International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Development of Records Tracking Management System with QR Code

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Abstract

At Surigao del Norte State University, the process of keeping track of records is done manually by writing or logging document descriptions in the physical logbook. When the office staff received and outgoing the document, they need to log it in the physical logbook. The process relies on a physical logbook to keep track of each document's movement. The problem here is some of the documents are missing during the process and no one can pinpoint a person since the system is not accurate and reliable.

To expedite the implementation process, the researcher opted to utilize the Rapid Application Development (RAD) model for realizing the system. This approach enables the developer to receive ongoing suggestions and feedback while constructing the system, allowing them to make necessary changes to the code as needed. By incorporating this iterative feedback loop, the developer can ensure that the system meets the requirements and expectations of the stakeholders promptly.

After implementing the Records Tracking Management System (RTMS) and analyzing the results, the system has performed exceptionally well in fulfilling its purpose of tracking and managing documents. It successfully tracks documents, verifies user authenticity, retrieves files when needed, and keeps a detailed audit trail. The functionalities of the system perfectly align with our organization's goals and effectively cater to the needs of our users.

To sum it all up, the evaluators have provided positive feedback, consistently rating the RTMS highly across all quality characteristics. With an average weighted mean of 4.44 out of 5, it is evident that the system has either met or exceeded expectations in terms of functionality, reliability, performance, usability, security, compatibility, maintainability, and portability. These findings provide a strong foundation for designing and developing an efficient and user-friendly Records Tracking Management System that effectively caters to our organization's document management needs.

Keywords: Rapid Application Development (RAD), Manual logbooks, Document tracking

Introduction

In the old document management system, information was entered manually into the logbook, which wasted time and increased the likelihood of errors in recording information. This process is inefficient and unsuitable for larger companies or institutions with a significant number of documents. Since many employees tend to lose track of document paths, these systems should have the capability to trace the journey of documents from their source to their destination [1].

QR codes, widely used for document tracking, are compact, square-shaped barcodes that can be scanned effortlessly with a smartphone or other QR scanner. This allows users to quickly find information or records related to the code. QR codes offer many benefits for document tracking, can involve expedient and effortless access to, as well as sharing of, information, And they easily integrate with existing records management systems [2].

At Surigao del Norte State University, the process of keeping track of records is done manually. The current document tracking process involves offices: Office 1 receives incoming documents and transfers them to Office 2. The process relies on physical logbooks to keep track of each document's movement.

Here is how it works: Office 1 records incoming documents in the logbook. When the documents are ready to be sent to Office 2, they are recorded again. Office 2 receives the documents, records them in their logbook, and processes them. After processing, Office 2 prepares the documents for transfer to another location, records them once more in the logbook, and obtains a signature. In the provisions of the Republic Act No. 11032 Section 9 [3], officers and receiving offices must fulfill their responsibilities in the efficient delivery of government services. The fault of the staff shall be impacted to the Office Heads as per stated in Section 8 [3].

With this, there is a need to come up with a better way to keep track of records and information using technology. One idea is to create a system that centralizes all the records in one place, making it easier to manage and track them. This system would use QR codes to keep track of where the records are and their history, including where they came from, where they are now, and how long it takes for them to be processed. It would be a web-based application built using the PHP Laravel framework, capable of storing different types of documents and allowing them to be stored both locally and in the cloud.

Records-tracking management systems are a type of information and communication technology (ICT) innovation that uses software to improve the way organizations manage and track their records. By providing a centralized platform for managing and tracking records, these systems can help organizations improve efficiency and transparency [4].

This system is specifically designed to improve the tracking of documents for Surigao del Norte State University. The traditional manual process of tracking documents can be time-consuming and prone to error, so by using this system, the tracking process is automated, making it more efficient and reliable.

Objectives of the Study

The study aimed to accomplish the following specific objectives:

1. To analyze the process flow using unified modeling languages.
2. To design the specific features, user interfaces, and database schema of the system.
3. To develop the system using a combination of technologies like PHP Laravel Framework, Livewire Component, Bootstrap 5, and jQuery.
4. To evaluate how well the system works in terms of its reliability, usability, security, and other factors using a standard software quality tool called ISO 25010.

