

Research Article

Design and Development of the Guest Registration Information System for Meteorology Station Class 1 Sultan Iskandar Muda

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ABSTRACT

Guest administration is an important component of orderly and traceable operations in government institutions. At the Class 1 Sultan Iskandar Muda Meteorological Station, guest registration previously relied on conventional guest books, creating limitations in data organization, retrieval, verification, and reporting. This study aimed to develop a web-based Guest Registration Information System that integrates guest pre-registration, data validation, administrative approval, QR Code generation, physical arrival verification, check-in recording, and visit reporting within a unified workflow. The study employed a Research and Development approach using the Waterfall software development model. System requirements were identified through direct observation and interviews with staff involved in guest reception and data management. The system was implemented using PHP, MySQL, and Bootstrap and evaluated using black-box functional testing. The testing covered the system's main registration, authentication, data storage, verification, QR Code, search, reporting, and data-export functions. All tested scenarios produced outputs consistent with the predefined functional requirements. The system therefore demonstrates functional feasibility for integrating guest registration and visit management into a centralized digital workflow. From a sustainability perspective, the system provides potential resource-efficiency benefits by reducing reliance on paper-based guest records and physical document storage. However, the study does not quantitatively establish improvements in efficiency, security, user satisfaction, or environmental performance. Future research should evaluate these outcomes using process-time measurements, usability assessment, security testing, and resource-consumption indicators.

Keywords: *Information System; Guest Registration; Digital Administration; Meteorological Station; Visitor Management; Resource Efficiency*

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INTRODUCTION

The rapid development of digital technologies has transformed administrative processes in public institutions by enabling information to be collected, stored, processed, and retrieved more systematically (Mergel et al., 2019; Vial, 2019). Digital information systems can improve data traceability, accessibility, and coordination across administrative activities. Beyond operational digitalization, recent research has increasingly examined how digital technologies can contribute to resource efficiency and the transition toward circular and sustainable systems (Neri et al., 2025). Digital technologies can support circular-economy practices by improving information availability, process integration, resource optimization, and data-driven decision-making. However, the contribution of digitalization to circularity depends on how technologies are embedded within organizational processes and how their outcomes are evaluated (Neri et al., 2025; Romo et al., 2025).

The Class 1 Sultan Iskandar Muda Meteorological Station, under the Meteorology, Climatology, and Geophysics Agency (BMKG), provides services and information related to meteorology, climatology, air quality, and geophysics. In performing its institutional functions, the station receives visitors from government institutions, academic institutions, students, researchers, and the general public. Visitor information therefore needs to be recorded and managed systematically to support administrative documentation, verification, monitoring, and reporting. At the study site, guest registration previously relied on a conventional guest book. Such a process can create difficulties in organizing records, searching historical information, preparing reports, and maintaining physical documents. The use of paper-based records also requires continued consumption and storage of physical administrative materials.

Digital guest-registration systems offer an opportunity to address these limitations by converting visitor information into structured and searchable digital records. Previous studies have demonstrated the practical value of web-based guest-book systems for supporting administrative data management. Nevertheless, a conventional digital guest book generally focuses on electronic recording and storage, while a more integrated visitor-management system can connect registration, verification, approval, physical arrival, and visit documentation within a single information flow.

This distinction is important because digitalization alone should not automatically be interpreted as a circular-economy or sustainability intervention. Recent literature emphasizes that digital technologies can contribute to circular systems through mechanisms such as resource efficiency, information integration, traceability, and improved process management, while empirical evaluation of these outcomes remains an important research need (Neri et al., 2025; Hariyani et al., 2024). Thus, in an administrative context, replacing paper-based registration with an integrated digital workflow can be viewed as a potential resource-efficiency intervention, particularly through reduced dependence on physical guest books and paper-based record storage. However, such a contribution should not be presented as an environmental improvement unless resource consumption is quantitatively measured.

Against this background, this study addresses the need for a visitor-management system that transforms guest registration from a simple recording activity into a structured administrative information process. The research aims to design and develop a web-based Guest Registration



Information System for the Class 1 Sultan Iskandar Muda Meteorological Station. The proposed system integrates guest pre-registration, data validation, administrative approval, unique QR Code generation, physical arrival verification, check-in recording, centralized data management, and visit reporting. This integrated workflow is intended to improve data traceability and administrative control while reducing dependence on conventional paper-based registration.

The novelty of this study lies in the integration of these functions into an end-to-end visitor-management workflow specifically adapted to the operational requirements of a government meteorological station. Unlike a basic digital guestbook that primarily digitizes data entry, the proposed system connects registration data with administrative verification and physical visit confirmation. The study therefore contributes an applied example of how digital information integration can support more structured and potentially resource-efficient administrative processes. Nevertheless, the present research focuses on functional development and testing; it does not claim quantitative improvements in efficiency, security, user satisfaction, or environmental performance. These outcomes require further empirical evaluation.

Accordingly, the study focuses on the following objectives: (1) to design and develop a web-based Guest Registration Information System for the Class 1 Sultan Iskandar Muda Meteorological Station; (2) to integrate guest registration, validation, approval, QR Code verification, check-in, and visit reporting within a centralized workflow; and (3) to evaluate the functional performance of the developed system using black-box testing.

LITERATURE REVIEW

2.1 Information System

Information systems are systems made up of a set of components that interact with each other to collect, process, store, and present information needed by an organization to support operational activities, management, and decision-making. Information systems combine humans, hardware, software, databases, computer networks, and work procedures to produce accurate, relevant, and timely information. According to Hutahaeen (2015), information systems play an important role in improving the efficiency and effectiveness of an organization because they can process data into valuable information. In practice, information systems have several main components, which are hardware, software, data, procedures, humans (brainware), and communication networks.

2.2 Digital Guest Registration Information System

The Digital Guest Registration Information System is a system used to manage the process of registering, recording, storing, and reporting guest data electronically. This system is designed to replace the manual guest recording process that uses conventional guest books. With a digital system, all visit data can be stored in a database, making it easier to search, manage, and report visit information. Using a digital guest registration system offers several benefits, such as speeding up the guest registration process, reducing the risk of data loss, enhancing information security, and making it easier for institutions to monitor visits. Research conducted by Karsa et al. (2024) shows that a web-based guest book system can increase administrative efficiency and make managing guest visit data easier.



