the primary planning and implementing unit of government policies, plans, programs, projects, and activities in the community. To fulfill this mandate, the Barangay must maintain an accurate and updated record of its residents, which serves as a vital resource for the identification of individuals, planning, and statistical purposes. In addition, the Barangay is responsible for issuing various essential documents, such as certificates of residency and permits, which require accurate and up-to-date resident information.

Despite the technological advancements in the Philippines, most Barangays, particularly those in the province of Oriental Mindoro, still rely on manual ways of keeping and managing resident records. This was confirmed when a survey conducted by the proponents in the town of Bongabong, Oriental Mindoro revealed that all thirty-six (36) Barangays in the town were using manual record-keeping processes, where data was written in logbooks and some records were printed and stored in cabinets. Other barangays also use word processing tools and spreadsheets like Microsoft Word and Excel which at least improved their process. While efforts were made to record and measure the data, they were still done manually, leaving them vulnerable to human error and bias (Benitez, et. al., 2017). As a result, Barangay personnel were not able to provide accurate data quickly enough. Another problem with manual data recording is its rapid growth over time which resulted in numerous issues in storage, management, and information retrieval.

The challenge can be readily addressed through the utilization of contemporary ICT solutions. Software technologies, particularly information systems, provide a more efficient, timely, and precise environment for storage, management, and data processing. As stated by Bondoc (2019), the adoption of an information system can enable barangays to manage document requests and streamline administrative procedures. Various studies, including those conducted by Lacasandile *et al.* (2020) and Requinto *et al.* (2019), have demonstrated the efficacy of implementing an information management system in multiple government units, including barangays. Such a system can greatly enhance the provision of quality services by the barangay. For this reason, the web-based resident information management system was conceptualized and developed.

The system was developed to facilitate an efficient and streamlined platform for resident record management and the issuance of different barangay documents. The system allows residents to log in and update their information, as well as request necessary documents, providing a straightforward and expedited process. With this system, barangay staff can supply important documents such as barangay clearance, barangay permit, certificate of residency, certificate of indigency, business permit, and other documents with ease and efficiency.

Moreover, the system enables the barangay to make informed decisions regarding the allocation and utilization of resources and the implementation of various government programs through the use of up-to-date resident information. Additionally, the system incorporates data visualization, which offers a rapid and comprehensive overview of resident data. By presenting data in an easily digestible format, visualizations can reduce the cognitive and intellectual strain involved in interpreting and analyzing information. This, in turn, could help barangay staff make informed decisions more quickly and accurately (Qin *et al.*, 2020). Additionally, by increasing the quantity of information presented, visualizations can enhance the overall efficiency and effectiveness of the resident information management system, allowing barangay staff to better manage resident data and provide improved services to residents. Consequently, this system can serve as an essential tool for any barangay seeking to optimize its administrative processes and improve its services to residents.

2. LITERATURE REVIEW

Data is a critical asset for individuals, organizations, and agencies alike. As the volume of data grows exponentially, relying on manual record-keeping could lead to numerous challenges, including poor management, data loss, unauthorized access, and the formation of data silos (Malak, 2023). Despite these risks, many local government agencies still use manual record-keeping methods (Oloyede, 2022). Conversely, numerous organizations are embracing computerized record management and information systems to enhance their operations and reduce the issues associated with manual record-keeping (Touray, 2021). It will also provide a strong foundation for managing paperwork efficiently, finding documents quickly, and making important information easily accessible when required. Furthermore, it offers better service delivery, accountability, continuity, and transparency (Guto & Jumba, 2021).