Related Literature and Systems

Keeping track of documents in an organization is very important, and some helpful technologies can be used to do this effectively. For example, QR codes, web-based systems, and barcode technology have all been shown to work well. This review of previous research will explore how these technologies have been used to track and manage documents.

The University of the Philippines (UP) employs a document tracking system (DTS) for enhanced efficiency and transparency [1]. The UP DTS lacks route functionality, causing potential delays [1]. Incorporating routes would significantly improve its effectiveness. QR codes, increasingly popular due to their touchless nature, connect physical and digital realms [2]. Customers (75%) express a strong preference for continued QR code use [2].

Document tracking can burden workers, causing displacement and missed deadlines [5][6]. Web-based systems offer a solution, aiding workplace efficiency [5]. Lingaya suggests a tracking model for Philippine education institutions, easing document management [6]. Google Drive, recommended by Muhammad, is a secure and widely-used option [7][8][9].

Arcon's study [10] found limited functionality in the "Integrating Notification Capability" system for tracking files within universities. Abidin's research [11] showcased the success of an Arduino and RFID-based system for real-time tracking of physical documents, enhancing efficiency, reducing storage needs, and improving resource management. Rellon et al. [12] developed a software solution utilizing barcode technology and SMS notifications for real-time document tracking. The system features person-to-person tracking and rigorous testing, but further evaluation is needed for comprehensive understanding of its capabilities.

Bala and Muhammad [13] propose a file tracking application to enhance file management and staff efficiency. The application employs innovative technology to expedite document retrieval, eliminate access delays, reduce paper and pen costs, and enhance overall tracking system efficiency. The study highlights challenges in the current manual system, including delays, record duplication, and potential corruption. This underscores the need for an automated file-tracking system.

Uniqueness of the Records Tracking Management System (RTMS)

The Records Tracking Management System (RTMS) introduces a range of distinctive features that set it apart from existing systems in academia. Unlike other solutions, RTMS offers continuous updates and support, ensuring its longevity and relevance. Real-time transparency is enhanced through QR codes and Email notifications, delivering instant updates on document status and location. The system boasts user-friendly interfaces, ensuring accessibility and scalability. RTMS prioritizes data security, employing encryption, access controls, and audit logs to safeguard sensitive information, while its cloud-based accessibility facilitates remote tracking and management. Notably, the system integrates an in-built communication tool for seamless collaboration. It provides comprehensive analytics and reporting capabilities, supports role-based access control, and uniquely integrates with Google Drive. Moreover, RTMS automates reminders, enforces secure document sharing, and maintains detailed user activity tracking and audit logs, enhancing accountability and efficient document handling.

Technical Background

Figure 1: System Architecture

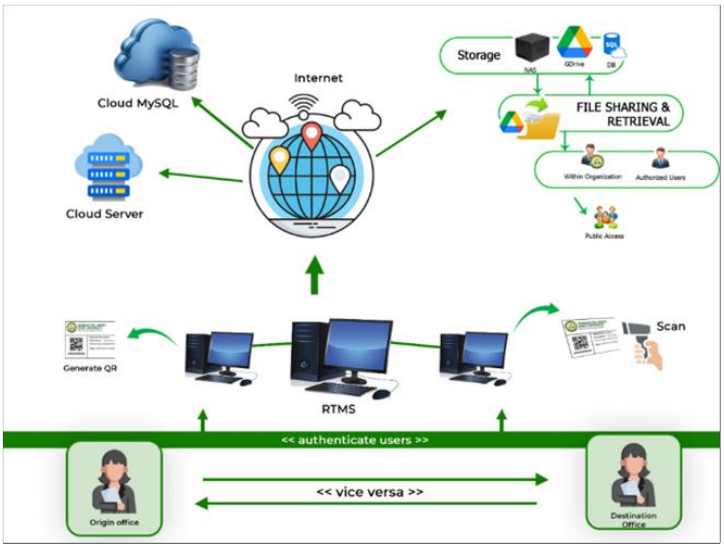
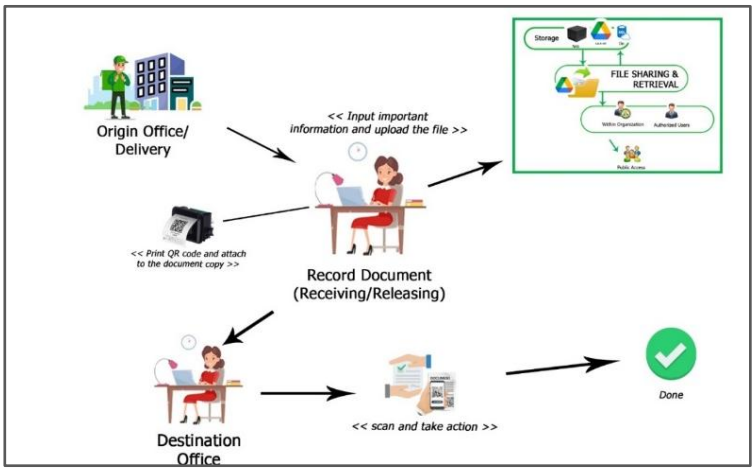