2.3 Web Technologies for Information System Development

The development of the Meteorology Class 1 Sultan Iskandar Muda Digital Guest Registration Information System requires support from technology and software that can produce applications that are reliable, secure, and easy to use. It requires a combination of server-side programming, client-side technologies, database management, and web-development infrastructure.

2.3.1 PHP

PHP (Hypertext Preprocessor) is a server-side programming language widely used in web-based application development. PHP can generate dynamic web pages and can be integrated with various database systems such as MySQL. Using PHP in this system allows guest data processing to be done quickly and efficiently.

2.3.2 HTML, CSS, and JavaScript

HTML (HyperText Markup Language) is used to build the structure of a web page. CSS (Cascading Style Sheets) is used to style and lay out the user interface to make it more attractive and responsive. Meanwhile, JavaScript is used to add interactive functions so users can interact with the system more easily and comfortably.

2.3.3 XAMPP

XAMPP is a software package that includes Apache, PHP, and MySQL, used as a web application development environment. XAMPP allows developers to run web applications locally before deploying them on a production server.

2.3.4 Bootstrap

Bootstrap is a front-end framework that provides reusable interface components and responsive layout structures. Its use can facilitate the development of interfaces that remain accessible across different screen sizes and devices. In the present system, Bootstrap supports the development of the user interface for guest registration and administrative functions.

2.4 Database

A database is a collection of data that is organized and stored systematically so that it is easy to access, manage, and update. In the BMKG Digital Guest Registration Information System, the database is used to store guest information, visit purposes, visit times, user data, and system activity history. Using a database offers various benefits, such as reducing data redundancy, improving information security, speeding up the data search process, and making report preparation easier. The database also plays a key role in ensuring the integrity and consistency of the information stored in the system.

2.5 MySQL

MySQL is a relational database management system (Relational Database Management System) that uses SQL (Structured Query Language) to manage data. MySQL is widely used in web application development because it is open source, easy to use, and performs well in handling large amounts of data. In the Digital Guest Registration Information System for Meteorology Class 1 Sultan Iskandar Muda, MySQL is used to store and manage all data related to guests, system users, and visit activities so that information can be accessed quickly and accurately.



2.6 Waterfall

The Waterfall model is a sequential software-development approach in which development progresses through defined stages, typically including requirements analysis, design, implementation, testing, and maintenance (Saravanos & Curinga, 2023). This method is applied because developing the guest registration information system requires structured stages. Each phase must be completed before moving on to the next stage to minimize errors.

2.7 System Security and Audit Log

“System security is an important aspect of information-system development because systems must protect organizational information from unauthorized access and misuse. Authentication establishes the identity of users, while authorization determines the functions and resources they are permitted to access. Security logging and audit trails can further support monitoring, accountability, and post-event investigation (National Institute of Standards and Technology [NIST], 2020).

2.8 Visit and User Management

Visit management is the process of handling guest data from registration to visit reporting. This system allows staff to monitor the number of guests, the purpose of visits, and visit history in real-time. Meanwhile, user management is used to manage access rights for each system user based on their role. Generally, there are several types of users in the system, namely administrators, reception staff, and managers. Proper access rights management can enhance both the security and efficiency of system usage.

2.9 AntiGravity IDE

AntiGravity IDE works as a website development tool used to write, edit, test, and manage code so that the website creation process becomes faster, easier, and more organized.

2.10 Digital Technologies, Resource Efficiency, and Circular Systems

The relationship between digitalization and circular economy has received increasing attention in recent research. Neri et al. (2025), through a systematic literature review, found that digital technologies can support circular-economy implementation, particularly through improved resource efficiency, information integration, and digital-enabled organizational capabilities. Similarly, Das et al. (2024) identified an important intersection between Industry 4.0 technologies, environmental sustainability, and circular economy, while Sharma et al. (2025) emphasized the role of information systems in supporting sustainability and circular-economy initiatives.

The contribution of digitalization to circularity, however, should not be assumed automatically. Recent research highlights the need to examine how digital technologies generate specific sustainability or circularity outcomes and to provide empirical evidence through appropriate performance measures (Neri et al., 2025). A digital system may therefore support resource efficiency by reducing paper-based activities, physical document storage, and repetitive manual processing, but these benefits should be distinguished from directly demonstrated environmental impacts. In addition, digitalization does not automatically eliminate paper consumption (Briscoe, 2022).



In the context of guest administration, the transition from physical guestbooks to an integrated digital system provides a potentially relevant example of resource-efficient administrative digitalization. The mechanism is primarily associated with reducing dependence on paper records and physical archiving while improving the accessibility and traceability of administrative information. Nevertheless, quantitative environmental benefits require additional measurement and are beyond the functional-testing scope of this study.

METHOD

3.1 Research Design

This study employed a Research and Development (R&D) approach to design and develop a web-based Guest Registration Information System for the Class 1 Sultan Iskandar Muda Meteorological Station. The R&D approach was used to produce a functional information system product based on operational requirements identified in the study setting. The software-development process adopted the Waterfall model, which provides sequential stages consisting of requirements analysis, system design, implementation, testing, and maintenance (Rosa & Shalahuddin, 2018).

The use of the Waterfall model was considered appropriate because the main functional requirements of the guest-registration process could be identified during the initial analysis and subsequently translated into structured system specifications. In this study, R&D represents the overall research approach, whereas Waterfall represents the development model used to construct the system. The Waterfall model consists of several sequential stages, including requirements analysis, system design, implementation, testing, and maintenance. The research flowchart is shown in Figure 1.

