

Smart Mail Management System at the Faculty of Science and Technology, Universitas Ibrahimy

Wardhatun Khasanah^{1✉}, Abd. Ghofur², Firman Santoso³

¹ Study Program of Information Technology, Faculty of Science and Technology, Universitas Ibrahimy, Indonesia

^{2,3} Study Program of Information Technology, Faculty of Science and Technology, Universitas Ibrahimy, Indonesia

✉ **Corresponding Author** : Wardhatun Khasanah (e-mail: wardhatunkhasanah23@gmail.com)

Article Information	ABSTRACT
Article History Received : June 03, 2026 Revised : June 20, 2026 Published : July 10, 2026	The increasing demand for efficient administrative services in higher education institutions has highlighted the need for effective correspondence management systems. Conventional mail handling processes often result in delays, misrouted documents, difficulties in archiving, and challenges in information retrieval. This study aims to develop a web-based Smart Mail Management System by integrating Optical Character Recognition (OCR), rule-based intelligent routing, automated notifications, and digital approval features to improve correspondence management within the Faculty of Science and Technology, Universitas Ibrahimy. The research employed a Research and Development (R&D) approach using the Waterfall Software Development Life Cycle (SDLC), which consists of requirements analysis, system design, implementation, testing, and maintenance. Data were collected through observation, interviews, documentation analysis, and literature review. OCR technology was utilized to convert scanned letters into digital text, while a rule-based mechanism automatically classified and routed correspondence to the appropriate recipient. The results indicate that the proposed system reduces manual processing, improves routing accuracy, accelerates document handling, enhances document traceability, and facilitates centralized digital archiving. Furthermore, the integration of automated notifications and digital approval features supports a more efficient administrative workflow. These findings demonstrate that the developed system contributes to improving the effectiveness, accuracy, and efficiency of correspondence management while supporting digital transformation initiatives in higher education institutions.
Keywords: <i>Smart Mail Management System; Optical Character Recognition (OCR); Rule-Based Routing; Correspondence Management; Digital Archiving.</i>	

INTRODUCTION

The rapid development of information technology has accelerated digital transformation in higher education institutions, including administrative services and correspondence management (Nikou and Aavakare 2021). Despite these developments, many institutions still rely on conventional procedures for recording, storing, and distributing documents. Such practices often result in delays, document misplacement, routing errors, and difficulties in retrieving archived information. Therefore, the implementation of digital correspondence systems has become increasingly important to improve efficiency and service quality. Optical Character Recognition (OCR) technology provides an effective solution by converting scanned documents

into machine-readable text, thereby reducing manual data entry and facilitating document retrieval and management (Díaz-García et al. 2022).

In addition to document digitization, correspondence management requires an intelligent mechanism capable of automatically directing documents to appropriate recipients. Manual distribution processes are prone to delays and classification errors, especially when a large number of letters are processed simultaneously. Rule-based routing offers a practical solution by analyzing document content through predefined keywords and applying IF–THEN rules to determine the destination of correspondence. Compared with machine learning approaches that require large datasets and complex training processes, rule-based methods are more transparent, computationally efficient, and easier to implement in organizational environments (Aubaid and Mishra 2020). Consequently, the integration of OCR and automated routing mechanisms can improve the efficiency and accuracy of document processing while supporting digital transformation initiatives in academic institutions (Mihir et al. 2022).

Previous studies have mainly focused on digitizing correspondence activities. Royani and Rohman (2023) developed a web-based correspondence management system that supports document recording and archiving. However, the system mainly functions as a digital repository and does not provide intelligent features such as OCR-based text extraction, automatic routing, or digital approval. Likewise, Londa et al. (2022) introduced a web-based disposition monitoring system that improves document traceability but lacks automated classification and routing mechanisms. Nurjanah et al. (2021) implemented a web-based correspondence information system using the CodeIgniter framework to centralize mail management, yet the system does not support intelligent document processing, digital approval, or automatic distribution mechanisms.

Table 1. Comparison of Previous Studies and Proposed System

Author	Main Features	Limitations
Royani & Rohman (2023)	Digital archiving and mail recording	No OCR, no automatic routing, and no digital approval
Londa et al. (2022)	Disposition monitoring and document tracking	No OCR and automatic classification
Nurjanah et al. (2021)	Centralized correspondence management	No intelligent processing and digital approval
Proposed System	OCR, rule-based routing, digital approval, notification, and digital archive	Provides integrated intelligent correspondence management

Based on Table 1, previous studies mainly focused on document digitization and correspondence monitoring. However, intelligent document processing and automatic correspondence distribution have received limited attention. In addition, manual document routing still requires human intervention, increasing the risk of delays and misclassification. Therefore, an integrated correspondence management system equipped with OCR and rule-based routing is required to improve efficiency and accuracy.

These limitations indicate that existing correspondence management systems primarily emphasize document storage and monitoring, whereas intelligent document processing and automatic correspondence distribution remain insufficiently addressed. In addition, manual document routing still requires significant human intervention, increasing the risk of delays and misclassification. Therefore, there is a need for a more adaptive correspondence management system that combines document digitization and intelligent workflow automation.

The novelty of this study lies in the integration of Optical Character Recognition (OCR), rule-based routing, digital approval, and notification features into a single web-based platform. Unlike previous studies that mainly focus on digital archiving and correspondence tracking, the proposed Smart Mail Management System introduces automated document processing and intelligent correspondence distribution to improve efficiency, accuracy, and reliability in administrative services.

