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Optimizing registry of inhabitants' record management: the development of municipal consolidation system for local governance

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ABSTRACT

This study focuses on developing a municipal consolidation system to optimize the registry of inhabitants' records management and address local government units' challenges. The system was created employing the iterative waterfall model, anchored to the system development life cycle framework. It is a cross-platform application, runnable on Windows and Android operating systems. The system underwent user testing and evaluations utilizing the system usability scale measure and an evaluation patterning the ISO 9126-1 software quality model standard to ensure its functionality. The results of the testing and evaluations show positive feedback from users, indicating that the developed system meets the users' needs and requirements and has a high acceptance rate from the local government unit. Therefore, the system can be considered a successful support tool for local governance. Consequently, we recommend that other local government units in the region adopt the system to improve their record management practices.

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KEYWORDS

Records Management; Municipality of Hinunangan; Registry of Inhabitants; Municipal Consolidation System; Local Governance; Iterative Waterfall Model; System Usability Scale; ISO 9126-1

INTRODUCTION

The registry of inhabitants in any form of government is vital to a country's development initiatives. It serves as the basis for better planning in any service requirement, like proper responses to any calamity's occurrences, correctly identifying vulnerable sectors, and helping prevent crime and acts that disrupt the peace and order situation of a particular nation or place. On the other hand, promoting digitalization is promising since applying information and communication technology (ICT) in the government sector has gained an advantage in several parts of the world. Moreover, it has played a vital role in improving governance by enhancing the government's role in digitalizing government records and reports (Lacasandile, 2020; Carpio, 2020; Santa et al., 2019; De Castro & De Castro, 2022).

Effective record management on the registry of inhabitants' data is crucial for local governance. Some municipalities in the country face the challenge of managing and maintaining accurate and up-to-date records of their inhabitants. As mandated in the Local Government Code (Sec. 394), the records of all inhabitants' personal and relevant information should be kept, maintained, and updated. The maintenance and updates of these records are necessary whenever there is a call of the times. Thus, there is a need to formulate a highly efficient system for keeping records of residents in all the country's local government units. One of the DILG Memorandum Circulars has also recommended adopting a computerized system to enhance records management and promote local governance. Hence, it is high time that this digitalization system reaches the bottom level of bureaucracy, like the local government units, as they play an essential role in achieving the country's national goals.

The local government units in the Philippines have implemented various systems for collecting and processing data useful for planning, program implementation, and impact monitoring. For instance, the Community-Based Monitoring System (CBMS) is a technology-based system designed for collecting and validating disaggregated data, primarily aiming to combat poverty and boost economic growth (Diokno et al., n.d.). Also, there are several systems related to health and medical records, criminal records, agricultural records, disaster records, water billing records, tax records, and permit records that have been developed (Acoba et al., 2020; Asor, 2020; Castro et al., 2022; Celi-Parraga et al., 2021; Dariagan, 2021; Estinar et al., 2018). Meanwhile, other regions in the country have adopted the Registry of Barangay Inhabitants and Migrants (RBIM) from the Commission on Population and Development (PopCom). The RBIM is used for tracking the internal movement of people from one place to another and identifying vulnerable members of the population for practical intervention during crises. Furthermore, some municipalities have implemented systems related to resident profiling; however, some vital and relevant information has been given less emphasis and needs to be addressed (Hashiyan et al., 2021; Lacasandile et al., 2020). This underscores the need to consider the development of systems that can capture and manage relevant information and generate reports tailored to the specific requirements of the national agencies.

The municipality of Hinunangan in Southern Leyte's province has 40 barangays. The consolidation of the registry of barangay inhabitants (RBI) reports has been maintained manually using paper-based records, making it susceptible to losses and taking time to retrieve records. According to one of the two Department of the Interior and Local Government (DILG) unit heads of the province, one of the challenging parts at the municipal level is asking for reports from the barangays, such as this registry of inhabitants. As for them, no computerized system has been adopted to consolidate the reports, making it challenging for them to provide up-to-date reports when other agencies in the country, like the Department of Social Welfare and Development (DSWD) and other national agencies, would require such.