The beneficial impact of computerized systems is driving numerous government agencies to adopt such technology, aiming to optimize their operations (Hinkley, 2023). For instance, the Department of Social Welfare and Development (DSWD) in Caraga, Philippines, has embraced digitization to safeguard records securely, ensuring both accessibility and compliance with departmental regulations (Jayoma *et al.*, 2020). Similarly, Carpio (2020) underscores the importance of computerized management systems at the barangay level, emphasizing their role in streamlining initial planning and implementation processes within the community. In addition to planning and implementing projects, barangays also provide a range of essential services, including issuing certificates and clearances, delivering health services, ensuring public safety and security, and more. These diverse offerings underscore the importance of establishing an organized and dependable information management system for residents. Villiones (2021) developed a Service Management System across various barangays in Talisay, Negros Occidental, and conducted an assessment if they need the system. Based on the results, the system is recommended for implementation in most of the barangays being surveyed to improve operational efficiency and transaction services for residents.

Conventional computerized systems like record management and information systems are being revolutionized by emerging technologies. For instance, most of the applications nowadays are web-based, which allows concurrent access by multiple

users using any platform with a browser and the internet (Joseph *et al.*, 2020). This contrasts with traditional standalone applications, which are limited to single users on a specific device. Commonly, web applications are built using the PHP scripting language and its frameworks, often in conjunction with MySQL as the database management system (Adam *et al.*, 2022). Aside from being web-based, some technologies are also integrated into the new system such as Quick Response (QR Code) for user authentication (Ahmed *et al.*, 2020) and data visualization to summarize the collected data (Karya & Heripracoyo, 2020).

Development of a software application is not an easy process. The success of development usually depends on the method being used. One of the promising methods was Rapid Application Development (RAD). To address the ever-changing needs of users, developers are increasingly turning to methodologies like the Rapid Application Development (RAD) method. As Yumhi *et al.* (2024) point out, RAD allows for faster design, analysis, and implementation of system changes. This iterative approach ensures the final product closely aligns with user feedback, making it more adaptable to dynamic needs. Similarly, Tongkaw *et al.* (2019) highlight that the RAD model prioritizes a rapid design and development cycle while aiming for high-quality results. It achieves this by drawing inspiration from established methodologies like waterfall, agile, and scrum. Evaluation is crucial to ensure the system meets all target user requirements. The ISO/IEC 25010:2011 standard provides a well-established framework for software quality evaluation (Estdale & Georgiadou, 2018). This approach goes beyond simply assessing the software product itself; it helps determine the effectiveness of the development processes and identify areas for improvement.

3. METHODOLOGY

3.1. System Development Method

To increase the likelihood of success in software development, it is crucial to choose an appropriate System Development Life Cycle (SDLC) model that suits the project's requirements. In the case of the resident information management system, the Rapid Application Development (RAD) model was utilized, as it was a project requirement for a bachelor's degree in Information Technology. RAD is particularly useful for developing modularized systems in a short amount of time, typically between two to three months. By adopting the RAD model, the development of the resident information management system can be expedited without compromising the quality of the system's output.

Phases of the model (Figure 1) comprise requirements capture, quick design, build prototype, and prototype evaluation. Each step will execute once the initial phase is complete and if necessary, the process could be repeated until the final product met the required functionality. The following explains the salient activities for each phase.

Requirement Capture

In this phase, all the requirements for the development were gathered such as user requirements, functional requirements, hardware, and software requirements as well as security requirements. Through onsite visits, interviews with Barangay

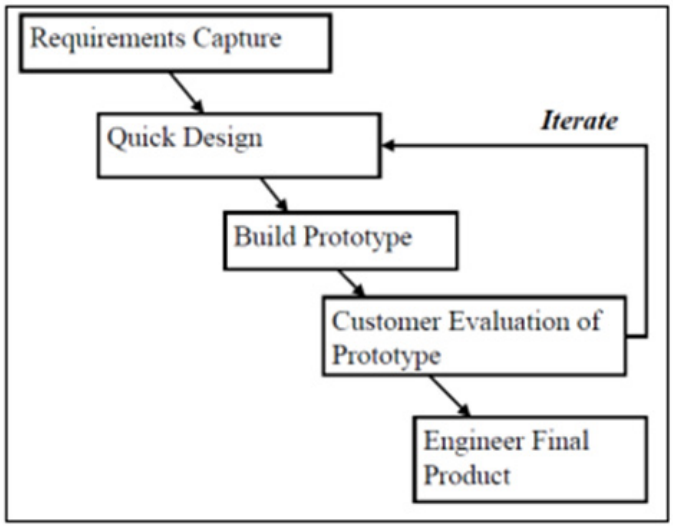

Figure 1. RAD Model (Sarker *et al.*, 2015)

