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Design and Development of a Web-Based Archival Information System Using the Rijndael Algorithm

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Abstract: Effective archival management is essential for ensuring transparency, accountability, and legal compliance in government institutions, as mandated by the Regulation of the General Election Supervisory Agency (Bawaslu) of the Republic of Indonesia Number 11 of 2020. The North Palu Panwascam Office currently relies on manual archival processes, which increase the risk of data loss, retrieval delays, and security vulnerabilities. This study presents the design and development of a web-based archival information system that integrates the Rijndael encryption algorithm to enhance data security and confidentiality. The system was developed using a structured Software Development Life Cycle (SDLC) approach and implemented as a web-based application with a centralized database. Functional validation was conducted using black-box testing to ensure that all system features operated as intended. System effectiveness was further evaluated using the DeLone and McLean Information Systems Success Model, focusing on system quality and information quality, based on feedback from six primary users. The evaluation results indicate that the system achieves a high level of system quality, demonstrating ease of use and reliability. In contrast, information quality is moderate, indicating the need for further refinement of data presentation and output completeness. Overall, the proposed system improves administrative efficiency, enhances archival security, and provides a compliant digital solution for archival management at the local government level.

Keywords : Archival Information System; Rijndael Algorithm; Web-Based System; Information Security; DeLone and McLean Model.

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1. Introduction

The management of official records is a fundamental pillar of modern governance and administration. According to the Regulation of the General Election Supervisory Agency (Bawaslu) of the Republic of Indonesia Number 11 of 2020, archives are defined as records of activities or events in various forms and media, created and received by state institutions and individuals in the implementation of national life [1]. This regulation underscores that as information and communication technology evolves, the media through which these records are preserved must also adapt to maintain relevance and accessibility.

In the context of state institutions, archives serve as the "corporate memory" that allows for the continuity of administrative functions. They are not merely passive storage items but are active sources of information that play a critical role in supporting the daily management processes of an institution [2]. Without a structured archival system, the institutional knowledge required to navigate complex legal and political landscapes is easily lost. The benefits of systematic archive management extend beyond simple organization. Well-maintained records provide essential data for informed decision-making and serve as indisputable evidence in the event of legal or administrative disputes [3]. In a democratic framework, the ability to retrieve specific records is vital for supporting management accountability and enhancing the overall transparency of bureaucratic performance [4].

Despite the clear mandates provided by Regulation Number 11 of 2020, many local election supervisory bodies, such as the North Palu Panwascam Office, still face significant challenges. The transition from physical paper-based systems to digital platforms is often hindered by a lack of specialized

software and infrastructure [5]. This leads to delays in data retrieval and a higher risk of physical document degradation over time. The shift toward e-government (electronic government) is a global trend aimed at increasing efficiency and reducing the costs associated with physical storage. Digital archiving systems allow for the categorization of documents using metadata, which significantly reduces the time required for employees to locate specific files during audits or reporting periods [6]. For an agency like Bawaslu, speed and accuracy in record retrieval are paramount during election cycles.

Furthermore, the security of sensitive election data is a primary concern for the Indonesian government. A web-based information system provides a centralized repository where access levels can be strictly controlled, ensuring that only authorized personnel can view or modify specific archives [7]. This aligns with national standards for data protection and information security in the public sector. Web-based applications offer the unique advantage of platform independence, meaning employees can access the archival database from various devices without needing complex local installations [8]. For the North Palu Panwascam Office, this flexibility ensures that field officers and administrative staff can remain synchronized regardless of their physical location within the district. Based on the existing problems of data redundancy and slow retrieval times at the case study site, the author identifies a clear need for a specialized digital solution. The proposed study, entitled "Design and Development of a Web-Based Archive Management Information System Based on the Regulation of the General Election Supervisory Agency of the Republic of Indonesia Number 11 of 2020," aims to bridge the gap between regulatory requirements and current operational realities [9].