Accordingly, this study aims to develop a Smart Mail Management System that integrates OCR technology and a rule-based routing mechanism to automate text extraction and correspondence distribution processes within higher education institutions (Dermawan, Mulyawan, and Lauro 2019). The proposed system is expected to minimize manual processing, reduce routing errors, accelerate document handling, and improve the effectiveness of administrative services. Furthermore, the integration of digital approval and notification features contributes to a more organized and transparent correspondence workflow, thereby supporting digital transformation in higher education environments (Pandey et al. 2023).

RESEARCH METHODS

This study employed a System Development Research approach to design and develop a web-based Smart Mail Management System for managing correspondence activities at the Faculty of Science and Technology, Universitas Ibrahimy. Requirement gathering was conducted through direct observation, interviews with system users, documentation studies, and literature reviews related to document management and information systems. The identified users consisted of three roles, namely Administrator, Head of Study Program (Kaprod), and Dean. Information obtained from these activities was used to determine functional requirements and system specifications.

The software development process adopted the Waterfall Software Development Life Cycle (SDLC), which consists of requirements analysis, system design, implementation, testing, and maintenance. During the requirements analysis stage, the existing correspondence workflow and user needs were identified. The design stage focused on system architecture, database design, and user interface preparation. System implementation was carried out using the Laravel framework with MySQL as the database management system. The application was developed using PHP, HTML, CSS, JavaScript, and Bootstrap. To support document digitization, Optical Character Recognition (OCR) functionality was implemented using the Tesseract OCR library enabling the extraction of textual information from scanned documents (Ragil et al. 2025). In addition, notification and digital approval features were integrated to improve correspondence processing efficiency (Rizal and Nuryasin 2025).

Figure 1 illustrates the stages of system development using the Waterfall methodology (Sanjaya Pinem 2021). The process begins with requirement analysis and continues through system design, implementation, testing, and maintenance.

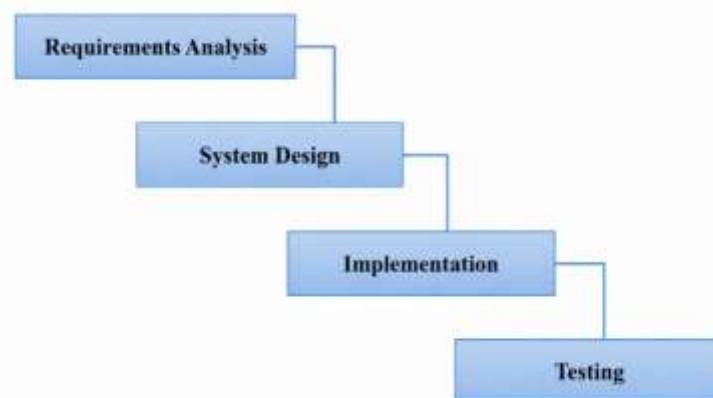


Figure 1. Waterfall Development Model

The system was developed and tested on a computer equipped with an Intel Core i3 processor, 8 GB RAM, and Windows operating system. Functional verification was performed through Black-Box Testing to ensure that each module operated according to the predefined requirements.

The Smart Mail Management System applies a role-based architecture consisting of three categories of users: Administrator, Head of Study Program (Kaprod), and Dean. The

Administrator is responsible for recording incoming and outgoing correspondence, managing digital archives, and performing OCR scanning on uploaded documents. The Head of Study Program handles document dispositions and monitors correspondence activities, while the Dean is responsible for providing approval and authorization for official documents.

To enhance the efficiency of correspondence management, the system incorporates a rule-based routing mechanism. After a document image is uploaded, the Tesseract OCR module extracts textual information from the letter content. Subsequently, the extracted text is analyzed using predefined IF–THEN rules based on specific keywords. For instance, documents containing keywords associated with financial matters are automatically directed to the Dean, whereas letters related to academic or curriculum issues are forwarded to the Head of Study Program. Through this mechanism, correspondence distribution can be performed automatically, thereby reducing manual intervention, minimizing routing errors, and accelerating document handling processes. Figure 1 illustrates the stages of system development using the Waterfall methodology, starting from requirements analysis and continuing through design, implementation, testing, and maintenance.