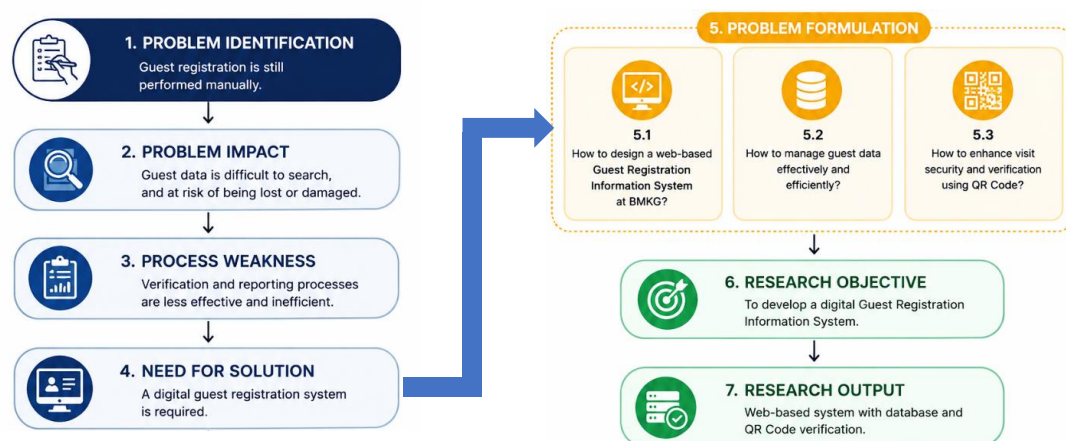


Figure 1. Flowchart of problem identification and research framework

3.2 Requirements Analysis

System requirements were identified through direct observation and interviews with staff involved in receiving and managing guest information at the study site. Observation was used to examine the existing guest-registration process, including guest identity recording, visit-purpose recording, verification, data storage, and preparation of visit reports. Interviews were



conducted to identify operational difficulties, user requirements, required system functions, and the mechanism needed to verify the physical arrival of registered guests.

The information obtained from observation and interviews was reviewed with the relevant staff to ensure that the identified requirements reflected the operational conditions of the institution. The resulting requirements were divided into functional and non-functional requirements.

The main functional requirements included guest registration, data validation, database storage, administrative verification, visit approval or rejection, QR Code generation, QR Code scanning, check-in recording, guest-data searching, reporting, and data export. The system also included user authentication and role-based access for administrative activities. The principal guest information recorded by the system included name, organization, contact information, purpose of visit, visit date and time, and supporting documentation.

In the context of guest registration, the analysis includes:

- User Requirements: The receptionist needs to quickly input guest data, while the management requires regular visit history reports.
- System Requirements: Data that must be stored includes the guest's name, organization, purpose of visit, photo (if using a webcam), and contact number.

3.3 System Design

The system-design stage translated the identified requirements into a technical and functional blueprint. The design included the system workflow, database structure, user interface, user roles, and QR Code verification mechanism. The proposed workflow connects the main stages of visitor management as presented in Figure 1:

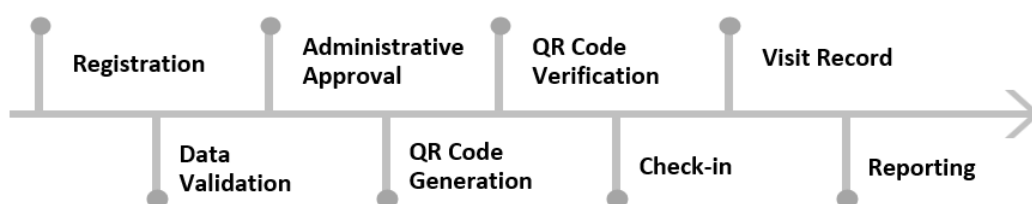


Figure 2. The proposed workflow connects the main stages of visitor management

The database was designed to store guest information, visit information, user accounts, approval status, and check-in records in a centralized structure. The interface was designed for the main user groups, including guests, administrators, and security personnel.

The design also incorporated access control so that administrative functions could be accessed only by authorized users. However, the present study focuses on functional system development and testing and does not constitute a comprehensive cybersecurity assessment.

The design created for the guest registration system, as shown in Figure 3, includes:

- Architecture & Database Design: Creating an Entity Relationship Diagram (ERD) and database table structures to store guest data.
- Interface Design (User Interface): Designing digital guest registration forms to be easy to use (user-friendly) when filled out by guests or receptionists.