Figure 1 illustrates the Records Tracking Management System (RTMS) architecture, accessible through LAN or the internet. Authentication precedes RTMS access for security. Users can create, process, and store incoming documents in the cloud database. RTMS accommodates document uploads via Google Drive, Local Storage, and Network-Attached Storage. Document management involves external (from outside sources) and internal (in-house) files, both needing entry into the system for effective tracking. All documents, regardless of origin, require entry into the system for tracking, involving input and scanning before forwarding to the next recipient.

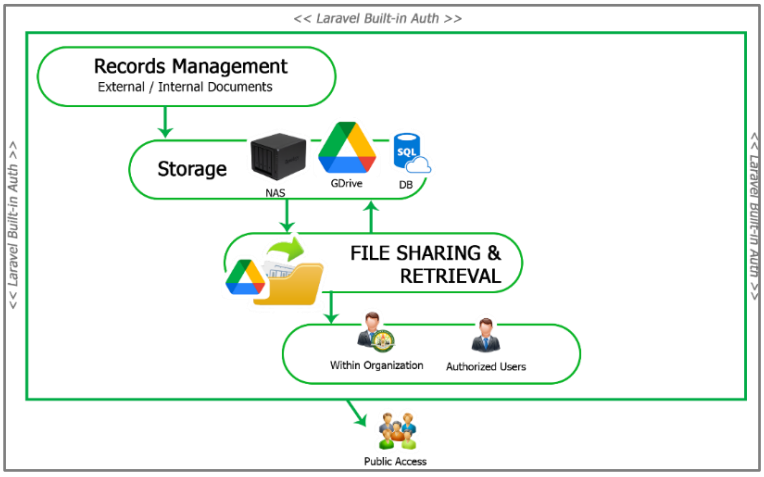
Figure 2: Records Tracking Process for Internal and External Documents



Storage: This system can use three types of storage for records: Network Attached Storage (NAS), Google Drive, and Structured Query Language Database (SQL). NAS is a storage device that centralizes records storage, sharing, and backup [16], while online storage that permits users to save and retrieve documents from any location is provided by Google Drive. SQL is a database management system used to store structured records, tracking logs, audit trails, and transaction records.

File Sharing and Retrieval: This system allows people to look for, exchange, and connect documents according to their authorized access. Users can securely access these files through the system.

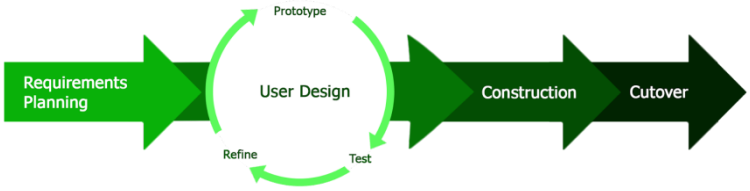
Figure 3: Internal and External Document Storage



Methodology of the Study

The Rapid Application Development model is a modified version of agile methodology that places great importance on frequent iterations and models that are shaped by feedback from users. This approach allows for the integration of updates that are informed by usage patterns, rather than adhering to a rigid development plan. Moreover, it enables project teams to manage changing requirements as they emerge, leveraging client and user feedback in real-time. These results in the swift production of prototypes that can be tested and refined further [17], see Figure 4.