Thus, the researcher aimed to design and develop a municipal consolidation system for the registry of inhabitants' records. The system can track the records of inhabitants in all its barangays, so it can quickly provide consolidation of reports. The system has features for synchronizing the updated records at the barangay level with the municipal level. Submission of RBI-related reports has two options: it can be submitted online or through importation when internet service is unavailable. Other agencies, like DSWD, are concerned with vulnerable sectors like persons with disabilities (PWD), senior citizens, out-of-school youth records, the Rural Health Unit on health and vaccination-related records, the Philippine Statistics Authority (PSA) on population-related records, and the Disaster Risk and Reduction Management Office (DRRM) on calamity-related records. They can access the system with restrictions only to the data they can view and monitor. The system is custom-tailored to address the specific requirements of local government units regarding reporting, especially in compliance with national agency mandates. The generated reports align with the exact specifications demanded by national authorities. Furthermore, the system offers distinction in terms of design concepts, user interfaces, and data reporting, which this approach introduces innovative features that set it apart. The user interfaces have been carefully designed for user-friendliness and efficiency, ensuring the system is accessible and intuitive for local government officials.

MATERIALS AND METHODS

The municipal consolidation system's development for the inhabitants' registry followed the Systems Development Life Cycle (SDLC) framework employing the iterative waterfall model. The iterative waterfall model is an enhanced version that addresses the shortcomings of the traditional waterfall model. It still has its sequential processes that move downward through the phases; however, developers are free to go back into previous phases of development to make any form of adjustment or improvement for which iterations are enabled. The phases of the iterative waterfall model are requirement analysis and specification, design, implementation (coding and unit testing), integration and system testing, system deployment, and maintenance (Govindan et al., 2021; Sharma, 2019), as shown in Figure 1.

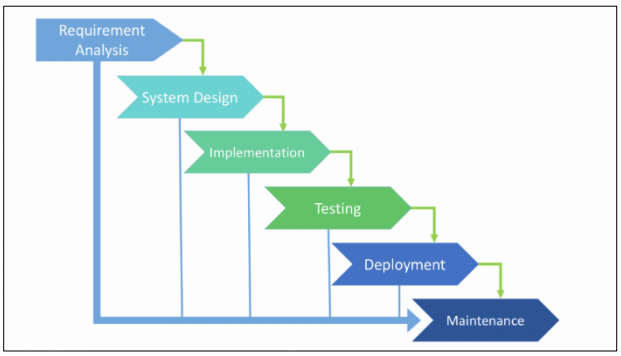

Figure 1: Iterative Waterfall Model

Requirement Analysis. The researcher and the local government unit identified the objectives and scope of the project, gathered, and documented the requirements, and ensured that the requirements aligned with the users' needs and the system's goals. As a result, the system features were

customized to meet local practices, satisfy local demands, and consider local conditions (Hertzum & Simonsen, 2019).

System Design. This phase addressed and defined the system components, interfaces, and interactions, including the architecture, data structure, and user interface design (Sommerville, 2010; Hurst, 2014; Pressman & Bruce, 2014). Figure 2 shows the context diagram of the municipal system and the top-level view of the systems that had been developed. In addition, it showed the system's boundaries and scope.

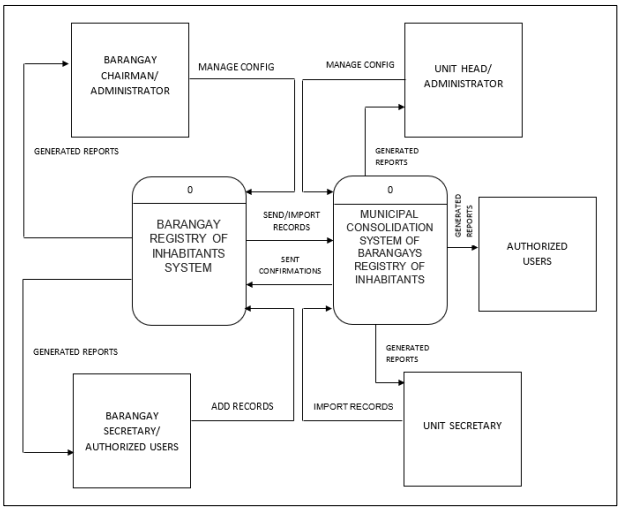

Figure 2: Context Diagram of the Municipal RBI System

Implementation. The creation of the system has been implemented in this phase. Activities like writing the code, presenting the system to the user, and testing the system were initiated here, ensuring that all required information had been integrated.