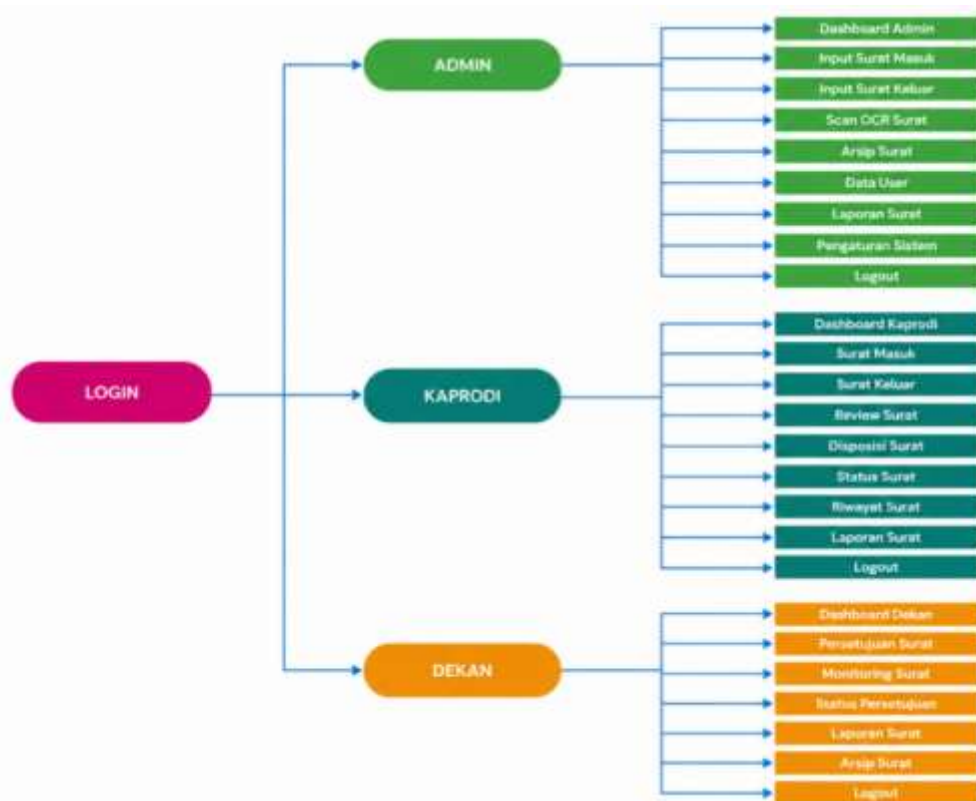


Figure 2. Smart Mail Management System Architecture

Figure 2 illustrates the architecture design of the Smart Mail Management System, which is organized based on role-based access control involving three categories of users, namely Administrator, Head of Study Program (Kaprodi), and Dean. Each user is granted different access privileges and responsibilities according to their roles to ensure secure and efficient correspondence management. The system begins with the login module, which authenticates users before granting access to the corresponding dashboard and functionalities.

The Administrator serves as the central operator responsible for managing correspondence data and maintaining system operations. Through the administrator dashboard, users can record incoming and outgoing letters, perform OCR scanning, manage archives, maintain user data, generate reports, configure system settings, and terminate sessions through the logout feature. These functionalities support document digitization and facilitate administrative activities.

The Head of Study Program (Kaprodi) is responsible for reviewing correspondence and managing document disposition processes. This role provides access to incoming and outgoing

letters, correspondence review, disposition management, status monitoring, correspondence history, report generation, and logout functionality. These features enable the Head of Study Program to supervise document processing and ensure that correspondence is handled appropriately.

The Dean acts as the final authority in the correspondence workflow. Through the Dean dashboard, authorized users can perform document approval, monitor correspondence activities, track approval status, access reports, manage archived documents, and log out of the system. This role supports decision-making processes and enhances transparency in correspondence management. Overall, the architecture design demonstrates that the Smart Mail Management System implements a role-based structure that integrates document processing, approval mechanisms, and information management within a single web-based platform, thereby improving efficiency, security, and accountability in administrative services.



Figure 3. Workflow diagram

Figure 3 illustrates the workflow of the proposed Smart Mail Management System. The process begins with user authentication and document uploading. Subsequently, the OCR module extracts textual information from correspondence documents and transfers the extracted data into the database. The system then applies predefined routing rules to determine the appropriate recipient. Afterward, authorized users perform disposition and digital approval processes. Notifications and status tracking functionalities enable users to monitor document progress, while completed correspondence is stored in the archive for future retrieval.

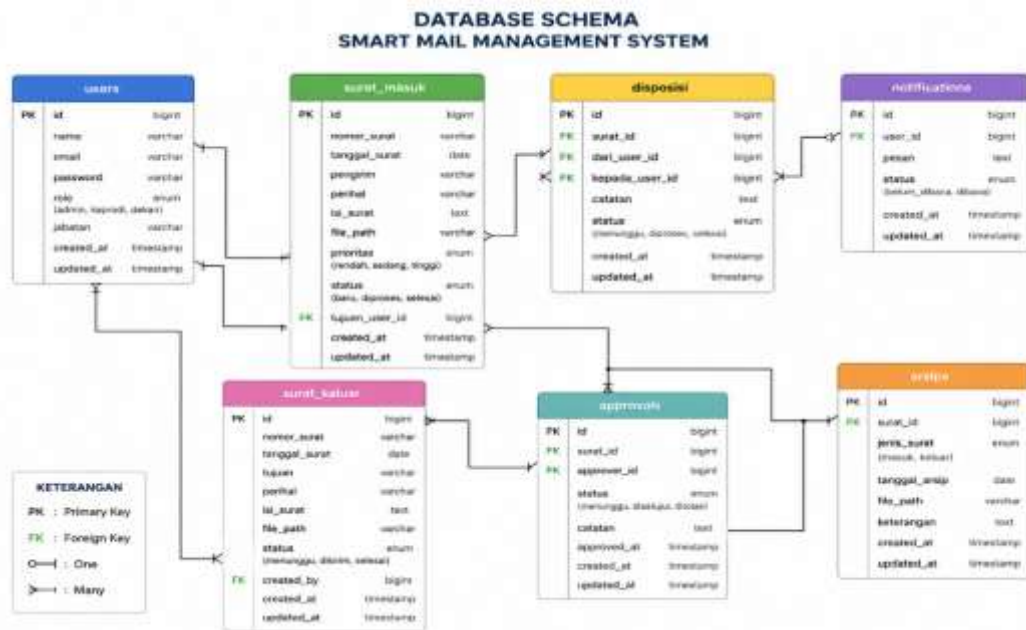


Figure 4. Database Schema

Figure 4 illustrates the database schema of the Smart Mail Management System, which consists of several related tables, including users, incoming letters, outgoing letters, dispositions, notifications, approvals, and archives. These entities are integrated to support various system functionalities, such as user authentication, OCR-based document processing, rule-based correspondence routing, digital approval, status tracking, and document archiving. The relationships among tables ensure data integrity and provide efficient information management, thereby supporting a more organized and reliable correspondence workflow within higher education institutions.