Figure 4:Rapid Application Development (RAD)



A. Requirements Phase

During this phase, the researcher gathered the needs, which are the system's process flow. The Unified Modeling Language (UML) was applied in this project which serves as a standardized visual modeling language used in software engineering to represent, design, and communicates system structures, behaviors, and processes. It provides a common language for software developers, architects, and stakeholders to understand, analyze, and document software systems [18]. Use case diagram will depict the process flow.

Figure 5: Use Case Diagram

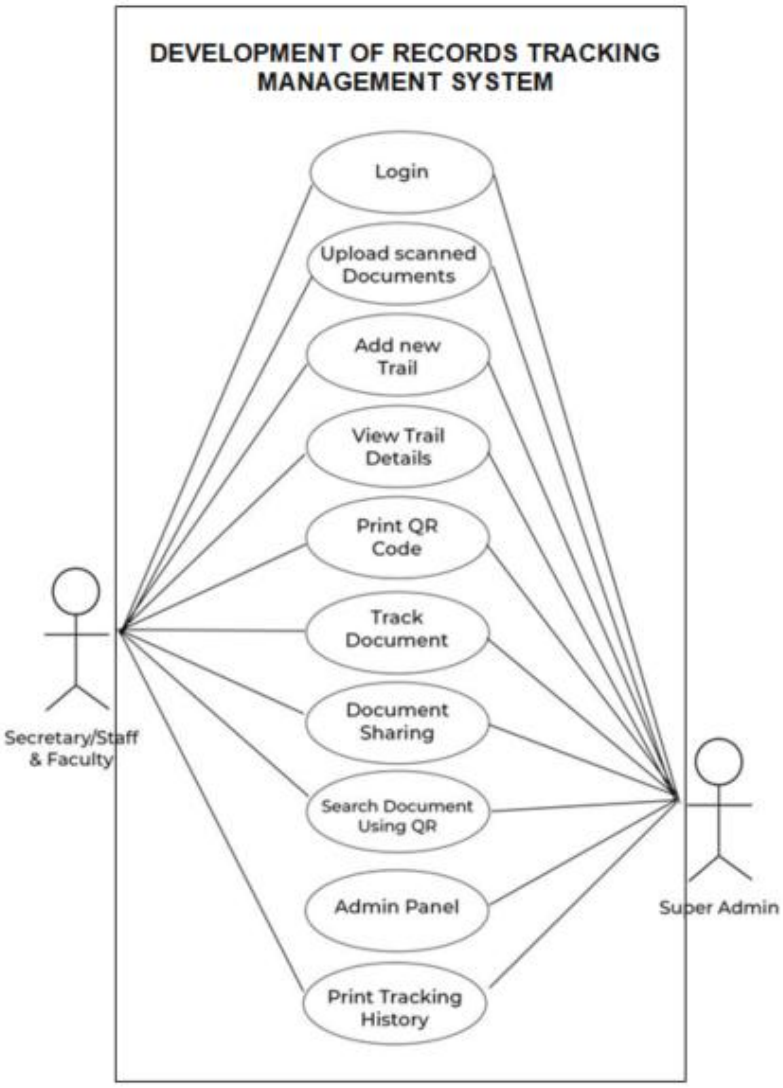


Figure 5 depicts that there are different roles involved, including the Super Admin and Secretary/Staff/Faculty.

Secretary, Staff, and Faculty can perform the following tasks:

1. Login: They can access the system by logging in with their credentials.
2. Upload scanned documents: They can upload scanned documents into the system.
3. Add New Trail: They can create a new trial for a document, recording its movement or updates.
4. View Trail Details: They can view the details of a specific trail to see the history of actions taken on a document.
5. Print QR Details: They can generate and print QR codes containing document details for easy tracking.
6. Track Documents: They can track the status and location of documents within the system.
7. Document Sharing: They have the option to share documents with other users as needed.
8. Search Document using QR: They can use the QR codes to quickly search and retrieve specific documents.