The development of this system will follow a structured Software Development Life Cycle (SDLC) to ensure that all functional requirements of the North Palu Panwascam Office are met. By automating the classification and storage process, the system is designed to significantly reduce human error and improve the reliability of the agency's records [10]. Ultimately, this information system is intended to empower employees in the archival field, making the management of records a seamless part of the institutional workflow. By adhering to the standards set forth in the 2020 Bawaslu Regulation, the North Palu Panwascam Office can serve as a model for modern, transparent, and digitally capable election supervision at the local level.

2. Method

The type of research used in this study is qualitative research. Qualitative research is a research method that uses data collection techniques such as interviews, observations, and focus groups. The purpose of qualitative research is to produce a comprehensive, balanced, and contextual understanding based on complete data.

The research approach used in this study is descriptive research. Descriptive research is a method that objectively describes the objects or subjects being studied based on systematic facts and the characteristics of the objects being examined accurately. In this study, the author conducted interviews to identify solutions to the problems at the North Palu Subdistrict Panwaslu Office, starting from literature surveys to data collection.

2.1. Data Analysis Method

The data analysis method used by the author is the Unified Modeling Language (UML) method, which is a method used for designing a system or software. The types of UML used in this study are Data Flow Diagram (DFD) and Entity Relationship Diagram (ERD).

2.2. System Development Method

The system development method used is the Waterfall method. The process of the Waterfall method includes:

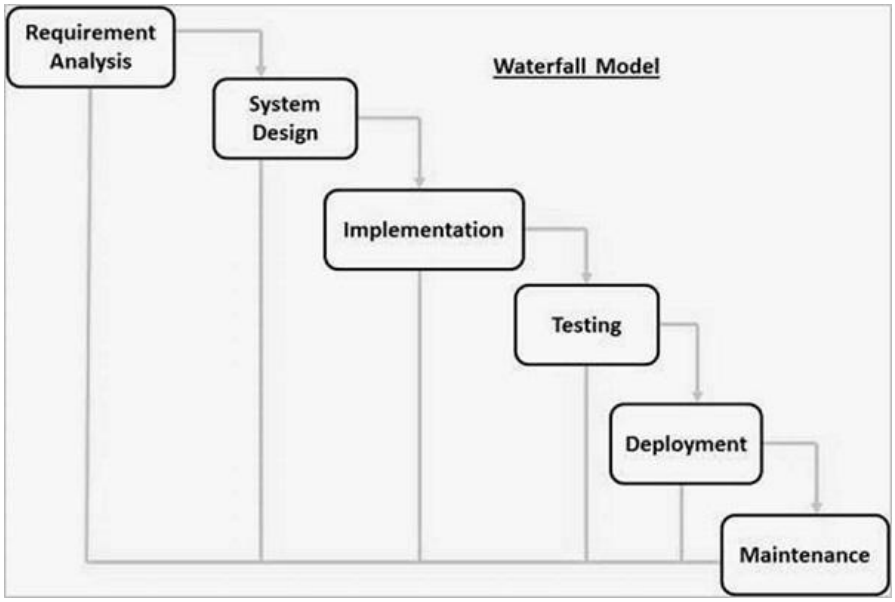

Figure 1. Waterfall Method

a. Requirements Analysis
This stage is the first step in building the system, where the author collects information using various methods such as interviews, discussions, surveys, observations, and others.

b. System and Software Design
At this stage, the information and specifications required by the system from the previous stage are studied and analyzed to be implemented in the system design. Next, the software interface and system design are created according to the system's requirements.

c. Implementation and Unit Testing
During the implementation and unit testing stage, the functionality of each module that has been implemented in the application is tested to determine whether it provides solutions to the identified problems. The system is implemented as a web-based application with a MySQL database.

d. Integration and System Testing
At this stage, after all units have been tested and developed, all units are integrated into a complete system. Then, system-wide testing is conducted to identify potential problems or system errors.

e. Operation and Maintenance
In this final stage, the tested and operational archive management information system will receive maintenance. Maintenance includes system corrections, development, enhancements, and adjustments according to user needs.