RESULTS AND DISCUSSION

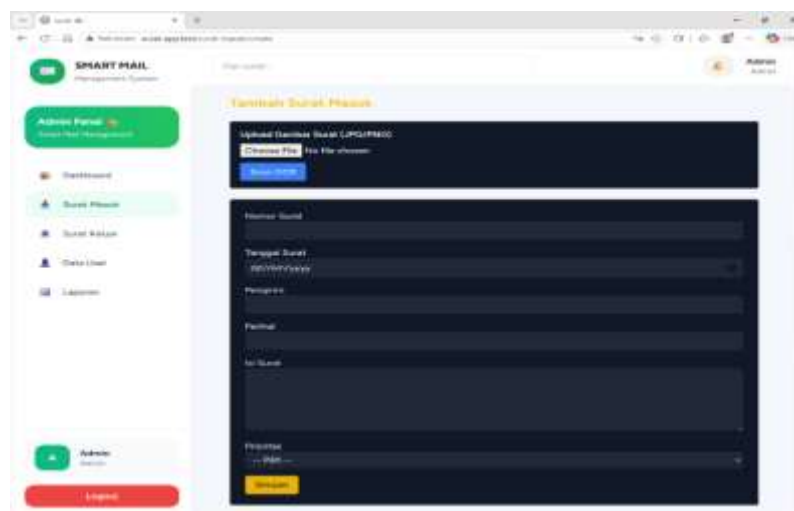


Figure 5. Incoming Mail Entry Interface

Figure 5 illustrates the incoming mail entry module used by administrators to digitize correspondence data. Users can upload document files in JPG, PNG, and PDF formats and perform Optical Character Recognition (OCR) scanning to extract textual information automatically. The extracted data, including letter number, sender, subject, date, and content, are subsequently stored in structured database fields. Experimental results indicate that the OCR

module successfully accelerates document registration and reduces manual input activities. Nevertheless, several recognition errors were observed, particularly in low-resolution images and handwritten characters, which affected the extraction accuracy of certain words and numbers.

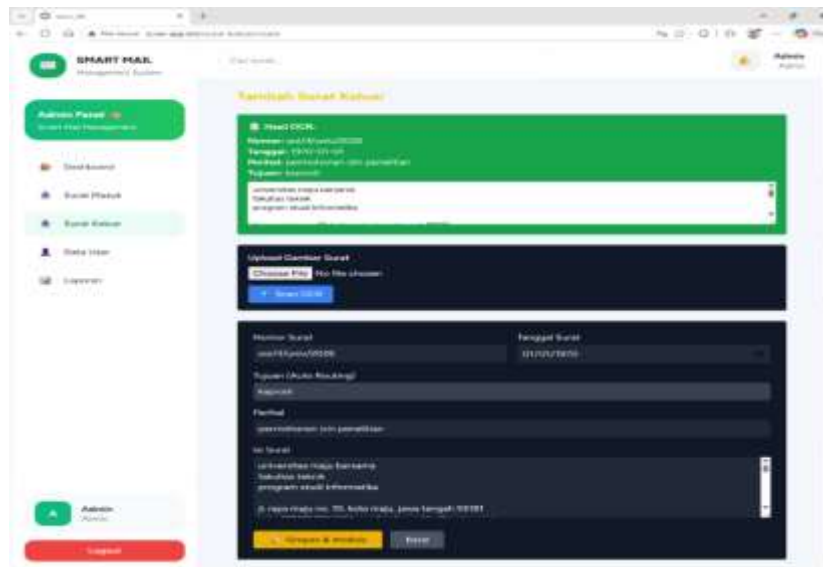


Figure 6. OCR Text Extraction and Auto-Routing Result

Figure 6 demonstrates the OCR extraction and intelligent routing mechanism implemented in the Smart Mail Management System. After the document is uploaded, the OCR engine converts the image into machine-readable text and extracts essential information from the correspondence. The extracted text is analyzed through predefined IF-THEN rules to determine the appropriate recipient automatically. This mechanism reduces the dependency on manual classification and contributes to a more efficient document distribution process. Compared with previous correspondence systems that mainly function as digital archives, the proposed system provides integrated document processing and intelligent routing capabilities.