9. Print Tracking History: They can generate and print the tracking history of a document for reference or reporting purposes.

Super Admin, in addition to the above tasks, has additional privileges. Super Admin can perform all the tasks that the secretary, staff, or faculty can do and access the Admin Panel, which provides additional functionalities for managing users, system settings, and other administrative tasks.

B. User Design Phase

During this phase, the researcher focused on designing the user interface and user experience of the system, as well as defining the system's processes. The researcher utilized Unified Modelling Language (UML) diagrams to create an easy and intuitive system design. Class diagrams and use case diagrams were among the UML diagrams used by the researcher, as they are commonly used tools in software development for understanding and communicating the design of a system. By utilizing UML diagrams, the researcher ensured a structured and organized approach to system design, facilitating effective communication and understanding among team members and stakeholders.

C. Construction Phase

During this phase of the project, the researcher builds the system using various software development tools and frameworks. These tools enable the researcher to create a functioning and durable system that satisfies the specifications and operates as planned. The technologies employed enable the researcher to build a high-performing, scalable, and resilient system capable of addressing user demands.

D. Cutover Phase

During the cutover phase, the researcher used a mechanism a combination of System Testing and User Acceptance Testing (UAT). System Testing involved comprehensive testing of the integrated system to ensure its proper functioning and identify any issues or defects. UAT, on the other hand, focused on testing this system from the end user's perspective to validate its functionality and usability. By employing these testing mechanisms, the researcher was able to ensure that the Records Tracking Management System (RTMS) performed effectively and met the requirements and expectations of both the system administrators and end-users.

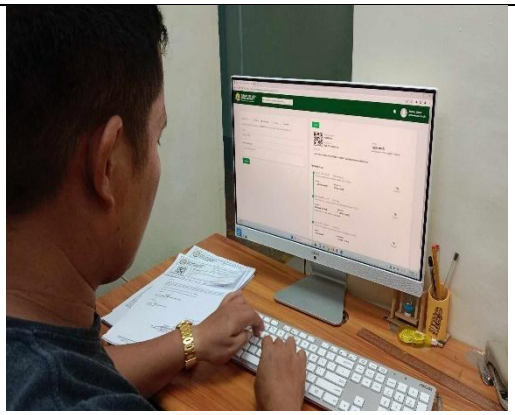


Figure 6: Actual Testing of Records

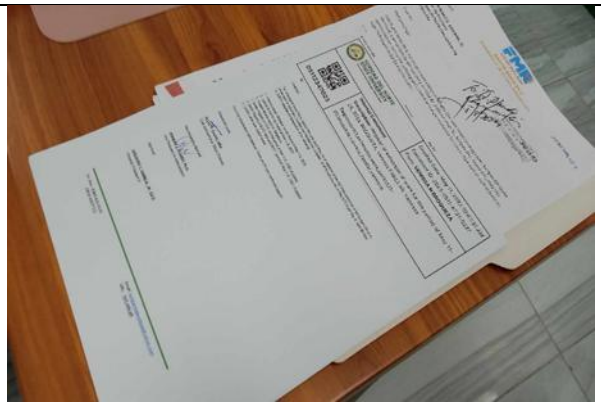


Figure7: Actual Output of Recorded Document Tracking Management System

Figure 6 and 7 shows the actual testing of the Records Tracking Management System. It is the transition from the old system or processes to the new system.

Evaluation Methods and Tools

The researcher evaluated the system's requirements and functions, including document tracking, user authentication, document retrieval, reporting, and audit trail. Google Forms and a Likert Scale were used to assess system usability and user preference, with ratings from 1 (Poor) to 5 (Excellent). Table 1 interprets the results using verbal descriptions and score ranges.