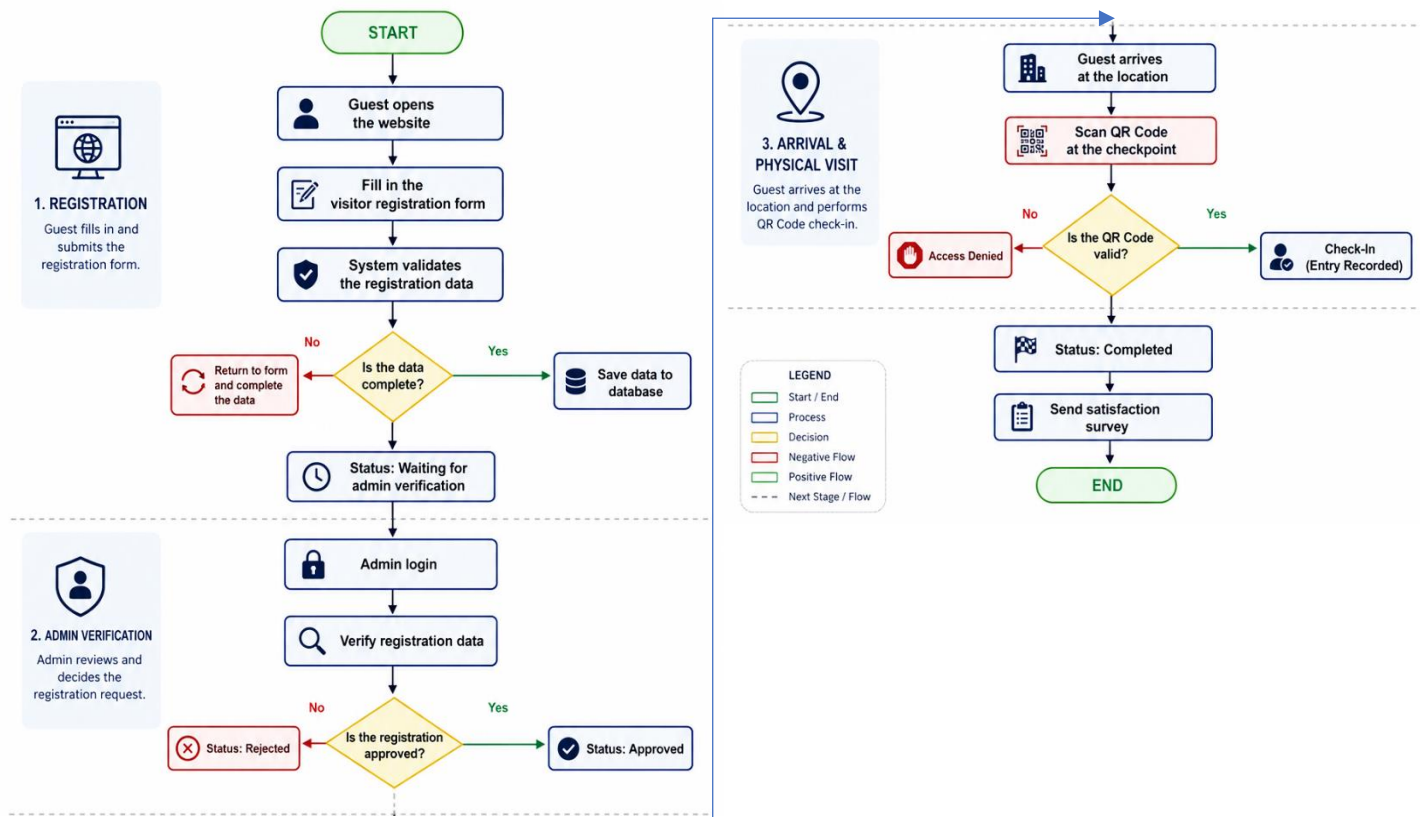


Figure 3. Guest Registration Process in the Proposed System

System Flow Diagram Description:

- Guests register through the website.
- The system validates and saves the data to the database.
- The system generates a visit ticket and QR Code.
- Admin verifies the visit request.
- If approved, guests can visit according to the schedule
- Security scans the QR Code when the guest arrives.
- The system validates the QR Code.
- If valid, the visit status changes to Completed.
- The system sends a satisfaction survey (IKM) to the guest.
- The visit process ends & the data is stored as a visit archive.

Building on these two process-level representations, Figure 4 presents the functional flow of the proposed digital Guest Registration Information System from the user's perspective. The diagram expands the system into its main functional pathways, including access to the website, registration-form submission, QR Code-related functions, information access, ticket checking, and database recording. Thus, Figure 4 does not represent a separate system process but provides a more detailed functional view of how the processes presented in Figures 2 and 3 are implemented through user-accessible system functions. The three figures therefore complement one another: Figure 2 describes the overall visitor-management workflow, Figure 2 details the registration process, and Figure 3 illustrates the functional interaction between users and the developed system. This layered representation provides a clearer basis for the subsequent system implementation and functional testing described in the following sections.



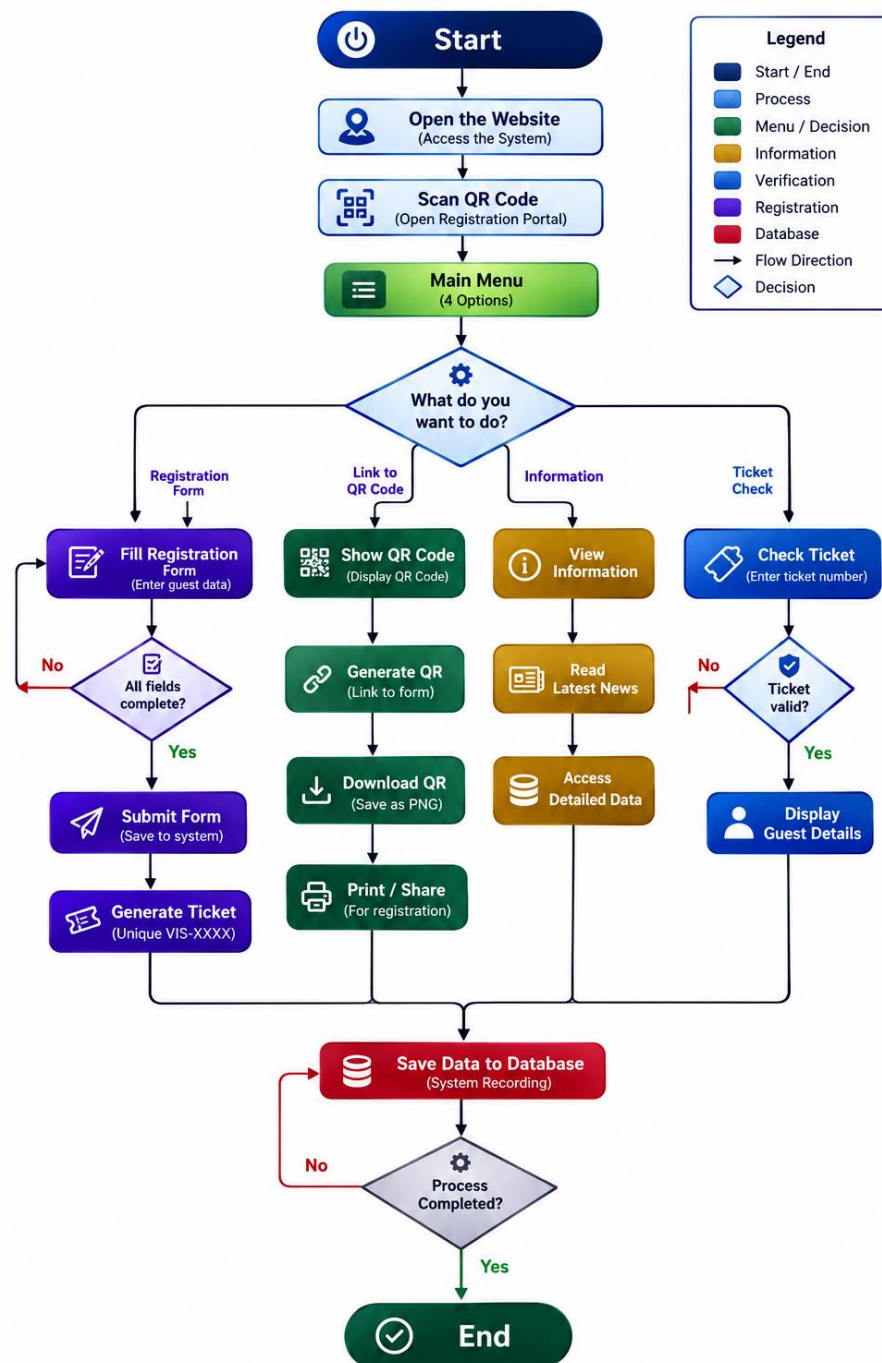


Figure 4. Functional flowchart of the proposed digital guest registration information system

3.4 System Implementation

The system was implemented as a web-based application using PHP, MySQL, and the Bootstrap framework, with HTML, CSS, and JavaScript supporting the interface and user interaction. The implementation translated the system design into functional modules covering guest registration, data validation, database management, administrative verification, QR Code generation and scanning, check-in recording, data searching, reporting, and Excel-compatible data export.