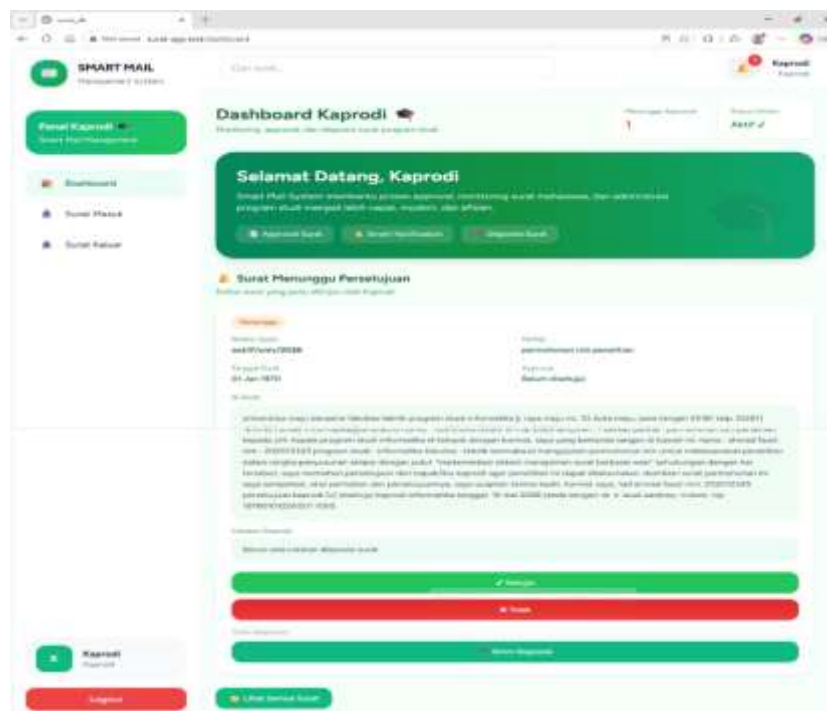


Figure 7. Automatic Routing Result on the Head of Study Program Dashboard

Figure 7 illustrates the implementation of the automatic routing mechanism in the Smart Mail Management System. After textual information is extracted through the OCR module, the system analyzes predefined keywords using IF-THEN rules to determine the appropriate recipient. Correspondence associated with academic or curriculum matters is automatically directed to the Head of Study Program, whereas letters related to financial affairs are forwarded to the Dean. This mechanism reduces the dependency on manual document classification and shortens processing time. Routing evaluation conducted on fifty incoming documents showed that forty-eight letters were successfully delivered to the intended recipients, resulting in a routing accuracy of 96%. Misclassification occurred in several cases due to ambiguous keywords and incomplete text extraction results.

The integration of OCR and rule-based routing contributes to a more efficient correspondence workflow compared with conventional approaches. In addition to supporting automated document distribution, the system minimizes administrative delays and reduces the risk of human error. Compared with previous studies by Royani and Rohman (2023), Londa et al. (2022), and Nurjanah et al. (2021), which mainly emphasized digital archiving, document tracking, and disposition management, the proposed system provides additional intelligent capabilities through automated routing and OCR-based information extraction. These findings indicate that the developed system is capable of improving efficiency, accuracy, and automation in correspondence management, which is consistent with the objectives established in this study.