3. Results and Discussion

3.1. Use Case Diagram

A use case diagram is a behavioral modeling tool used to represent the functional requirements of a system from the user's perspective. It illustrates the interactions between system actors and the system itself by identifying the actions that can be performed to achieve specific goals. The primary purpose of a use case diagram is to clearly define what the system does, rather than how the system is implemented, thereby providing a high-level overview of system functionality and user access rights. This model is particularly useful for validating system requirements and ensuring alignment between user needs and system capabilities.

As shown in Figure 2, the use case diagram of the proposed Web-Based Archival Information System illustrates the interaction between a single primary actor, namely the Admin, and the system. The Admin represents authorized personnel at the North Palu Panwascam Office who are responsible for managing institutional archives. Granting full access to a single actor is consistent with the operational structure of the organization, where archival responsibilities are centralized to ensure data consistency, accountability, and security. The authentication use cases, including login and logout, serve as the initial security layer to restrict system access to authorized users only. These functions are essential for preventing unauthorized access to sensitive archival records and ensuring compliance with institutional data protection policies. Once authenticated, the Admin can access the archive management module, which includes functionalities to add, edit, delete, and view archive records, as well as upload and download archival documents.

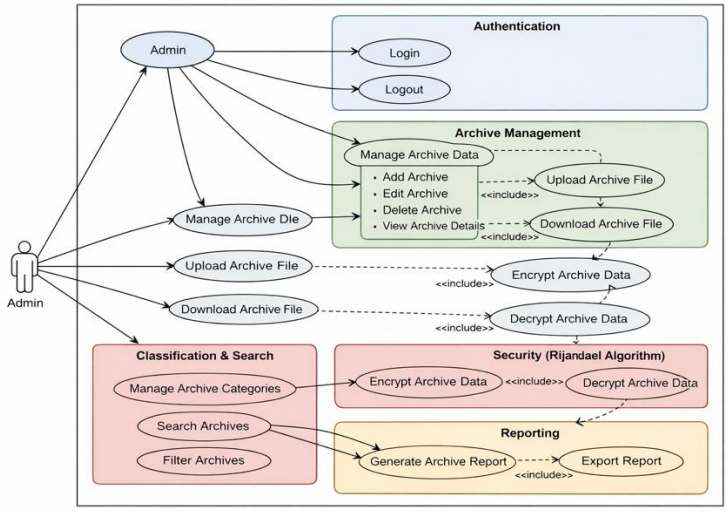

Figure 2. Use Case Diagram.

To ensure data confidentiality and integrity, the system integrates the Rijndael encryption algorithm, which is automatically applied during the file upload process and reversed during file access or download. This security mechanism protects archival data from unauthorized disclosure and tampering, particularly in a web-based environment where data transmission risks are higher. In addition, the system provides archive classification and search functionalities, enabling the Admin to organize documents based on predefined categories, apply filters, and perform keyword-based searches. These features significantly improve retrieval efficiency and reduce the time required to locate specific documents. Finally, the reporting module allows the Admin to generate and export archival reports, supporting documentation, supervision, and decision-making activities.

Overall, the use case diagram demonstrates that the developed system is functionally complete, secure, and aligned with the operational needs of the institution. It highlights the integration of archival management, security, and reporting functionalities within a unified web-based platform, emphasizing efficiency, data integrity, and regulatory compliance.

3.2. Application Interface

The application interface represents the visual interaction layer that connects users with the web-based archival information system. A well-designed interface is essential to ensure system usability, efficiency, and accuracy in managing archival data. The developed interface emphasizes simplicity, clarity, and ease of navigation to support daily archival activities at the North Palu Panwascam Office. The main interface components of the system are described as follows.

a. Login Page

The Login Page, as shown in Figure 3, serves as the primary access point to the system. This page requires users to enter a registered username and password to authenticate their identity before accessing system features. The authentication mechanism ensures that only authorized users can access sensitive archival data, thereby supporting data security and confidentiality. Upon successful authentication, users are redirected to the dashboard page, while invalid credentials trigger error notifications to prevent unauthorized access.