The implementation followed the sequential stages of the Waterfall model. Each development stage was completed before proceeding to the subsequent stage, allowing the system requirements and design specifications to be translated systematically into the operational application.

3.5 System Testing

Functional testing was conducted using the black-box testing method, which evaluates system functionality by examining inputs and outputs without directly examining the internal program code (Mustaqbal et al., 2015). The testing focused on whether each principal system function produced the expected output according to the predefined requirements.

The tested functions included administrator authentication, guest registration, data storage and retrieval, QR Code generation, administrative verification, QR Code scanning, data searching, report generation, and Excel data export. Additional scenarios covered form validation, visit approval/rejection, check-in recording, visit-history management, and logout.

For each test scenario, the expected output was compared with the actual system output. A function was classified as successful when the system produced the expected output under the specified test condition. The functional testing results were subsequently summarized as the number of successful and unsuccessful scenarios.

The functional testing was intended to establish whether the developed system operated according to its predefined specifications. It was not designed to measure improvements in processing efficiency, usability, user satisfaction, information-security performance, or environmental impact. Consequently, the study does not interpret successful functional testing as quantitative evidence of improvement in these dimensions.

3.6 System Deployment and Maintenance

Following functional testing, the system was prepared for use in the operational environment of the Class 1 Sultan Iskandar Muda Meteorological Station, including computers used by relevant administrative and security personnel. Maintenance involves correcting identified functional problems, addressing security-related updates, adapting the system to changes in the operating environment, and making necessary adjustments to reporting or administrative requirements.

3.7 Sustainability and Resource-Efficiency Perspective

The system was also considered from a resource-efficiency perspective because it replaces conventional paper-based guest registration with digital recording and centralized information management. Digital technologies can support circular and sustainable systems through improved information integration and resource efficiency (Neri et al., 2025; Das et al., 2024). However, the present study did not quantitatively measure paper consumption, printing, physical storage, processing time, or associated environmental impacts.

Therefore, the sustainability relevance of the system is treated as a potential resource-efficiency contribution, rather than as a quantitatively demonstrated environmental benefit. Further assessment would be required to determine the actual magnitude of resource savings resulting from implementation.



RESULT

4.1 Research Results

The study resulted in a web-based Guest Registration Information System for the Class 1 Sultan Iskandar Muda Meteorological Station. The system was developed to integrate guest registration, data validation, administrative verification, QR Code generation, physical arrival verification, check-in recording, data searching, reporting, and data export within a centralized digital workflow.

The system was implemented using PHP, MySQL, and Bootstrap, with supporting web technologies for interface development and user interaction. The resulting application provides separate functions for guests, administrators, and security personnel. Rather than functioning solely as a digital replacement for the conventional guestbook, the system connects the registration record with subsequent administrative approval and physical visit verification.

The implemented workflow can be summarized as shown in Figure 2. This workflow allows information entered during registration to be retained and reused during subsequent verification and visit-management activities.

4.2 System Implementation

The system implementation is carried out based on the analysis and design made in CHAPTER III, which consists of several principal interfaces that support different stages of the visitor-management process. These include the homepage, guest registration page, administrator dashboard, visitor-ticket management, QR Code scanning interface, and reporting functions.

4.3 Home Page

The homepage provides the initial interface for users accessing the system as presented in Figure 5. It contains some functions, including:

- Displays agency information.
- Shows guest registration menu.
- Provides system usage instructions.



Figure 5. Homepage of the Guest Registration Information System



4.4 Guest Registration Page

The guest registration page allows visitors to submit information required for visit administration. The registration fields include full name, organization, telephone number, email address, purpose of visit, date and time of visit, and supporting documentation where required, such as an introduction letter.

After the registration information is submitted successfully, the system generates a visit record and a QR Code associated with the registered visitor. The QR Code subsequently functions as an identifier during the physical verification process. Figure 6 displays the Registration Form Page.

4.5 Admin Dashboard Page

The administrator dashboard provides the central interface for managing visitor information. Its main functions include viewing guest records, verifying registrations, approving or rejecting visit requests, managing user accounts, viewing visit information, and generating reports. The main admin dashboard page is shown in Figures 7 and 8. Figure 7 illustrates the primary administrative interface, while Figure 8 displays the approval page of the system.

The screenshot shows a mobile application interface for guest registration. At the top, there's a link to 'Kembali ke Portal Utama'. The main title is 'Formulir Pendaftaran Tamu' with a subtitle 'Lengkapi data diri Anda di bawah ini untuk memperoleh tiket masuk digital.' Below this, there's a weather widget showing '32°C Cerah Berawan' and '56% 1 km/jam'. The form fields include: 'Nama Lengkap Tamu Utama' (Example: Budi Santoso), 'Instansi / Perusahaan / Sekolah' (Example: Universitas Indonesia / PT Sejahtera), 'Nomor Telepon / WhatsApp' (Example: 081234567890), and 'Alamat Email Aktif' (Example: budi@mail.com). There's a section for 'Denah Lokasi Kunjungan Kantor BMKG' with four room options: 'AULA', 'RUANG KEPALA', 'RUANG TEKNIKI', and 'RUANG METEOROLOGI'. Below this, there's a section for 'Tujuan Kunjungan' (Koordinasi / Rapat Kerja), 'Jumlah Rombongan (Orang)' (1), 'Tanggal Rencana Kunjungan' (2026-06-18), and 'Pilihan Sesi Kunjungan' (SESI PAGI I 09:00 WIB, SESI PAGI II 11:00 WIB, SESI SIANG I 13:00 WIB, SESI SIANG II 15:00 WIB). There's also a 'Kapasitas Kunjungan Harian' section showing '49 sisa (2% terisi)'. A 'Lampiran Surat Kunjungan' section has a file upload area with a 'Klik atau seret file ke sini' prompt and a 'Doc1.docx' file. At the bottom, there's a 'Keamanan' section with a 'Berapa hasil dari 6 + 7?' question and a 'Kirim & Buat Tiket Kunjungan' button.

