

## Development of an Integrated Employe Management System Based on Web and Mobile Using the Agile Methodology

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### ABSTRAK

This research aims to develop a web and mobile-based Human Resource Management System (HRMS) for Warung Makan Joglo Nartoatmojo. The main issues include attendance recording, work schedule management, leave management, and employe contract administration, which are still done manually. The method used is Agile with a qualitative approach thru observation and interviews. The technology used includes Flutter for the employe mobile application, the system encompasses QR Code attendance, work scheduling, leave and permit management, digital announcements, and employe contracts. The results of the black box testing on 24 scenarios showed a success rate of 100%, thereby increasing the efficiency, accuracy, and transparency of HR management and providing an integrated solution for small businesses

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## INTRODUCTION

The development of information technology in the digital era has brought significant transformations to various aspects of life, including the management of human resources (HR) in the business sector. The digitalization of business processes has become an urgent necessity for entrepreneurs to enhance efficiency and accuracy in daily operations (Muhamad Faiz Akmal Mohamad Noor et al., 2023). In the context of employe management, the use of mobile-based technology has proven capable of optimizing attendance recording, work scheduling, and internal communication processes more effectively than conventional methods (Felix et al., 2024).

The Joglo Nartoatmojo eatery is a culinary business located in Yogyakarta. In addition to providing various culinary needs for the community, Joglo Nartoatmojo also plays an important role in the local economy by providing employment opportunities for many people. As the business grows, the need for a structured and efficient employe management system becomes increasingly urgent. However, until now, the process of employe attendance and scheduling at Joglo Nartoatmojo is still done manually using notebooks and verbal communication.

The conventional management of attendance and work schedules has caused a number of problems. First, manual recording thru attendance books is prone to recording errors and takes a relatively long time. Second, the work schedule system that uses shifts and involves many employes often results in poorly organized schedules. Third, business owners face difficulties in monitoring employe attendance in real-time. Similar issues have also been found in various previous studies, where manual attendance systems have been proven to reduce productivity and operational efficiency (Al Amin et al., 2024; Sari et al., 2022).

Several previous studies have developed digital solutions for similar problems. (Felix et al., 2024) developed a QR Code-based mobile application for employe attendance recording, which is considered more effective and affordable. (Pati et al., 2023) designed a QR Code-based attendance tracking system that can enhance efficiency and minimize administrative burden. Meanwhile, (Muhamad et al., 2022) developed an Android-based employe attendance information system that achieved a usability score of 92% based on the System Usability Scale test. However, these studies generally have not integrated automatic alert notification features and flexible work scheduling into a single unified platform.

Although various previous studies have developed QR Code-based attendance systems and mobile applications for employe management, most of these studies still focus on a single main function, such as attendance or monitoring presence only. Moreover, the integration of flexible work scheduling features, automatic notifications, and administrative management such as leave and employe contracts into a single unified platform has not been comprehensively studied. This indicates a research gap in the development of integrated and adaptive HR management systems for the operational needs of small businesses.

Therefore, this research offers an innovation in the form of the development of an integrated web and mobile-based employe management system that not only includes digital attendance but also integrates work scheduling features, leave management, digital announcements, and contract management into a single platform. Additionally, the application of the Agile method in this research allows for the development of a system that is more flexible and responsive to user needs in small business environments.

## **THEORETICAL REVIEW**

### ***Digital Attendance Management System***

The digital attendance management system is a technology designed to automatically and accurately monitor and record employe attendance. According to (Felix et al., 2024), mobile application-based attendance systems with QR Code technology offer a contactless, effective, and affordable solution for attendance monitoring. This system replaces manual methods that are prone to recording errors and data manipulation (Al Amin et al., 2024). The development of digital attendance systems is also supported by advancements in camera-based scanning technology, which are becoming increasingly accurate and faster in processing attendance data in real-time (Pati et al., 2023).

### ***Employe Scheduling***

Employe scheduling is the process of arranging work hours based on operational needs and organizational policies. According to (Faizin Ridho & Mahendra Syahputra, 2022), effective and digitized scheduling helps increase productivity and reduce scheduling conflicts among employes. In the context of small and medium enterprises, good scheduling allows for optimal allocation of human resources according to the workload in each shift (Setiawan et al., 2023). The digital scheduling system also allows for flexibility in schedule management and ease in making quick schedule changes.