Table 1: Likert Scale for System Evaluation

Scale	Mean Range	Verbal Interpretation
5	4.21 – 5.00	Excellent
4	3.41 – 4.20	Very Good
3	2.61 – 3.40	Satisfactory
2	1.81 – 2.60	Fair
1	1.0 – 1.80	Poor

The collected data were analyzed and interpreted using the following formula by the researcher.

1. $\sum (i=1 \text{ to } 5) [Vi * (6 - i)]$
   $\sum (i=1 \text{ to } 5) [Vi * (6 - i)] = V1 * 5 + V2 * 4 + V3 * 3 + V4 * 2 + V5 * 1$
   Where:
   i=1: This indicates that the index variable i start from 1.
   i=1 to 5: The range of the index variable i is from 1 to 5. This means we will consider values of I from 1, 2, 3, 4, to 5.
   Vi: This represents the value at the ith position in the sequence. For example, V1 corresponds to the value in the first position; V2 corresponds to the value in the second position, and so on.
   (6-i - i): This term calculates the weight for each value. It subtracts the index i from 6. As it increases, the weight decreases, following a reverse linear pattern.
   Vi * (6 - i): This represents the product of the value at the ith position and its corresponding weight.
   [Vi * (6 - i)]: The entire expression inside the square brackets represents the term to be summed for each value of i.
   $\sum (i=1 \text{ to } 5) [Vi * (6 - i)]$: This indicates that we sum the terms for each value of i, ranging from 1 to 5.
2. $M = \sum (i=1 \text{ to } 5) [Vi * (6 - i)] / NN$
   Where:
   NN = Total of respondents
3. Grand Weighted Mean (GWM) = (Mi) / N
   Where:

N represents the total number of categories.
Mi represents the mean of each category (M1, M2, M3, ..., M8).
M1: Mean of category 1 (Functional Suitability)
M2: Mean of category 2 (Reliability)
M3: Mean of category 3 (Performance Efficiency)

M4: Mean of category 4 (Usability)
M5: Mean of category 5 (Security)
M6: Mean of category 6 (Compatibility)
M7: Mean of category 7 (Maintainability)
M8: Mean of category 8 (Portability)

Table 2: Distribution of Respondents

Respondents	N	Percentage
Secretary/Staff	31	77.5%
Faculty	9	22.5%
Total	**40**	**100%**

Table 2 shows the number and percentage of respondents based on their job roles in a survey. The survey was conducted among a total of 40 respondents. Out of these 40 respondents, 31 of them (77.5%) were secretaries and staff, and 9 of them (22.5%) were faculty members. This means that a large majority of the respondents in the survey were secretaries or staff, while a smaller minority was faculty members.

Results and Discussion

The technical details and designed graphical user interfaces are presented in Figures 8 to 11.

Figure 8 presents the role-based login screen for user access, utilizing credentials or Google accounts. The real-time dashboard in Figure 9 displays dynamic charts and reports, depicting Tracking Logs, Active Users, and Generated QRs per day, and storage details. Figure 10 showcases the trail management page, listing compiled document information, whether internal or external. Lastly, Figure 11 demonstrates the tracking feature enabling users to designate document status (INCOMING, OUTGOING, RETURN, TERMINAL), while QR code scanning initiates time tracking until OUTGOING status.