Figure 6. Main Guest Registration Form Page

4.6 Visitor Ticket Process

After submission, the visitor registration appears in the administrator interface with an approval status: Pending Approval. The administrator reviews the submitted information and decides on one of the following options:

- Approving the visit
- Rejecting the visit.
- Along with the Status

The resulting status is sent as a notification to the visitor, recorded in the system, and can subsequently be used to determine whether the visitor is authorized to proceed with the visit. The notification of the unapproved visit is displayed in Figure 9 and the approved visit in Figure 10.



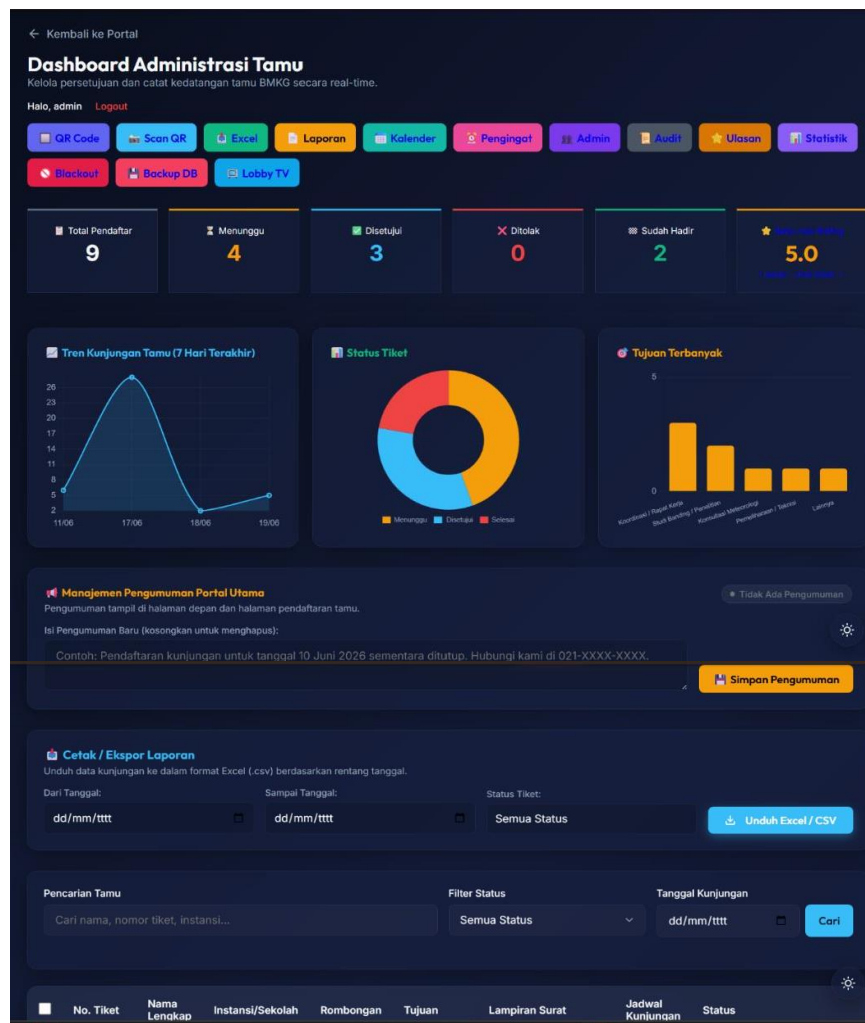


Figure 7. The primary administrative interface

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■	VIS-20260611-7561	testing	skolah	5	Studi Banding / Penelitian	Template Laporan ...	11-06-2026 13:00 WIB	DISETUJUI	Check In
■	VIS-20260617-1901	Dr. Andi Pratama	Kementerian Komunikasi dan Informatika	3	Koordinasi / Rapat Kerja	—	17-06-2026 09:00 WIB	SELESAI	Body
■	VIS-20260617-1002	Budi Santoso	Universitas Indonesia	15	Studi Banding / Penelitian	—	17-06-2026 13:00 WIB	DISETUJUI	Check In
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■	5	Studi Banding / Penelitian	Template Laporan ...	11-06-2026 13:00 WIB	DISETUJUI	Check In	Badge	Email	Jadwal
■	3	Koordinasi / Rapat Kerja	—	17-06-2026 09:00 WIB	SELESAI	Badge	Email	Jadwal	Hapus
■	15	Studi Banding / Penelitian	—	17-06-2026 13:00 WIB	DISETUJUI	Check In	Badge	Email	Jadwal
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Figure 8. The primary administrative interface



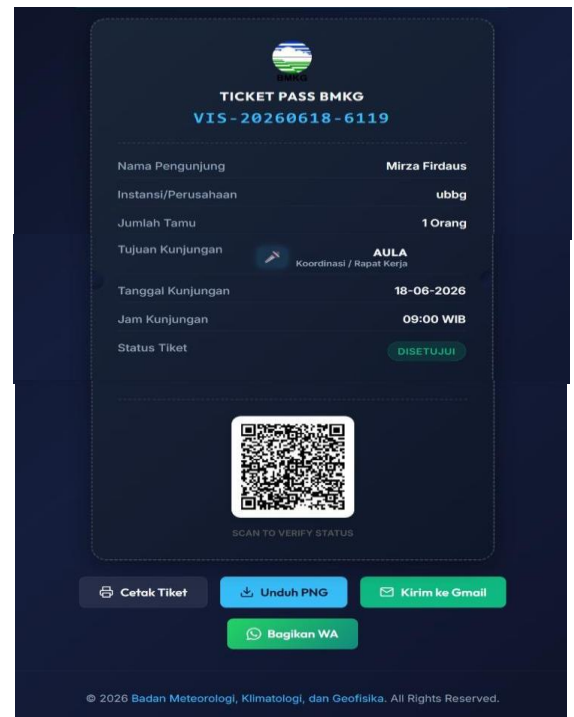
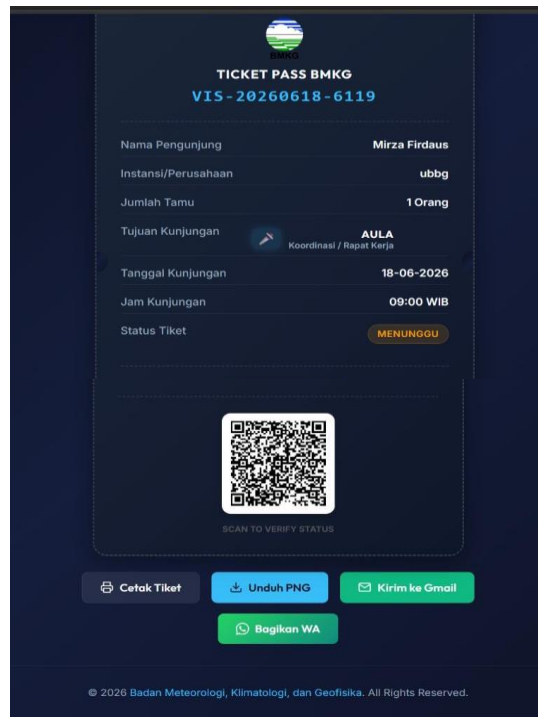