### ***Alert Notification on Mobile Application***

Alert notifications are an automated message delivery system to users as a form of notification or confirmation of an event within the system. In the context of attendance and scheduling systems, notifications are used to inform employes about attendance results, schedule changes, and task reminders (Naboureh et al., 2022). According to recent research, push notifications on mobile applications have a higher readability rate compared to communication via email, making them more effective for conveying time-sensitive information (Sahami Shirazi et al., 2014).

### ***Flutter as a Mobile Development Framework***

Flutter is an open-source framework developed by Google for building high-performance cross-platform applications. According to (Bhagat, 2022), Flutter allows developers to create a single codebase that can run on various platforms such as Android, iOS, Web, and Desktop, thereby reducing development costs and complexity. (Muhamad Faiz Akmal Mohamad Noor et al., 2023) also shows that Flutter is very suitable for developing employe attendance systems due to its ability to build responsive interfaces and performance equivalent to native applications. The hot reload feature in Flutter

allows developers to see changes in real-time without having to recompile, thus speeding up the development iteration process.

### *Arsitektur Three-Tier Client-Server*

The three-tier client-server architecture is a software architecture model that separates applications into three main layers: the client layer, the server layer, and the data layer. This architecture allows for a clear separation of concerns between the user interface, business logic, and data storage (Stošović et al., 2022). The use of this architecture in the development of web and mobile-based systems facilitates scalability, maintenance, and independent testing of the system at each layer.

### *Agile Method in Software Development*

The Agile method is a software development approach that emphasizes flexibility, rapid iteration, and responsiveness to changing user needs. According to an empirical study by (Tetteh, 2024), Agile enables development teams to deliver valuable products incrementally thru short development cycles (sprints). The Agile approach is considered highly suitable for projects that require rapid adaptation to user feedback, as each iteration produces a product that can be directly tested and evaluated by stakeholders (Dahabiyeh & Constantinides, 2022).

After reviewing the theory and previous research, the conceptual framework of this study can be illustrated in the following figure, which depicts the relationship between the problem, technological solutions, and the expected outcomes:

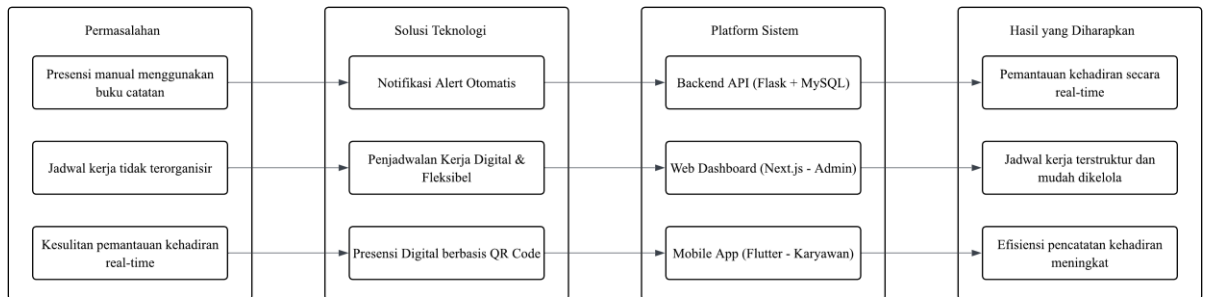


Figure 1. Research Conceptual Framework

Based on theoretical studies and previous research, it can be concluded that the utilization of digital technology such as QR Codes, mobile applications, and client-server architecture plays an important role in enhancing the efficiency of HR management. However, most research still develops solutions partially and has not yet integrated all employee management needs into a single unified system. Therefore, this study combines these various concepts into a single integrated system model to produce a more comprehensive and applicable solution for small businesses.

## METHODOLOGY

This research uses a qualitative approach with the Agile system development method. The qualitative approach was chosen because this research aims to deeply understand the operational problems faced by Joglo Nartoatmojo as well as the users' needs in managing attendance and employe scheduling. Data were collected thru direct observation at the business location and semi-structured interviews with the business owner and employes.

The Agile method is used as a framework for system development due to its iterative and adaptive nature, allowing for continuous system adjustments based on user feedback. The stages of the Agile method in this research are illustrated in Figure 2.