officials and residents of Bongabong, observation, document analysis, and benchmarking of the relevant current system, all the requirements were determined and finalized.

Requirement capture was followed by three iterative phases such as quick design, building a prototype, and customer evaluation.

Quick Design

Upon identifying all the requirements, the preliminary design was drafted. The researchers began by drawing a simple wireframe of the site and then translating it later into a mockup (Figure 2). This will help the target users to initially visualize the system to give their feedback in the early stage of development. This will make sure that the system development is on the right track.

Figure 2. Sample Mockup of the Developed System

Build Prototype

The developed mock-up in the previous phase was transformed into a working prototype in this phase. The prototype was developed using Hypertext Markup Language (HTML), and Cascading Style Sheet (CSS) frameworks such as Bootstrap for the front end and PHP and MySQL for the back end.

Customer Evaluation

Upon development of the prototype, it was evaluated by the target users and some external experts. Their feedback will be integrated to improve the total capability of the system. The final evaluation used ISO 25010 criteria.

Engineer Final Product
After improving the prototypes based on feedback, the system was finalized and ready for implementation.

3.2. Testing and Evaluation

The system underwent to series of tests like unit, integration, and system testing which are mandatory for software development. Every prototype was tested by the developers using test cases. On the other hand, upon finalization of the system, it was evaluated using ISO 25010 criteria.

Six criteria from ISO 25010 software quality standards were used as evaluation criteria as shown in Table 1. Each criterion has three indicators. The proponents utilized a verbal interpretation of strongly agree to strongly disagree on a four-point Likert scale to measure respondents' beliefs. The evaluators are purposively selected.

Table 1. Evaluation Instrument based on ISO 25010

Criteria	Indicators
1. Functional Suitability	The system covers all the specified tasks and user objectives.
	The system provides the correct results with the needed degree of precision.
	The system facilitates the accomplishment of specified tasks and objectives.
2. Performance Efficiency	The system's response and processing times and throughput rates, when performing its functions, meet requirements.
	The system's amounts and types of resources used when performing its functions meet requirements.
	The system's maximum limits of parameters meet requirements.
3. Compatibility	The system smoothly runs on any device.
	The system is accessible on any device with an internet connection.
	The system generates an effective result of data from the prototype.
4. Usability	The system allows users to recognize if it is appropriate for their needs.
	Specified users can use the system to achieve specified learning goals effectively, and efficiently and have freedom from risk and satisfaction in a specified context.
	The system has attributes that make it easy to operate and control.
5. Reliability	The system meets the need for reliability under regular operation.
	The system is operational and accessible when required for use.
	The system can operate as intended despite the presence of hardware or software faults.
6. Security	The system can be accessed only by the authorized users.
	The system is secured and protected in terms of data transmission.
	The system provides its unique account to each end user.

4. RESULTS AND DISCUSSION

The development of a Resident Information Management System (RIMS) has a lot of aspects to consider such as the different requirements of the users, appropriate technologies to be used, how it should be implemented, and the like. After considering those aspects and following the rapid application development (RAD) methodology the system was successfully developed. The following section will present the system output and its evaluation result.