Testing. Here, the end user's environment has tested the system. Test scripts were served to the testers to document the testing activities. A user acceptance test certificate was issued to prove that all system modules and features are functional, operational, and valuable. The secretary was responsible for the required testing activities. The unit head was the one who certified and approved that the testing activities had gone through the process, including issuing the certificate for the user acceptance test, which signified that the agency had accepted the system (Hertzum, Simonsen, 2019). The system was evaluated using the system usability scale (SUS) created by John Brooke (1986), consisting of a 10-item questionnaire. It has five response options for participants, from strongly disagree (1) to strongly approve (5) (Table 4). The odd-numbered questions were positively framed, while the even-numbered questions were negatively framed. To get the SUS score, first, get the sum for all odd-numbered questions (X) and even-numbered questions (Y). It will be calculated then to be X0 = X–5 and Y0 = 25–Y. To calculate the SUS score, add X0 and Y0 and multiply by 2.5 (SUS Score = (X0 + Y0) *2.5). The SUS Score indicates the usability performance of the system in the aspects of effectiveness, efficiency, and overall ease of use. For example, if the average SUS score is 68, a score of 68 will just put you at the 50th percentile. See Table 1 for SUS interpretation.

Table 1: SUS Interpretation

SUS Average Score	Grade	Adjectival Rating
>80.3	A	Excellent
68-80.3	B	Good
68	C	Okay
51-68	D	Awful
<51	F	Poor

Another system evaluation was then conducted using the adopted survey questionnaire patterned from ISO 9126-1 (Software Quality Model Standard) to assess system functionality, usability, efficiency, reliability, and maintainability (Manun-og, et al., 2022). The survey consists of a 20-item questionnaire with five response options for participants, from highly disapprove to highly approve (Table 2). The secretary and three experts in the field served as system evaluators.

Table 2: Systems evaluation

Criteria	Rating
System functionality	
1. System features performed accurately.	1 to 5
2. The interface of this system is pleasant.	1 to 5
3. Report generated is consistent with the recorded entries	1 to 5
4. Easily locate and search recorded entries.	1 to 5
5. Transactions can be done quickly.	1 to 5
System usability	
6. User-friendly environment is evident.	1 to 5
7. The system quickly completes my work.	1 to 5
8. The system helps me become productive.	1 to 5
9. The information provided by the system is effective in helping me complete my work.	1 to 5
10. This system has all the functions and capabilities I expect it to have.	1 to 5
System efficiency	
11. Retrieval of records can be done quickly.	1 to 5
12. Update and correction of entries can be updated and altered.	1 to 5
13. Generation of the report done promptly.	1 to 5
14. Report can be easily interpreted.	1 to 5
15. Reports can be provided anytime as needed.	1 to 5
System reliability and maintainability	
16. Records are safely secured and can be retrieved by an authorized person	1 to 5
17. System is strongly secure with a password	1 to 5
18. Modification of system settings can be done by an authorized person	1 to 5
19. Alteration of records can be traced and recognized.	1 to 5
20. Errors in the system can be immediately corrected.	1 to 5

Note: 1-Highly Disapprove, 2-Disapprove, 3-Neutral 4-Approve, 5-Highly Approve

Deployment and maintenance. This was the time when the system was deployed in the end-user's environment. It involves installing the system and providing users with training and support (Garcia & Pardo, 2006). In addition, a memorandum of agreement between the two parties will be executed to ensure that both parties' responsibilities are clearly understood. Finally, the system will be monitored and maintained to ensure its continued operation. If necessary, it may involve fixing bugs, updating the system, and providing ongoing support (Cockburn, 2006).