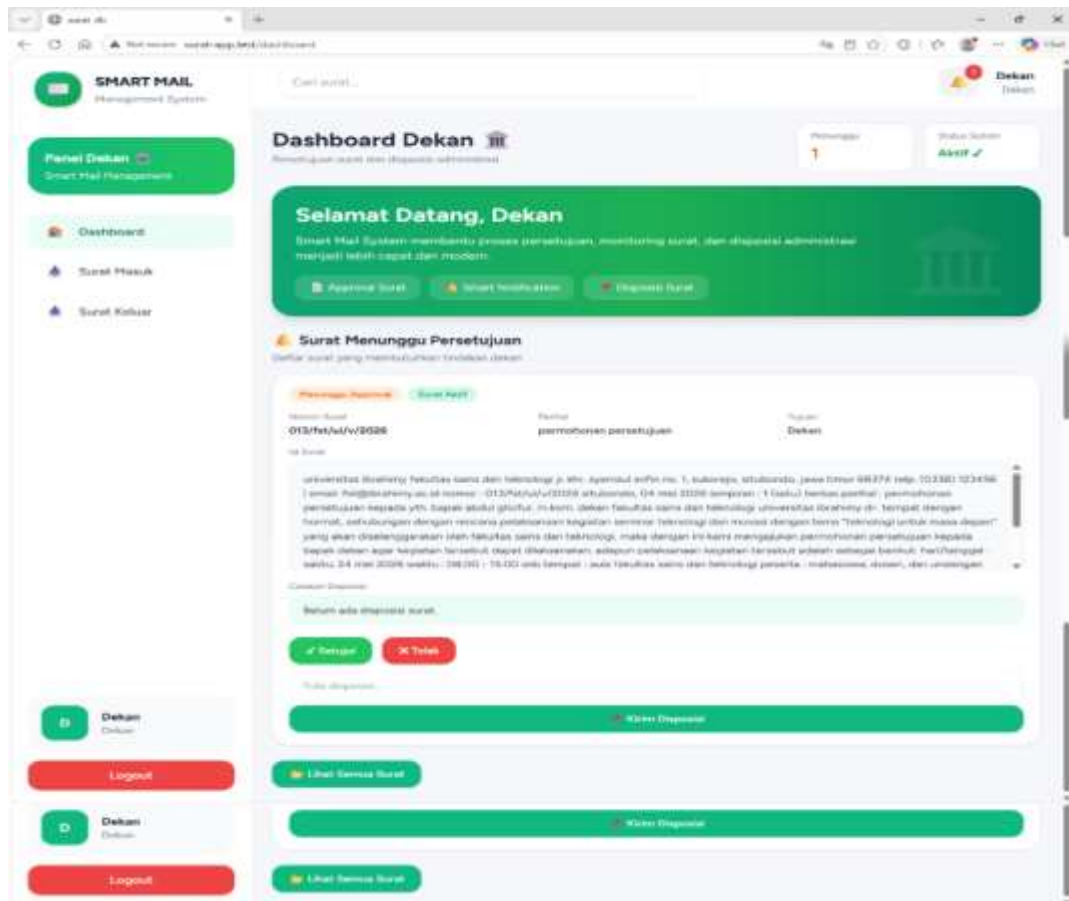


Figure 8. Notification and Digital Approval

Figure 8 presents the digital approval and disposition module implemented in the Smart Mail Management System. This feature enables authorized users, particularly the Head of Study Program, to review correspondence details, provide disposition instructions, and approve or reject submitted documents through a structured digital workflow. The approval process begins when a letter has been successfully recorded and routed by the system. Subsequently, authorized users can evaluate the document and determine its status before forwarding it to the next stage of processing.

In addition to supporting approval activities, the system provides status tracking and audit trail functionalities. Each correspondence record is assigned a specific status, such as pending, approved, rejected, or completed, allowing administrators and users to monitor the progress of document processing in real time. Furthermore, all approval actions, disposition notes, and status changes are automatically stored in the database, creating an audit trail that improves document traceability and accountability. These capabilities facilitate monitoring and reduce the risk of document loss or unrecorded modifications.

Compared with previous studies conducted by Royani and Rohman (2023), Londa et al. (2022), and Nurjanah et al. (2021), which mainly emphasized digital archiving and correspondence monitoring, the proposed system provides a more comprehensive workflow by integrating OCR-based text extraction, automatic routing, digital approval, status tracking, and audit trail mechanisms within a single platform. These integrated features enhance transparency, minimize manual intervention, and improve the efficiency and reliability of correspondence management processes. The findings indicate that the developed system successfully supports the objectives of this study by providing a more accurate, automated, and organized correspondence management environment within higher education institutions.

To evaluate the performance of the proposed Smart Mail Management System, several assessments were conducted, including functional testing, OCR performance evaluation, routing accuracy analysis, and user satisfaction measurement. Black-box testing indicated that all modules, including login, OCR scanning, automatic routing, disposition management, notification delivery, and digital approval, operated according to the specified requirements without critical errors. These findings demonstrate that the developed system was capable of supporting correspondence management activities effectively and ensuring the reliability of each functional component.

Table 2. Black-Box Testing Results

Function	Expected Result	Status
Login	User successfully accesses the system	Valid
OCR Scan	Text information extracted correctly	Valid
Automatic Routing	Correspondence assigned to intended recipient	Valid
Disposition	Disposition notes stored properly	Valid
Digital Approval	Document status updated correctly	Valid
Notification	Notification displayed successfully	Valid

The OCR module was evaluated using fifty correspondence documents in JPG, PNG, and PDF formats. Experimental results showed that textual information was successfully extracted from forty-seven documents, resulting in an accuracy rate of 94%. Recognition errors were mainly observed in blurred images, skewed documents, and characters with insufficient contrast. These findings indicate that image quality has a considerable influence on OCR performance. Furthermore, confusion matrix analysis revealed that several extraction errors were caused by image degradation and similarities among character patterns.

Table 3. White-Box Testing Results

Module	Cyclomatic Complexity	Independent Paths	Status
Login	3	3	Valid
OCR Processing	4	4	Valid
Rule-Based Routing	5	5	Valid
Digital Approval	3	3	Valid
Notification	2	2	Valid

In addition to functional testing, white-box testing was performed to examine the internal logic and control flow of the developed modules. The evaluation focused on several critical

components, including login authentication, OCR processing, rule-based routing, digital approval, and notification modules. Cyclomatic complexity analysis indicated that all independent execution paths could be executed successfully without logical errors. These results demonstrate that the implemented algorithms and program structures functioned properly and provided reliable support for correspondence management processes.

Table 4. OCR Confusion Matrix

Actual Condition	Correct Recognition	Incorrect Recognition
Positive	47	3
Negative	48	2

In addition to OCR performance analysis, the effectiveness of the rule-based routing mechanism was evaluated using fifty incoming letters. Based on predefined IF–THEN rules, the system correctly assigned forty-eight documents to the intended recipients, producing a routing accuracy of 96%. Misclassification occurred in a limited number of cases due to ambiguous keywords and incomplete information obtained during the OCR extraction process. Nevertheless, the routing mechanism successfully reduced manual intervention and accelerated correspondence distribution compared with conventional administrative procedures.

Table 5. Routing Accuracy Results

Total Documents	Correct Routing	Incorrect Routing	Accuracy
50	48	2	96%

The developed application also supports a structured approval workflow involving authorized users. Once correspondence has been processed and distributed automatically, users can review documents, provide disposition notes, and approve or reject submissions. The system facilitates status tracking by allowing users to monitor document conditions, including pending, approved, rejected, and completed statuses. In addition, every activity related to approval and disposition is recorded automatically in the database, creating an audit trail that improves transparency, accountability, and document traceability throughout the correspondence lifecycle.