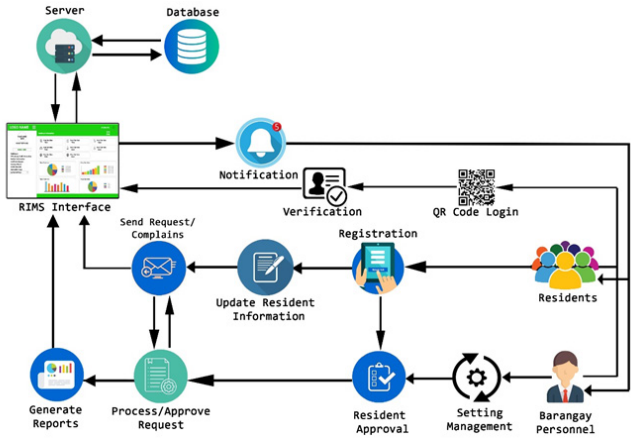

Figure 3. System Architecture of the Developed System

4.1. System Architecture

Figure 3 shows how the system works with the Barangay Personnel and individual residents. Both users could access the system using a quick response (QR) code generated when they created their accounts. As a second level of security, the users also need to undergo verification through a mobile pin(MPIN). The Barangay Personnel served as an administrator that was able to customize the information that would appear on the resident end. The administrator could also approve the residents, process their requests and generate reports. On the other hand, the resident should register first to be able to use the system to be approved by the administrator. Once approved, the residents can update their information, send document requests or complaints, and receive notifications from the system.

4.2. System's Features

Table 2 shows the salient features of the developed system. These features are from the analyzed user requirements.

Table 2. Identified Features and Functions

Features/Functions	Description
User Authentication	The system administrator, as well as barangay residents, has individual accounts to log in.
Data Visualization	The system features graphs and will evaluate historical data to help users better comprehend changes that have taken place.
QR code-driven	The QR codes will be applied to allow access to the system and resident accounts.
Online Complaint Blotter/Reporting	Submit complaint details and edit the status update through the system.
Certificates Processing and Issuance	The system automates the preparation of Barangay Documents needed by the residents.
Generate Query and Print Report	The system enables filtering records depending on chosen parameters and printing them.
Online Document Request	The system has featured that residents can submit the request form for their needs.
Fully Customizable	The system could be customized wherein any barangay could possibly use the system

Table 2 shows the salient features of the developed system. These features are from the analyzed user requirements.

4.3. System Development Output

As previously mentioned, the system has been designed to cater to two primary users - the Barangay Staff who serve as administrators, and the residents. To gain access to the system, residents are required to follow a simple three-step registration process.

The first step is to carefully read and accept the policy and agreement stated on the website. By doing so, residents can familiarize themselves with the terms and conditions of using the system and agree to abide by them.

The second step involves entering their personal information, as shown in Figure 4. This information is crucial as it is used to create a resident account and provide access to the system. Residents must provide accurate and up-to-date information to enable the system to provide efficient and effective services.

The final step requires residents to upload a valid ID for verification purposes. This step is essential in ensuring the system's security and authenticity, as it verifies the user's identity and confirms that they are legitimate residents of the barangay. The uploaded ID will be checked against the system's database to ensure that only authorized individuals can access the system.

Upon completing the registration process, a verification email will be sent to the resident's registered email address. Once the resident verifies their email, they can log in to the system using

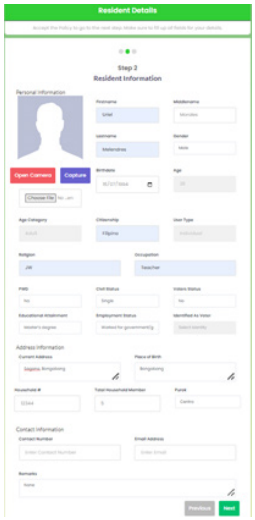

Figure 4. Required Resident Information

their username, password, and resident pin. The verification email is a critical step in ensuring the system's security and confirming the resident's email address. By doing so, the system can prevent unauthorized access and protect the residents' personal information. Once verified, residents can easily access the system and utilize its features to facilitate their barangay-related transactions.