Figure 9. Tickets That Haven't Been Approved **Figure 10.** Tickets That Have Been Approved

4.7 Visitor Ticket Review Process

The visitor-ticket review process connects the information submitted by the visitor with the administrative verification process. The system records the submitted registration and its subsequent processing by the administrator. The ticket review process can be seen in Figure 11.



Figure 11. Ticket Review Process

4.8 QR Code Scan Page



The QR Code scanning interface is used by security personnel to verify visitors when they arrive at the station. The QR Code is linked to the corresponding registration record, allowing the system to retrieve the relevant visitor information and support the check-in process. QR Code Scanning Interface process is shown in Figure 12.

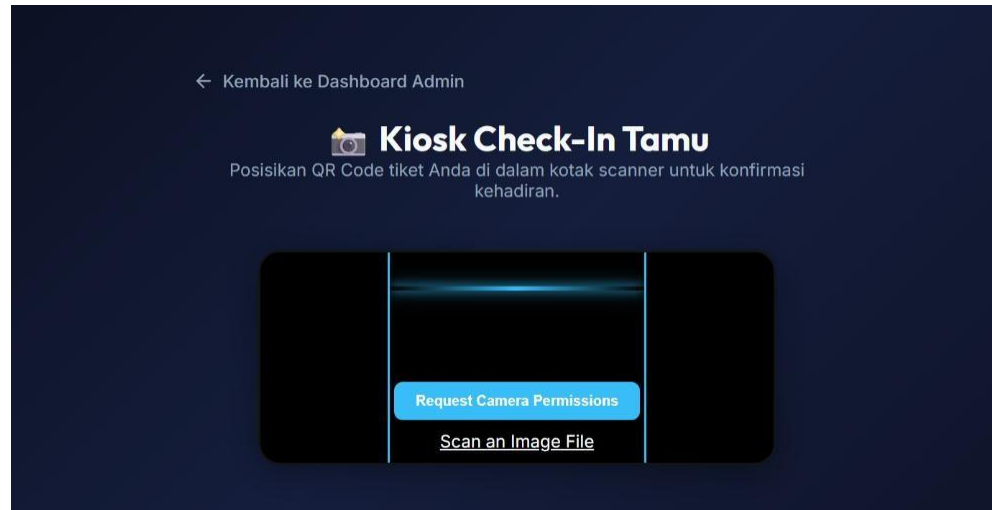


Figure 12. QR Code Scanning Interface: Place to scan visitor barcodes

4.9 System Testing

The developed system was evaluated based on user needs and using black-box functional testing, which assesses whether system functions produce the expected outputs for specified inputs without examining the internal program code (Mustaqbal et al., 2015). Based on the test results, all main features of the system were able to function well according to user requirements. Table 1 presents the functional system testing results.

Table 1. Functional Testing Results of the Guest Registration Information System

Functionality Tested	Testing Description	Expected Result	Test Result	Status
Administrator Login	Testing the administrator authentication process using valid username and password credentials.	The system successfully authenticates the administrator and provides access to the administrative dashboard.	The administrator was successfully authenticated and redirected to the dashboard.	Successful
Guest Registration	Testing the process of entering and submitting guest registration information into the system.	The system accepts valid guest information and successfully records the registration data.	Guest registration data were successfully entered and recorded in the database.	Successful
Data Storage	Testing the system's ability to store and retrieve guest registration data in the database.	All valid registration data are stored accurately and can be retrieved without data loss or inconsistency.	The submitted guest data were successfully stored and retrieved from the database.	Successful
QR Code Generation	Testing the automatic generation of a unique QR Code based on the	The system generates a unique and readable QR Code	A unique QR Code was successfully generated for the registered guest.	Successful



	registered guest information.	corresponding to the registered guest data.		
Administrator Verification	Testing the administrator's ability to verify guest registration information and confirm the validity of the submitted data.	The administrator can verify and validate guest information through the system interface.	Guest information was successfully verified and validated by the administrator.	Successful
QR Code Scanning	Testing the QR Code scanning functionality to identify and retrieve the corresponding guest registration record.	The system successfully scans the QR Code and displays the associated guest information.	The QR Code was successfully scanned, and the corresponding guest data were displayed.	Successful
Data Search	Testing the search functionality for locating guest records using relevant keywords or identification parameters.	The system returns accurate and relevant guest records based on the entered search criteria.	The requested guest records were successfully located and displayed.	Successful
Report Printing	Testing the functionality for generating and printing guest registration reports.	The system generates a properly formatted report containing the required guest registration information.	The guest registration report was successfully generated and printed.	Successful
Excel Data Export	Testing the functionality for exporting guest registration records into an Excel-compatible file format.	The system successfully converts and exports the selected guest data into an Excel file without data loss.	Guest registration data were successfully exported into an Excel file.	Successful

Based on the functional testing results presented in the table above, all nine tested functionalities were successfully executed. The testing covered the main operational components of the guest registration information system, including administrator authentication, guest registration, database storage, QR Code generation and scanning, data verification, data retrieval, report generation, and data export.

The successful results indicate that the developed system is capable of performing its core functional requirements consistently and according to the predefined specifications. In particular, the integration of QR Code technology facilitates faster identification and verification of registered guests, while the database component ensures that registration records can be systematically stored, searched, and retrieved. Furthermore, the availability of printing and Excel export functionalities supports administrative reporting and data management requirements.