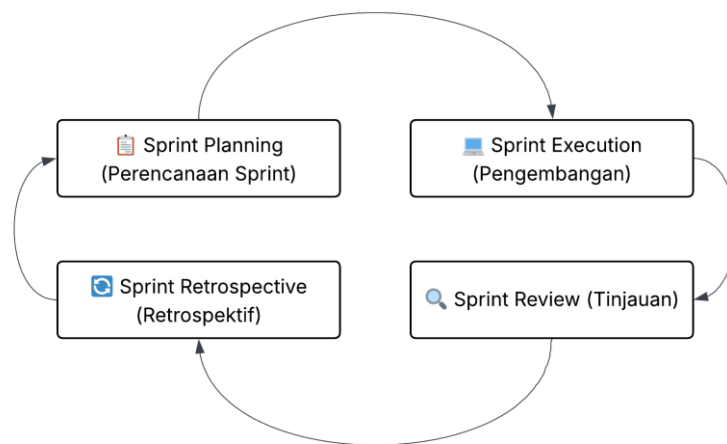


Figure 2. Agile Method Iteration Cycle

### *Sprint Planning*

At this stage, system requirements are identified based on observations and interviews with stakeholders at Joglo Nartoatmojo. The researchers, together with the business owner, formulated the priority features to be developed in each sprint cycle. Functional and non-functional requirements are documented in detail as a reference for development. The main features identified include: (a) role-based user authentication (admin and employees), (b) employe data management, (c) work scheduling with shift settings, (d) digital attendance based on QR Code, (e) automatic alert notifications, (f) employe leave and permission management with approval workflows, (g) digital announcement board with reading tracking, (h) contract and tenure management with automatic reminders, and (i) analytical dashboard with operational statistics visualization.

### *Sprint Execution*

The sprint execution phase includes system design and implementation activities. Design includes creating system architecture, database design using Entity Relationship Diagram (ERD), process flow design with flowcharts, and user interface design thru wireframes. Implementation is carried out in stages according to the agreed-upon feature priorities. Each sprint has a predetermined duration and produces features that can be functionally tested.

**Sprint Review**

After each sprint is completed, a review is conducted with the business owner and several selected employees to evaluate the development results. User feedback is recorded and analyzed to determine the necessary adjustments. Functional testing using the black box testing method is also conducted at this stage to ensure that each feature operates according to the defined requirements. The formula for calculating the success rate of the testing is:

$$\text{Result} = (\text{Number of Successful Tests} / \sum \text{Tests}) \times 100\% \dots\dots\dots (1)$$

**Sprint Retrospective**

The retrospective stage is an internal evaluation of the development process. At this stage, aspects that went well and obstacles encountered during the sprint are identified. The evaluation results serve as input for process improvements in the next sprint, ensuring that the quality of development continues to gradually increase.

The data sources in this research consist of primary and secondary data. Primary data were obtained thru direct observation at the Warung Makan Joglo Nartoatmojo location and interviews with the business owner regarding the attendance process, scheduling, and issues encountered. Secondary data were obtained from literature studies in the form of scientific journals, books, and technical documentation relevant to the research topic.

Table 1. Research Data Sources

<b>No</b>	<b>Type of Data</b>	<b>Source</b>	<b>Collection Method</b>
1	Data primer	Owner of Warung Joglo Nartoatmojo	Semi-structured interview
2	Data primer	Daily operational process	Direct observation
3	Data primer	Joglo Nartoatmojo Employee	Interviews and system testing
4	Data sekunder	Journals and scientific articles	Literature review

The technology used in the development of this system includes a three-tier client-server architecture with the following components:

Table 2. Technologies Used

<b>No</b>	<b>Component</b>	<b>technology</b>	<b>Function</b>
1	Backend API	Flask (Python 3.x)	Lightweight RESTful API framework
2	Basis Data	MySQL 8.x	Relational data storage
3	Web Dashboard	Next.js 15.x (TypeScript)	Web-based admin dashboard
4	Mobile Application	Flutter 3.x (Dart)	Cross-platform application for employes

5	QR Scanner	mobile_scanner	Scanning QR Code thru the camera
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## RESEARCH RESULTS

### *System Architecture*

The Joglo Nartoatmojo Employee Attendance and Scheduling Management System is built with a three-tier client-server architecture consisting of three main layers: the client layer, the server layer, and the data layer. This architecture is designed to separate responsibilities between the user interface, business logic, and data storage, making it easier to develop and maintain the system sustainably.