Figure 5 displays the user-friendly interface for the resident that allows them to request documents and update their information effortlessly. Additionally, residents can download a QR-coded ID, which serves as a valid identification card.

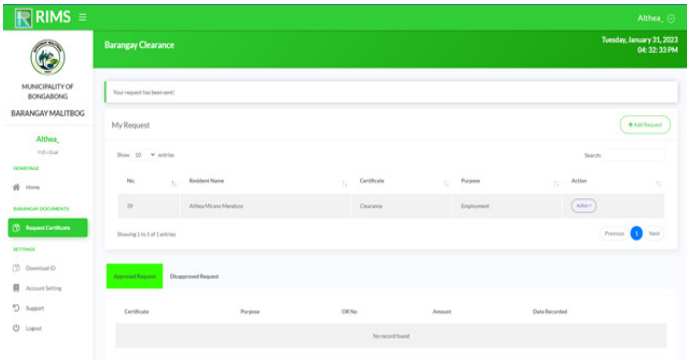

Figure 5. Resident Page

Upon login, the administrator is redirected to the dashboard, which provides a comprehensive overview of the system's key metrics, such as the population and requested documents. Figure 6 illustrates the dashboard's interface, which is designed to be user-friendly and easy to navigate. The administrator has the flexibility to customize the barangay information to suit their specific needs. This customization ensures that the system can be adapted and utilized by any barangay that wishes to implement it, providing a versatile and efficient solution for barangay-related transactions.

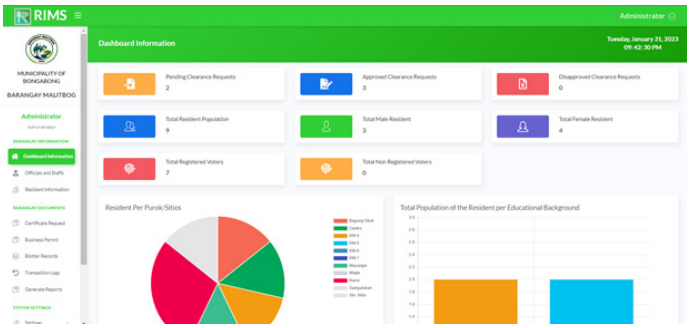

Figure 6. Administrator's Dashboard

The system enables the administrator to manage document requests efficiently. The administrator has the authority to approve or disapprove requests, as shown in Figure 7. Additionally, the system provides a notification feature that enables the requesting party to be informed of the status of their request promptly.

Apart from clearances and permits, the system also allows for the recording of blotters. This feature provides a centralized platform for recording and managing such incidents, enhancing the barangay's ability to monitor and address security concerns effectively.

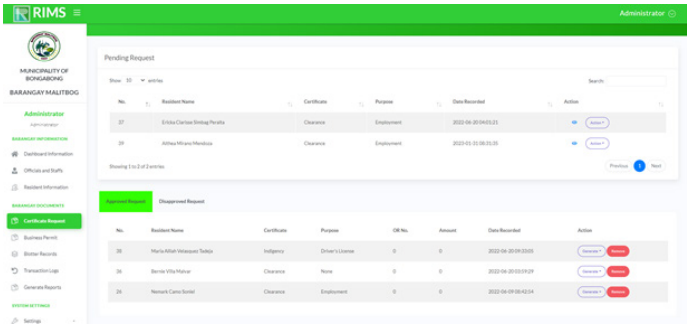

Figure 7. Document Request Page

The system is equipped with a reporting feature that allows the administrator to generate reports based on various filters such as resident category, Sitio/Purok, and gender of the residents (Figure 8). The ability to generate reports based on various filters ensures that the administrator can quickly retrieve the required information, saving time and effort. This feature enables the barangay to get summarized data that could be used for projects or programs for its residents, enhancing the barangay's ability to plan and implement programs effectively.