Figure 3 Login Page

b. Dashboard Page

The Dashboard Page, illustrated in Figure 4, functions as the central control panel of the system. This page provides users with an overview of available system features and quick access to core functionalities, such as incoming mail management, supervision reports, and archive classification. The dashboard is designed to present information in a structured layout, allowing users to efficiently navigate between modules. By consolidating system functions into a single interface, the dashboard enhances operational efficiency and reduces the time required to perform administrative tasks.

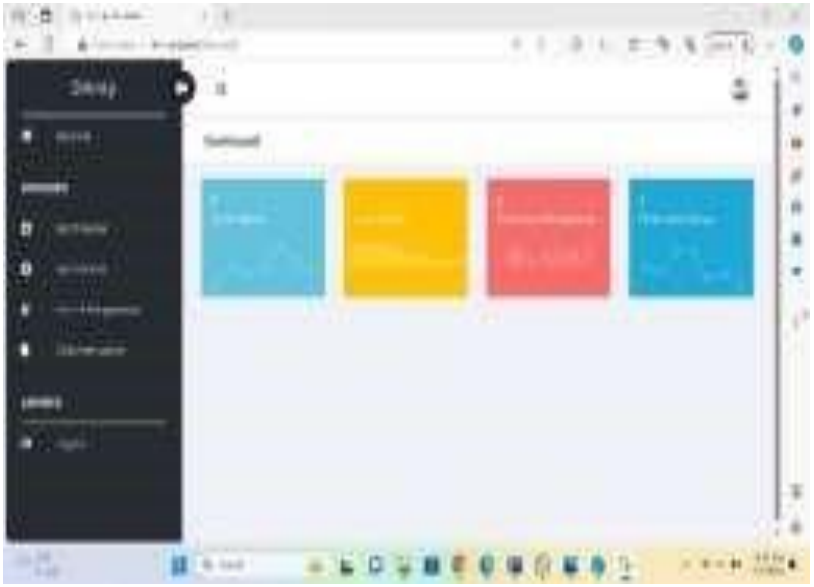

Figure 4. Dashboard Page

c. Incoming Mail Page

The Incoming Mail Page, shown in Figure 5, is used to manage incoming correspondence received by the institution. This page displays a list of stored incoming mail documents along with relevant metadata, such as document number, sender, date received, and subject. Users can view, search, edit, or delete records as needed. The structured presentation of incoming mail data enables faster document retrieval and supports accurate archival classification, thereby minimizing the risk of document loss or misplacement.

Figure 5. Incoming Mail Page

d. Incoming Mail Input Page

The Incoming Mail Input Page, as presented in Figure 6, facilitates the entry of detailed information before incoming mail documents are archived. On this page, users are required to complete essential fields, including document identification data, classification category, and file uploads. Once the data is submitted, the system automatically stores the document in the database and applies encryption using the Rijndael algorithm to ensure data security. This page plays a critical role in maintaining data consistency and standardization across archived records.