Figure 8: Multi-factor Authentication

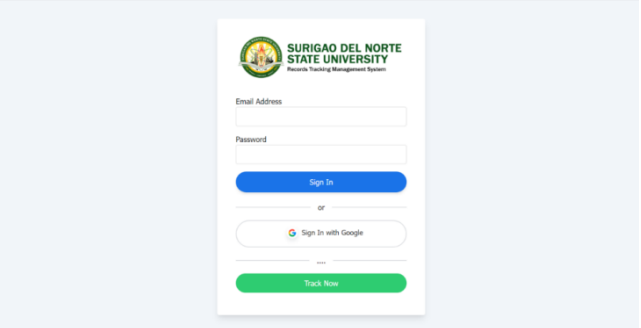


Figure 9: Dashboard of the System

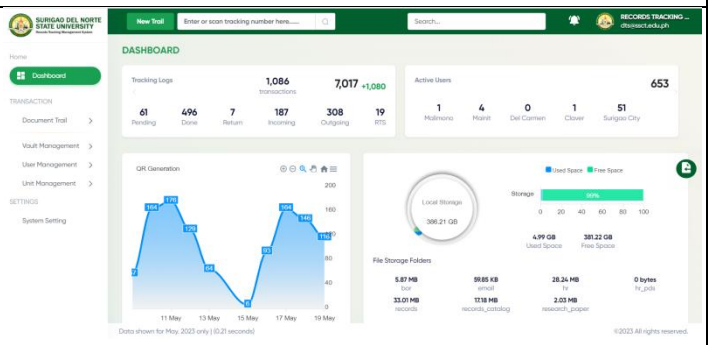


Figure 10: Trail Management

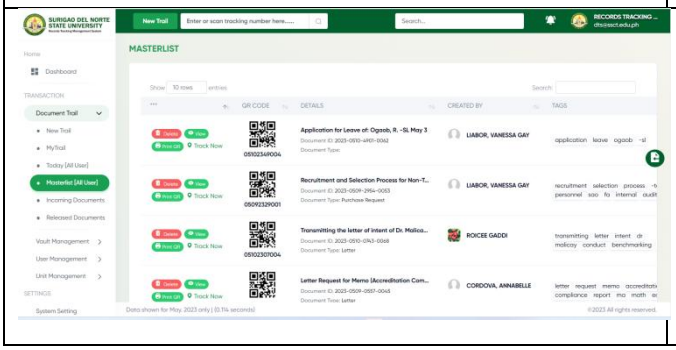
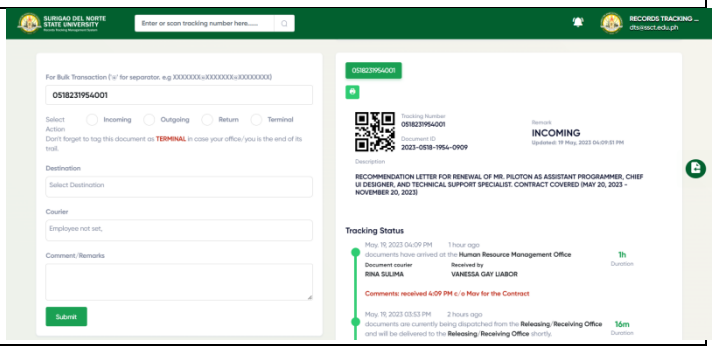


Figure 11: Tracking Transaction



System Evaluators

The researcher presents the demographics and familiarity of system evaluators with various automated systems. The data presented below highlights key insights into the gender distribution, age groups, educational attainment, and familiarity with automated systems among the respondents.

Table 3: System Evaluator's Demographic Distribution

Demographic Characteristics	Count	Percentage (%)
Gender		
Male	10	(25.0%)
Female	30	(75.0%)
Age Group		
24 - 35 yrs. old	14	(35.0%)
36 - 47 yrs. old	21	(52.5%)
48 - 60 yrs. old	5	(12.5%)
Highest Educational Attainment		
Bachelor	18	(45.0%)
Master	21	(52.5%)
Doctorate	1	(2.5%)
Automated Systems Familiarity		
Yes	40	(100.0%)
No	0	(0.0%)
Automated Systems		
SNSU fgHEMIS Portal	38	(95.0%)
SNSU FIS - Financial Information System	24	(60.0%)
Grab	29	(72.5%)
Food Panda	36	(90.0%)
Automated Attendance Systems	27	(67.5%)

Human Resource Information System (HRIS)	30	(75.0%)
SNSU fgLMS	30	(75.0%)
Procurement System	9	(22.5%)
Asset Inventory System	7	(17.5%)

Examining the data in Table 3 reveals distinct demographic trends among respondents. The majority (75%) are female, spanning various age groups, with 36-47 years (52.5%) being most common, followed by 24-35 years (35%) and 48-60 years (12.5%). Respondents are educationally diverse, with 52.5% holding master's degrees, 45% bachelor's degrees, and 2.5% doctorates. All respondents (100%) show familiarity with automated systems, especially the "SNSU fgHEMIS Portal" (95%), "Food Panda" (90%), "SNSU fgLMS" and "HRIS" (75% each). "Procurement System" (22.5%) and "Asset Inventory System" (17.5%) exhibit lower recognition, revealing varying technology engagement levels.