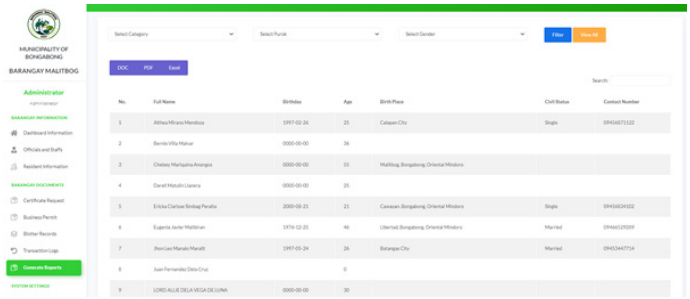

Figure 8. Generating Report

4.4. Evaluation Results

The developed system was evaluated using six characteristics of ISO 25010 software quality standards, each having three indicators. To assess the system's performance, it was initially deployed in Barangay Malitbog, Oriental Mindoro, where it underwent rigorous testing and evaluation.

During the evaluation, a varied group of participants provided feedback, including residents of Barangay Malitbog (43% of evaluators), barangay officials and staff (20%), and IT professionals with experience in system development (17%). Barangay Malitbog residents were active users of the system being evaluated.The following is the presentation of the actual result of the evaluation.

Functional Suitability

Functional suitability implies the presence of the required functionalities and features as well as their behavior. The three indicators represent the completeness, correctness, and appropriateness of every function of the developed system.

Table 3. Functional Suitability Evaluation Result

Indicators	Mean	Verbal Interpretation	Rank
The system covers all the specified tasks and user objectives.	3.10	Agree	3
The system provides the correct results with the needed degree of precision.	3.67	Strongly Agree	1.5
The system facilitates the accomplishment of specified tasks and objectives.	3.67	Strongly Agree	1.5
Weighted Mean	3.48	Agree	-

The evaluation results (Table 3) show that the respondents strongly agreed that the system provided proper and appropriate functionality. Nevertheless, the evaluators only agreed on the completeness, resulting in a minor decrease in the weighted mean to 3.48. This implies that, while the system's core functions suit the expectations of its users, there may be potential for development in terms of additional features or services. Overall, the results proved the system's dependability and efficacy, although there is always room for improvement and modification to better serve its users.

Performance Efficiency

How relative is the system's performance to the number of resources utilized under specific conditions? This is an important question when checking the performance efficiency of the developed system. The response time of the system, the resource utilization, and the limitation of the system were expressed by the three indicators in this area.

Table 4. Performance Efficiency Evaluation Result

Indicators	Mean	Verbal Interpretation	Rank
The system's response and processing times and throughput rates, when performing its functions, meet requirements.	3.7	Strongly Agree	1.5
The system's amounts and types of resources used when performing its functions meet requirements.	3.7	Strongly Agree	1.5
The system's maximum limits of parameters meet requirements.	3.47	Agree	3
Weighted Mean	3.62	Strongly Agree	-

Performance efficiency received the highest weighted mean among all the evaluation criteria. This indicates that most of the respondents strongly agreed that the system meets the requirements for response time and resource utilization. This is a positive indication that the system is operating smoothly and efficiently. By providing users with a seamless and responsive experience, the system is better equipped to meet the needs of its users and improve overall user satisfaction. It is clear from the evaluation that the system's performance efficiency is a strength that should be maintained and potentially built upon in future iterations.

Compatibility

Compatibility represents how the system adapts to different environments and working conditions. It is important to check how the system responds to different types of devices or operating systems.