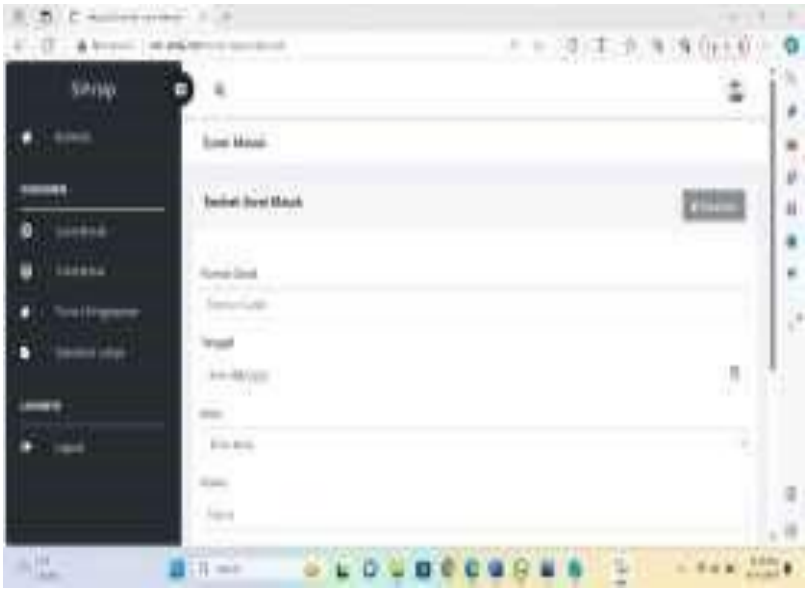

Figure 6. Incoming Mail Input Page

e. Supervision Report Page

The Supervision Report Page, depicted in Figure 7, is designed to manage supervision report documents generated during monitoring and evaluation activities. Similar to the incoming mail module, this page allows users to store, display, and manage supervision reports in a structured format. Users can access reports based on specific criteria, such as reporting period or document category, which supports accountability and transparency in supervisory activities. The integration of this page within the archival system ensures that supervision reports are securely stored and easily retrievable when needed.

Figure 7. Supervision Report Page

3.3. System Testing

After the system has been successfully developed, system testing is carried out. In the Design and Development of a Web-Based Archival Information System, Blackbox Testing is used. The Blackbox method is applied to determine whether all system functions are working properly. The final phase of the software development life cycle is critical to ensuring that the product meets the initial requirements. After the system has been successfully developed, comprehensive system testing must be carried out to validate its performance and reliability [11]. This phase acts as a quality gate, ensuring that the software is ready for deployment in a live environment. In the context of the "Design and Development of a Web-Based Archival Information System," the testing phase focuses specifically on the interaction between the user and the interface. Testing ensures that the digitization of sensitive records adheres to the functional standards required by the institution [12]. Without rigorous testing, a web-based system may fail to secure or retrieve documents accurately.

The methodology chosen for this specific project is Blackbox Testing. This approach focuses on the functional requirements of the software, allowing the tester to evaluate the system's behavior without needing knowledge of the internal code structure or logic [13]. By treating the software as a "black box," the developer can simulate a real-world user experience. The Blackbox method is primarily applied to determine whether all system functions are working properly according to the defined specifications. It examines the fundamental aspects of the application, such as menu navigation, data entry accuracy, and the successful execution of database queries [14]. This ensures that every button and input field performs its intended task. One of the primary advantages of Blackbox Testing in an archival system is its ability to identify functional gaps. For instance, it can detect if the "Upload" function fails to handle specific file formats or if the "Search" function returns incorrect results based on metadata [15]. Identifying these errors early prevents data loss in the future.

3.4. Delone and McLean Testing

The evaluation of a newly developed information system is essential to measure its effectiveness and alignment with organizational goals. In this study, the success of the Web-Based Archive Management Information System was assessed using the DeLone and McLean (D&M) Information Systems Success Model [16]. This model is widely recognized in software engineering and information systems research for its multidimensional approach to measuring the performance of digital platforms. Data collection was executed through a structured questionnaire distributed to six primary users at the North Palu Panwascam Office. These users represent the actual stakeholders who will operate the system daily, making their feedback critical for identifying operational strengths and weaknesses [17]. The small sample size is consistent with usability testing protocols where the focus is on qualitative depth and specific functional feedback within a localized office environment.