Table 4: Quality evaluation summary

Quality Characteristic	Mean	Verbal Interpretation
Functional Suitability	4.33	Excellent
Reliability	4.44	Excellent
Performance Efficiency	4.43	Excellent
Usability	4.47	Excellent
Security	4.51	Excellent
Compatibility	4.38	Excellent
Maintainability	4.49	Excellent
Portability	4.43	Excellent
Grand Weighted Mean	**4.44**	**Excellent**

In Table 4, the system's performance is assessed through user feedback ratings. Across various dimensions like suitability, reliability, performance, usability, security, compatibility, maintainability, and portability, the system excels. With an average rating of 4.44 out of 5, denoting excellence, users perceive the system as effective, efficient, and aligned with their needs and expectations.

Conclusion

The research objectives were to develop a customized system that would meet the specific needs and standards of users, and to assess its performance using recognized software quality tools. The ultimate goal was to develop this system to the university. To achieve these objectives, the researcher utilized various tools such as the PHP Laravel Framework, Livewire Component, Bootstrap 5, and jQuery to create the Records Tracking Management System (RTMS), which underwent thorough evaluation.

Based on the evaluation results, the researcher confidently conclude that the Records Tracking Management System met all the research objectives and complied with the required standards of the ISO 25010 software product quality assessment. To support this claim, the evaluation reports and data confirmed the system's performance in various areas of software quality, including functionality, reliability, Performance efficiency, usability, security, compatibility, maintainability, and portability.

The Records Tracking Management System (RTMS) has successfully met the specific needs of users and has demonstrated compliance with the ISO 25010 software product quality standards (see Table 4). The use of various tools and meticulous evaluation processes has led to the creation of a reliable and high-performing system, recommending its deployment to the University for Effective Records tracking and management.

Recommendation

Based on the analysis and evaluation, it is recommended that Surigao del Norte State University should deploy the Records Tracking Management System. However, proper training should be provided to users to ensure efficient usage of the system. It is also advised that regular maintenance and updates should be conducted to ensure that the system meets users' needs and standards over time. The success of the Records Tracking Management System highlights the importance of following a structured software development process and ensuring software products meet quality standards.

Acknowledgement

I would like to express our sincere appreciation to all those who have contributed to the success of this research project. Your support and guidance have been invaluable, and we are deeply grateful for your involvement.

First and foremost, I extend our heartfelt thanks to Abba Father through his son Jesus for the blessings, guidance, and wisdom that have been instrumental throughout this research. His grace has provided us with the strength and motivation to overcome challenges.

I am particularly grateful to our project adviser, Dr. Monalee A. dela Cerna, for her unwavering support, expertise, and encouragement. Her constructive criticism and feedback have significantly shaped the quality of this research.

Our sincere thanks also go to the beneficiaries of this study, whose willingness to share their experiences made this research possible. We greatly appreciate their time and effort in contributing to this project.
I would like to acknowledge the invaluable support and insights provided by our colleagues and friends. Their contributions have helped refine our ideas and approach. Special recognition is due to our technical adviser, Engr. Ritchie A. Reyna, for his technical expertise and guidance, which were vital in implementing the system used in this research.

I would also like to express our heartfelt gratitude to the members of the panel. Dr. Orven E. Llantos, your expertise as an external expert panelist enriched this work. Dr. Gregorio Z. Gamboa Jr., thank you for chairing the panel and providing valuable feedback. Dr. Merlyn L. Estoque, your input as another esteemed member of the panel was greatly appreciated.

Finally, we extend our deepest thanks to our family, especially our sister, Antoneth L. Piloton, for her unwavering support and assistance, particularly in financial matters. Her generosity and belief in us have been a constant source of inspiration and motivation.

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