RESULTS AND DISCUSSION

System Design and Implementation

The system was developed using various technologies, including Node.js and the Express API, Dart Flutter for the UI, the.NET Framework using C# for the desktop service, and the HeidiSQL database. Figure 3 shows the main screen of the Municipal Consolidation System of Registry of Barangay Inhabitants, which serves as the system's navigation hub. It features a dashboard that summarizes the total count of relevant information. The system also offers menus that consist of Information, Lookup, Reports, and Settings.

Under the Information menu, users can access information related to residents, households, health, occupation, death, education, disaster assistance family access card (DAFAC), kasambahay, person who uses drugs (PWUD), and vaccination. All recorded information comes from municipal barangays. In addition, the Lookup menu offers flexible customization of selections, such as civil status, occupation, citizenship, and more.

In addition, the Report menu allows users to generate consolidated reports per barangay, such as monitoring updated RBI records, summaries of residents and households, DAFAC, kasambahay, vaccination, and other vulnerable information. Finally, the Settings menu provides options for generating users, assigning user roles, displaying audit logs, and allowing import and export functions. Finally, the Logout menu enables users to exit the system.

Figure 4 displays the residents' data per barangay, where users can quickly locate and search for specific records. Figure 5 shows the architectural layout of the implemented system. Barangays with an internet connection can access the system directly by connecting to their IP address and selecting a specific barangay. For barangays without an internet connection, the system is installed locally. Import and export functions are utilized to update records and reports at the municipal level. All barangay RBI reports are stored at the municipal level for centralized management, monitoring, and accessibility.

Figure 3: The Municipal Consolidation System of RBI Main Screen

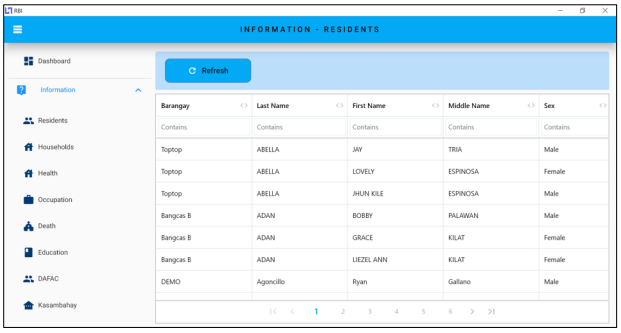

Figure 4: The Interface of Residents Information

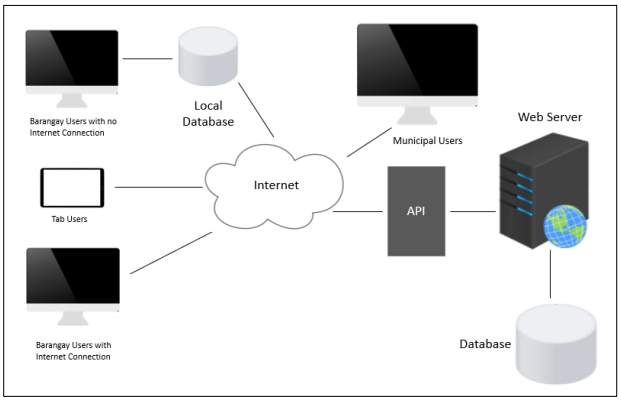

Figure 5: The Systems Registry of Inhabitants Architectural Layout

System Testing

In this phase, testing activities were undertaken to ensure the operation and functionality of the system. The local government unit secretary serves as the tester, the system's end-user. In addition, the system was evaluated by the same person and another three experts in the field: one is a senior programmer in a prestigious software company with 15 years of experience in the industry, another is a system administrator at a university for more than 12 years and an IT faculty member at a university for 20 years. Tables 3, and 4 show the system evaluations with corresponding results, respectively.

System Deployment and maintenance

The system has been already adopted and successfully deployed in the user's environment. The memorandum of agreement between the municipality of Hinunangan and the Southern Leyte State University has been duly executed by the respective leaders. The system will also be monitored and maintained for continued operation.