Therefore, the functional testing demonstrates that the developed Guest Registration Information System has achieved a 100% functional test success rate (9 out of 9 test cases). This result indicates that, based on the tested scenarios, the system is functionally ready to support guest registration and administrative data management activities.



4.10 System Advantages

Based on the implemented functions, the principal advantages of the system are its ability to provide centralized digital visitor records, integrate registration and verification processes, generate QR Codes for physical visit verification, facilitate visitor-data searching, boost guest service efficiency, and support report generation and Excel data export.

The system also reduces reliance on the conventional paper-based guestbook by providing a digital alternative for recording and managing visitor information. However, the magnitude of any resulting reduction in paper consumption or physical storage was not measured in this study.

4.11 System Limitations

The implemented system has several limitations. First, its operation depends on network availability. Second, a dedicated Android application has not yet been developed. Third, the system is not currently integrated with other BMKG information systems. Fourth, the notification function, including potential WhatsApp integration, can be further developed.

More importantly from an evaluation perspective, the present study is limited to functional testing. The study does not quantitatively evaluate processing time, usability, user satisfaction, cybersecurity performance, or environmental/resource savings. These aspects should therefore be addressed in future research.

DISCUSSION

5.1 Functional Performance and Integration of the Digital System

The functional testing results demonstrate that the developed Guest Registration Information System can perform the principal functions defined during the requirements-analysis stage. The significance of this result lies not only in the successful operation of individual functions but also in their integration into a continuous visitor-management workflow. In the conventional process, guest information is primarily recorded in a physical guestbook and subsequently used for administrative purposes. The proposed system connects registration, validation, approval, QR Code generation, physical verification, check-in, and visit-record management. Consequently, information entered at the registration stage can be reused during subsequent stages without requiring the same information to be repeatedly recorded. This integration improves information continuity and traceability within the visitor-management process.

The findings are consistent with the broader role of information systems in supporting structured organizational information management. Digital systems can improve the availability and integration of organizational information by connecting data collection with subsequent processing and reporting activities. In this study, the database functions as a central repository that allows registered visitor information to be searched, retrieved, and reused for any purpose. However, because the study did not measure processing time or error rates before and after implementation, the findings should not be interpreted as quantitative evidence that the digital system is faster or more accurate than the manual system.



5.2 Comparison of Manual and Digital Systems

The comparison between the existing manual process and the developed digital system illustrates several structural differences in how visitor information is recorded and managed. The comparison of the processes can be summarized in Table 2.

Table 2. Comparison of Manual and Digital Visitor Management

Aspect	Manual System	Digital System
Recording	Physical guestbook	Centralized database
Data searching	Manual record checking	Digital search
Storage	Physical documents	Digital record
Monitoring	Limited record monitoring	Dashboard-based monitoring
Reporting	Manual recapitulation	System-supported reporting
Risk of data loss	Relatively high	Can be minimized with backup
Access speed	Relatively slow	Faster
Visit history	Difficult to trace	Easy to trace
Check-In/Out Monitoring	Limited	Integrated
Scalability	Low	Higher

The comparison indicates that the principal contribution of the system is the transformation of visitor information from a paper-based record into a structured digital information resource. This transformation enables the same data to support several administrative functions, including verification, monitoring, searching, reporting, and visit-history management. Therefore, the system represents more than the digitization of a guestbook; it establishes an integrated information flow across different stages of visitor management. Nevertheless, qualitative comparison should not be interpreted as evidence of quantified performance improvement. For example, the digital system is expected to facilitate searching and reporting, but the present study did not measure the time required to complete these activities under the manual and digital conditions. Similarly, the study did not quantify reductions in recording errors or improvements in user satisfaction. These outcomes should therefore be considered potential operational benefits requiring further empirical evaluation.

5.3 Research Contribution and Implications

The main contribution of this study is the development of an integrated visitor-management system that connects several previously separate administrative functions within one digital workflow. The integration of guest registration, administrative approval, QR Code verification, check-in recording, centralized data management, and reporting provides a more structured approach to managing visitor information than a conventional guestbook-based process.

From a practical perspective, the system provides the Class 1 Sultan Iskandar Muda Meteorological Station with a centralized mechanism for managing visitor records and verifying physical visits. From a broader digital-transformation perspective, the study illustrates how a relatively focused administrative process can be redesigned as an integrated information flow. The sustainability relevance of this contribution lies primarily in the potential reduction of paper-based administrative activities and the improved reuse of digital information.



The study also demonstrates an important methodological boundary. Functional testing can establish whether a developed information system performs its predefined functions, but it cannot by itself establish improvements in efficiency, usability, security, or sustainability. Future research should therefore extend the evaluation using before-and-after process-time measurements, user-acceptance or usability instruments, security assessment, and quantitative measurement of paper and other administrative resource consumption.

CONCLUSION

This study developed a web-based Guest Registration Information System for the Class 1 Sultan Iskandar Muda Meteorological Station that integrates guest registration, data validation, database management, administrative verification, QR Code generation and scanning, check-in recording, visit-history management, and reporting within a unified workflow. The system transforms the conventional paper-based registration process into a centralized digital information-management process, allowing visitor information to be retained and reused across registration, verification, check-in, and reporting activities.

Functional evaluation using black-box testing demonstrated that all nine documented test cases (9/9; 100%) produced the expected outputs. These results establish the functional feasibility of the developed system and confirm that its principal functions operate according to the predefined specifications. In particular, the integration of QR Code generation and scanning provides a mechanism for linking registration records with physical visitor verification, consistent with previous research on QR-based authentication and verification mechanisms (Chow et al., 2024).

From a sustainability and resource-efficiency perspective, the system provides a potential digital alternative to paper-based guest registration and physical record management. However, the present study did not quantitatively measure paper consumption, processing time, user satisfaction, security performance, or environmental impacts. Therefore, the study does not claim a quantified improvement in efficiency, sustainability, or environmental performance. Future research should evaluate these dimensions through before-and-after process measurements, usability or user-acceptance assessment, security testing, and quantitative assessment of administrative resource consumption.

Overall, the developed system provides a functional foundation for more integrated, traceable, and potentially resource-efficient visitor administration at the Class 1 Sultan Iskandar Muda Meteorological Station.

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