The evaluation specifically targeted two key variables from the D&M model: system quality and information quality. System quality refers to the technical performance of the software, including ease of use, system reliability, and response time [18]. Meanwhile, information quality focuses on the output of the system, measuring the accuracy, timeliness, and completeness of the data provided to the users [19]. Regarding the system quality variable, the questionnaire utilized six specific items to gauge user experience. The results revealed a score range of 18–30, with a calculated mean and median of 24. The alignment of the mean and median indicates a normal distribution of user perception, suggesting a consistent level of satisfaction across the testing group [20]. This statistical balance confirms that the architectural design of the archival system is stable and intuitive. A score of 24 in system quality signifies that users perceive the platform as having high usability. Most respondents reported that they were able to understand the system's navigation and features quickly and effectively [21]. This is a crucial metric for the North Palu Panwascam Office, as it implies that the transition from manual archiving to a digital web-based system will require minimal training for the staff.

Conversely, the evaluation of information quality, which comprised five questions, yielded a score range of 15–24. The data showed an average score of 19.5, while the median stood at 20. The fact that the mean is 0.5 lower than the median suggests a slight negative skew, indicating that while most users were satisfied, a few respondents felt the system's output was lacking in certain areas [22]. The disparity in information quality scores suggests that the system's output does not yet fully meet the specific expectations of every user. In an archival context, this often relates to how data is formatted or the granularity of the search results provided by the system [23]. Users may require more detailed reporting features or more comprehensive metadata fields to satisfy their administrative requirements according to Bawaslu standards. This feedback loop is a vital component of the iterative design process in software engineering. According to the D&M model, low scores in information quality can directly impact user satisfaction and the eventual "net benefits" the system provides to the organization [16], [24]. Addressing these discrepancies is necessary to ensure the system remains a reliable source of truth for the agency's records.

To improve these scores, the system's data processing layer may need refinement to ensure that retrieved archives are presented in a more user-friendly and complete manner. Enhancing the precision of the information provided will help align user expectations with the system's capabilities [25]. This adjustment is a standard part of post-development maintenance to ensure long-term system adoption. In conclusion, the testing at the North Palu Panwascam Office demonstrates that while the technical infrastructure (system quality) is robust, the informational output requires further calibration. By applying the DeLone and McLean framework, the author can pinpoint specific areas for enhancement, ensuring the final Web-Based Archive Management Information System fully complies with the Regulation of the General Election Supervisory Agency Number 11 of 2020.

4. Conclusion

This study successfully designed and implemented a web-based archival information system for the North Palu Panwascam Office in accordance with the Regulation of the General Election Supervisory Agency (Bawaslu) Number 11 of 2020. The developed system represents a significant transition from manual archival practices to a secure and structured digital environment. The integration of the Rijndael encryption algorithm ensures the confidentiality and integrity of archival documents, addressing critical concerns related to data security in public-sector information systems. Functional testing using the black-box method confirmed that all core system features operate correctly, including document classification, storage, retrieval, and access control. Furthermore, evaluation using the DeLone and McLean Information Systems Success Model demonstrated strong system quality, indicating that users found the system reliable, intuitive, and easy to use. However, the information quality evaluation revealed areas requiring improvement, particularly in terms of data completeness and output presentation, suggesting the need for further system refinement.

Overall, the proposed archival information system enhances administrative efficiency, supports regulatory compliance, and strengthens information security at the local election supervisory level. Future research may focus on improving information quality through enhanced metadata structures, advanced search capabilities, and broader user testing to further increase system effectiveness and long-term adoption.

Author Contributions Statement

Muh Rizki Rizaldi (First Author & Corresponding Author): Acted as the primary researcher and developer. Responsible for the field study at the North Palu Panwascam Office, designing the web-based architecture, implementing the Blackbox testing, and conducting the DeLone and McLean evaluation. Mohammad Yazdi Pusadan (Second Author): Provided academic supervision throughout the research process. Focused on the alignment of the system with the Bawaslu Regulation Number 11 of 2020 and ensured the statistical validity of the questionnaire results. Mohamed Fal Mohamed Fadel (Third Author): Contributed to the comparative analysis of archival information systems and provided a global perspective on e-government standards. Assisted in the final structural review and English technical editing of the manuscript.

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