Table 6. User Acceptance Test Results

Evaluation Aspect	Percentage
Ease of Use	90%
System Functionality	92%
Interface Design	88%
Overall Satisfaction	90%

User evaluation involving the Administrator, Head of Study Program, and Dean indicated that the developed system fulfilled operational requirements and supported administrative processes effectively. The User Acceptance Test (UAT) results showed a high level of user satisfaction regarding functionality, usability, and interface design. Furthermore, the System Usability Scale (SUS) evaluation produced a score of 84.5, which falls into Grade A and is categorized as excellent. These findings indicate that the application provides a satisfactory user experience and can be adopted easily by users.

Table 7. System Usability Scale Results

Average Score	Grade	Category
84.5	A	Excellent

The implementation of Optical Character Recognition technology significantly reduced repetitive manual data entry and accelerated document registration processes. Moreover, the

integration of rule-based routing improved the efficiency of correspondence distribution by assigning documents automatically according to predefined keywords, thereby minimizing delays and reducing classification errors. Compared with previous studies conducted by Royani and Rohman (2023), Londa et al. (2022), and Nurjanah et al. (2021), which mainly focused on digital archiving, correspondence tracking, and disposition management, the proposed system introduces additional intelligent capabilities through OCR-based text extraction, automatic routing, digital approval, status tracking, and audit trail mechanisms. These integrated functionalities contribute to improving administrative efficiency and support digital transformation initiatives within higher education institutions.

Although the developed system achieved satisfactory performance, several limitations remain. OCR accuracy may decrease when processing low-quality images, blurred characters, or documents with insufficient contrast. Furthermore, the rule-based routing mechanism relies heavily on predefined keywords, which may result in incorrect classification when ambiguous expressions are encountered. Future studies may incorporate machine learning and natural language processing approaches to improve classification accuracy and enhance the adaptability of intelligent correspondence management systems.

CONCLUSION

The development of the Smart Mail Management System demonstrates that the integration of Optical Character Recognition (OCR) technology and a rule-based routing mechanism can improve the efficiency and reliability of correspondence management in higher education institutions. Experimental results showed that the OCR module achieved an accuracy of 94% by successfully extracting textual information from 47 out of 50 document samples, while the routing mechanism correctly assigned 48 out of 50 incoming letters to the intended recipients, resulting in a routing accuracy of 96%. Furthermore, user evaluation involving the Administrator, Head of Study Program, and Dean indicated satisfactory system performance, and the System Usability Scale (SUS) assessment yielded a score of 84.5, which falls into the excellent category.

The findings of this study provide both practical and scientific contributions to intelligent correspondence management. By integrating OCR-based text extraction, automatic rule-based routing, digital approval, status tracking, and audit trail functionalities within a single web-based platform, the proposed system offers a more comprehensive solution compared with previous correspondence management systems that mainly focus on digital archiving and document monitoring. These integrated capabilities support administrative digital transformation and contribute to improving efficiency, transparency, and accuracy in correspondence processing.

Despite achieving satisfactory performance, several limitations remain. OCR accuracy is strongly influenced by document quality and may decrease when processing blurred images, skewed documents, or low-contrast characters. In addition, the rule-based routing mechanism depends on predefined keywords, which may lead to misclassification when ambiguous terms are encountered. Therefore, future studies may incorporate more advanced intelligent approaches, such as machine learning and natural language processing techniques, to improve classification accuracy and enhance the adaptability of correspondence management systems.

ACKNOWLEDGEMENTS

The authors would like to express their appreciation to the Faculty of Science and Technology, Universitas Ibrahimy, for providing the facilities and academic environment necessary for conducting this research. Gratitude is also extended to lecturers, administrative staff, and all individuals who contributed valuable insights, support, and assistance throughout the development and evaluation of the Smart Mail Management System. Their contributions have been instrumental in the successful completion of this study.

REFERENCES

- Alfian Tri Putra, Darti Akhsa, Burhan Muhammad Ikhwan, and Munandar Aris. 2025. "Integrasi OCR Dan TF-IDF Untuk Metadata Otomatis Pada Pencarian Dokumen Digital." *Jurnal Fasilkom* 15(2): 304–11.