Table 3: SUS average score result

Particular	Average Score
1. I think that I would like to use this system frequently.	5.0
2. I found the system unnecessarily complex.	5.0
3. I thought the system was easy to use.	5.0
4. I think that I would need assistance to be able to use this system.	1.0
5. I found the various functions in the system were well integrated.	5.0
6. I thought there was too much inconsistency in this system.	1.0
7. I would imagine that user would learn to use this system very quickly.	5.0
8. I found the system very awkward to use.	1.0
9. I felt very confident using the system.	5.0
10. I needed to learn a lot of things before I could get going with this system.	1.0

Note: 1.0-1.8 (Strongly Disagree), 1.9-2.6 (Disagree), 2.7-3.4 (Neutral), 3.5-4.2 (Agree), 4.3-5.0 (Strongly Agree)

Table 4: SUS result

X (sum of odd numbers)	Y (sum of even numbers)	X0 (X-5)	Y0 (25-Y)	SUS Average Score (X+Y) * 2.5	Grade	Adjectival Rating
25	9	20	16	85	A	Excellent

Table 5: Systems evaluation result

Criteria	Weighted Mean
Systems functionality	5.00
Systems usability	5.00
Systems efficiency	4.95
Systems reliability and maintainability	4.90

Note: 1:0-1.8 (Highly Disapprove), 1.9-2.6 (Disapprove), 2.7-3.4 (Neutral), 3.5-4.2 (Approve), 4.3-5.0 (Highly Approve)

Figures 3 and 4 display the interface of the consolidation system at the municipal level, showcasing relevant information counts per barangay and records submitted by barangays.

The System Usability Scale (SUS) results, presented in Tables 3 and 4, demonstrate an impressive average score of 85, which belongs to the top-rated score. This score indicates that the system's usability, effectiveness, efficiency, and overall ease of use are excellent.
Furthermore, the evaluation results in Table 5 reveal that the system's functionality, usability, efficiency, reliability, and maintainability were all highly approved, demonstrating that it has met the software quality standard ISO 9126-1 (software quality model standard).

Based on the positive feedback from user testing and evaluations, including the high acceptance rate by the local government unit in the municipality of Hinunangan, it can be implied that the developed system is a success. The system has effectively addressed the challenges faced by the agency and can be considered a useful, operational, and high-quality tool for managing their registries of inhabitants. Furthermore, the developed system had been customized to fit the agency's work practices, meet local demands, and consider local conditions (Hertzum & Simonsen, 2019).

Accordingly, applying ICT tools to government agencies has provided instant access to information and supported better decision-making for residents, businesses, and other government arms (Lacasandile, 2020; Carpio, 2020). Moreover, it enables the delivery of speedy, inexpensive, trustworthy, and reliable government services to households and businesses (Mirchandani et al.; S., 2018). Therefore, digitalizing government processes, including recording transactions, is increasingly recognized as an essential strategic tool for delivering efficient public services (Santa et al.; M., 2019).

In conclusion, the developed system has effectively addressed the agency's issues and is a success. Applying information and communications technology (ICT) to government services can make them more efficient, responsive, ethical, accountable, and transparent (De Castro & De Castro, 2022). Therefore, the developed system is an excellent example of how ICT can be utilized to enhance government services and meet the needs of local communities.

CONCLUSIONS AND RECOMMENDATIONS

The development of the municipal consolidation system has provided a solution for addressing the challenges the local government units face in their record management for the registries of inhabitants. The system has enabled the efficient retrieval and consolidation of records per barangay, resulting in timely reporting and monitoring of barangay compliance. In addition, the system's accessibility anytime and anywhere has made it easier for local officials to retrieve relevant information, even while traveling. In addition, the system's capability of being a cross-platform application can be accessed and utilized conveniently by users, providing a more efficient and effective way of managing the registry of inhabitants. Furthermore, providing the relevant information required by other agencies like DSWD and RHU has become more efficient and streamlined, with information readily available on the system. The positive feedback from user testing and evaluation and the high acceptance rate from the local government unit indicate the potential benefits of adopting this technology-driven solution, ultimately improving local governance record management practices. It is recommended that other local government units

in the region adopt the system to improve their record management practices.

CONFLICT OF INTEREST

The authors declared that there is no conflict of interest.

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CONTRIBUTIONS OF INDIVIDUAL AUTHORS

This research article is an extract from a dissertation study conducted by the lead author, with the second author as the adviser.

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