Table 5. Compatibility Evaluation Result

Indicators	Mean	Verbal Interpretation	Rank
The system smoothly runs on any device.	3.37	Agree	3
The system is accessible on any device with internet connection.	3.47	Agree	2
The system generates an effective result of data from the prototype.	3.70	Strongly Agree	1
Weighted Mean	3.58	Strongly Agree	-

Given that the developed system relies on internet access, it is not surprising that the internet connection is the main factor affecting its performance on different devices. This is reflected in the evaluation results, with the indicator related to running behavior having the lowest mean among the three indicators as shown in Table 5. While this is a limitation of the system, it is not unique to this particular application, and rather a common challenge for any system that relies on internet connectivity. It is important for users to ensure they have a stable internet connection to ensure the system operates optimally. Nonetheless, this finding highlights the importance of considering the impact of external factors, such as internet connectivity, when developing and evaluating digital systems.

Table 6. Usability Evaluation Result

Indicators	Mean	Verbal Interpretation	Rank
The system allows users to recognize if it is appropriate for their needs.	3.37	Agree	2.5
Specified users can use the system to achieve specified learning goals effectively, and efficiently and have freedom from risk and satisfaction in a specified context.	3.37	Agree	2.5
The system has attributes that make it easy to operate and control.	3.53	Strongly Agree	1
Weighted Mean	3.42	Agree	-

Usability

One of the important characteristics of any application software or system is its usability. The system should achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use. The three indicators used in the evaluation represent appropriateness recognizability, learnability and operability.

The developed system is comprehensive, and its intended users could be from all age groups. Having trouble learning how to use it could prevent its utilization. This could explain the evaluation result for usability (Table 6). In the first two indicators, evaluators simply agreed that the developed system is appropriate for their needs and its learnability. In contrast, the system's ability to offer a few features that make it simple to use and control is a benefit to the users.

Reliability

Reliability was evaluated by looking at how the system product executes its specified functions under certain conditions for a specific period. The system's maturity, availability, and fault tolerance which are represented by three indicators were evaluated under reliability.

Table 7. Compatibility Evaluation Result

Indicators	Mean	Verbal Interpretation	Rank
The system meets the need for reliability under regular operation.	3.43	Agree	2
The system is operational and accessible when required for use.	3.50	Strongly Agree	1
The system can operate as intended despite the presence of hardware or software faults.	3.40	Agree	3
Weighted Mean	3.44	Agree	-

Based on the data presented in Table 7, the system remains reliable despite only two indicators receiving agreement from the evaluators. It is worth noting that the system's availability when needed was ranked first among the indicators, possibly due to its online availability. The majority of residents in the area have access to mobile phones and reliable internet signals, which allows them to use the system easily.

However, it is essential to consider that the evaluators' agreement on only two indicators may indicate areas for improvement in the system. Further evaluation and analysis may be necessary to identify specific areas that require attention and enhancements to improve the system's overall functionality and reliability.

Security

The developed system holds sensitive information about the residents thus, checking the security of the information stored on the system is very important. The confidentiality of data and the accountability of the users from where the data came to represent the indicators in this criterion.

Table 8. Security Evaluation Result

Indicators	Mean	Verbal Interpretation	Rank
The system can be accessed only by authorized users.	3.73	Strongly Agree	1
The system is secured and protected in terms of data transmission.	3.40	Agree	2.5
The system provides its unique account to each end user.	3.40	Agree	2.5
Weighted Mean	3.51	Strongly Agree	-

The system's security was evaluated and the results (Table 8) indicate that it is secure and does not compromise the confidentiality of resident data. While two indicators received a general rating of "Agree," the overall weighted mean of 3.51 indicates that respondents strongly agreed with the system's security.

5. CONCLUSIONS

The developed system has shown itself to be efficient and helpful in monitoring residents' records and offering convenient community services. The system was tested and assessed in Barangay Malitbog, Oriental Mindoro, and could also be implemented in other barangays. It has two primary users: barangay employees and residents, and it includes functions such as document request management, blotter recording, and report generation. The evaluation findings show that the system meets the functional requirements of its target users; however, further features such as e-payment and smarter authentication may be implemented to improve it even further. To guarantee that the system is being used effectively, proper training should be provided to the implementing barangay. Overall, the developed system represents an important step toward digitization.

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