- Aubaid, Asmaa M., and Alok Mishra. 2020. "A Rule-Based Approach to Embedding Techniques for Text Document Classification." *Applied Sciences (Switzerland)* 10(11). doi:10.3390/app10114009.
- Dermawan, Maulana Sandy, Bagus Mulyawan, and Manatap Dolok Lauro. 2019. "Perancangan Aplikasi Sistem Manajemen Dokumen Dan Pencarian Teks Dengan Menggunakan Optical Character Recognition (OCR)." *Jurnal Ilmu Komputer dan Sistem Informasi* 7(1): 81–86.
- Díaz-García, Vicente, Antonio Montero-Navarro, José Luis Rodríguez-Sánchez, and Rocío Gallego-Losada. 2022. "Digitalization and Digital Transformation in Higher Education: A Bibliometric Analysis." *Frontiers in Psychology* 13(December). doi:10.3389/fpsyg.2022.1081595.
- Dika Ade Royani, and Abdul Rohman. 2023. "Sistem Informasi Manajemen Surat Menyurat Berbasis Web Menggunakan Metode Waterfall Di Desa Bodeh Kecamatan Randublatung Kabupaten Blora." *Jurnal Mahasiswa Teknik Informatika* 2(2): 31–38. doi:10.35473/jamastika.v2i2.2447.
- Fitri Siti Nurjanah, Yuda Permana, Falaah Abdussalaam, and Jaenal Arifin. 2021. "Web Based Incoming and Outgoing Mail Management Information System with CodeIgniter Framework." *Digital Zone: Jurnal Teknologi Informasi dan Komunikasi* 12(2): 147–59. doi:10.31849/digitalzone.v12i2.7495.
- Hasibuan, Henni Novita Sari. 2022. "Optical Character Recognition Untuk Manajemen Surat." (*CoSIE*) 01(3): 146–51.
- Kowsari, Kamran, Kiana Jafari Meimandi, Mojtaba Heidarysafa, Sanjana Mendu, Laura Barnes, and Donald Brown. 2019. "Text Classification Algorithms: A Survey." *Information (Switzerland)* 10(4): 1–68. doi:10.3390/info10040150.
- Londa, Maria Adelvin, Yohanes Ardianus Wee, and Melky Radja. 2022. "Implementasi Sistem Informasi Monitoring Disposisi Surat Masuk Dan Surat Keluar Berbasis Website." *MATRIK: Jurnal Manajemen, Teknik Informatika dan Rekayasa Komputer* 21(2): 379–88. doi:10.30812/matrik.v21i2.1443.
- Mahawan, I Made Avendias, and I Putu Agus Eka Darma Udayana. 2020. "Implementasi Optical Character Recognition (Ocr) Dan Pendekatan Thesaurus Untuk Menemukan Informasi Pada Surat Masuk Di Stmik Stikom Indonesia." *Jurnal Teknologi Informasi dan Komputer* 6(1): 39–44. doi:10.36002/jutik.v6i1.1002.
- Di Marzo Serugendo, Giovanna, Maria Assunta Cappelli, Gilles Falquet, Claudine Métral, Assane Wade, Sami Ghadfi, Anne Françoise Cutting-Decelle, Ashley Caselli, and Graham Cutting. 2024. "Streamlining Tax and Administrative Document Management with AI-Powered Intelligent Document Management System." *Information (Switzerland)* 15(8). doi:10.3390/info15080461.
- Mihir, P, D Ritik, V Vivek, P Shrinit, and Chandrayani Rokade. 2022. "Smart Document Management System Using OCR." 3(05): 32–35.
- Minaee, Shervin, Nal Kalchbrenner, Erik Cambria, Narjes Nikzad, Meysam Chenaghlu, and Jianfeng Gao. 2021. "Deep Learning Based Text Classification: A Comprehensive Review." 1(1): 1–43. <http://arxiv.org/abs/2004.03705>.
- Nikou, Shahrokh, and Milla Aavakare. 2021. "An Assessment of the Interplay between Literacy and Digital Technology in Higher Education [Evaluación de La Interacción Entre La Alfabetización y La Tecnología Digital En La Educación Superior]." *Education and Information Technologies* 26: 3893–3915. <https://doi.org/10.1007/s10639-021-10451-0>.
- Pandey, Mrinal, Mamta Arora, Shraddha Arora, Charu Goyal, Varun Kumar Gera, and Harsh Yadav. 2023. "AI-Based Integrated Approach for the Development of Intelligent Document Management System (IDMS)." *Procedia Computer Science* 230: 725–36. doi:10.1016/j.procs.2023.12.127.
- Putri, Anindya Handzikie. 2024. "Digitalisasi Arsip Vital Di Dinas Perpustakaan Dan Arsip

- Kabupaten Bandung Dengan Penggunaan Teknologi Optical Character Recognition.” *Ilmu Informasi Perpustakaan dan Kearsipan* 13(2): 209. doi:10.24036/jiipk.v13i2.131998.
- Ragil, Dewi, Megaputri Nathalina Panjaitan, Syifa Khairunisa, Reinata Carolina Widia Pasaribu, Fadillah Emilia Nasution, Ruth Grace Arlyana Manurung, Rifqi Jabraha Rhah, et al. 2025. “Implementation of Web-Based Monitoring for the Evaluation of the Performance of Intern Students at BPJS Ketenagakerjaan Medan Kota.” *Journal of Digital Scholarship in Archives and Information* 1(1): 28–34. doi:10.58723/jdsia.v1i1.19.
- Rizal, Dimas Fahrul, and Ilyas Nuryasin. 2025. “Implementasi Blackbox Testing Pada Sistem Informasi Sirkulasi Perpustakaan Berbasis Website Dengan Teknik Equivalence Partitioning.” *Decode: Jurnal Pendidikan Teknologi Informasi* 5(1): 65–78. doi:10.51454/decode.v5i1.1052.
- Sanjaya Pinem, Victor E. Hutagaol; Victor M. Pakpahan. 2021. “Implementasi Sistem Informasi KRS Online Dengan Metode Software Development Life Cycle Model Waterfall.” *Jurnal Informatika Universitas Pamulang* 6(2): 283–89. <http://openjournal.unpam.ac.id/index.php/informatika283>.
- Siti Nur Khalishah Lisa., Firman Santoso., and Sunardi. 2025. “Implementasi Optical Character Recognition Pada Sistem Informasi Persuratan Berbasis Web Di Kantor IKSASS Alumni .” *KARSA NUSANTARA: Prosiding Seminar Nasional Kolaborasi Rekayasa dan Sains Nasional untuk Teknologi, Riset, dan Kecerdasan Buatan*. 2: 40–46.