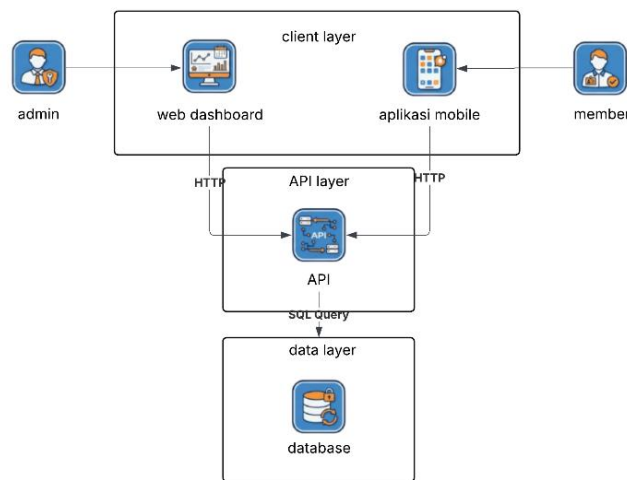


Figure 3. System Architecture

The client layer consists of two platforms that serve two main types of users. The Web Dashboard is built using Next.js 15 with TypeScript and equipped with HeroUI interface components and styled using TailwindCSS. This platform is used by admins or business owners to manage employe data, work schedules, attendance, leave, announcements, contracts, and monitor operational metrics thru an analytics dashboard. The Mobile Application is built using Flutter 3.x with Provider state management, used by employes to clock in thru QR Code, apply for leave, view announcements, monitor contract status, and access leave balance.

The server layer is built using Flask as a lightweight REST API framework. The data layer uses MySQL 8.x as a relational database management system with 11 interrelated tables. Access to the database is done thru SQLAlchemy ORM, which provides object-relational abstraction, while schema migration management uses Flask-Migrate (Alembic). The v2.0 tables are equipped with optimized indexes for efficient query performance.

### *Database Design*

Database design uses an Entity Relationship Diagram (ERD) to illustrate the relationships between entities in the system. There are 11 interrelated tables,



### Implementation of Web Dashboard Interface (Admin)

The web dashboard is built as a control center for admins or business owners. This dashboard consists of several main pages that are interconnected.

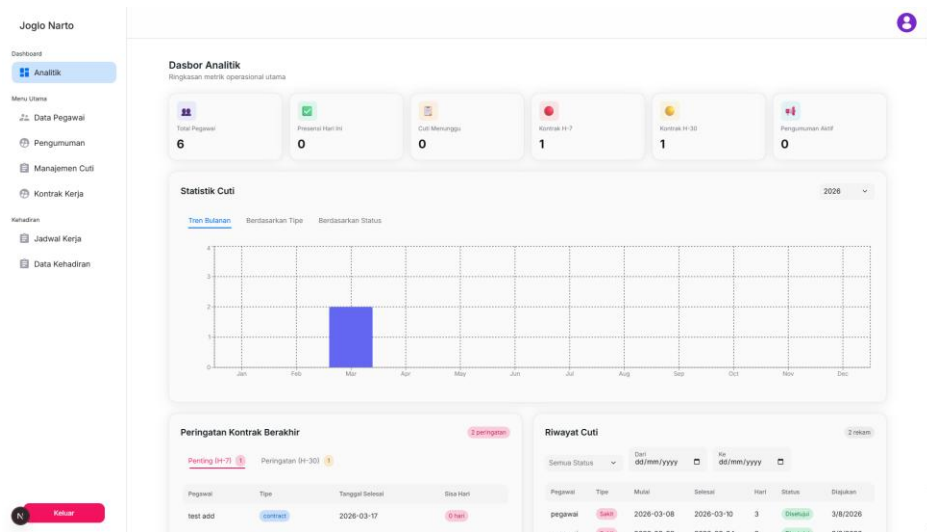


Figure 6. Dashboard Page

The Analytics Dashboard is the main page that presents a summary of operational metrics in a single integrated view. This page consists of four main sections: (1) six KPI (Key Performance Indicator) cards displaying total employees, today's attendance, the number of leave requests pending approval, contracts expiring in 7 and 30 days, and active announcements; (2) leave statistics with monthly trend bar charts and pie charts showing distribution by type and status along with a year selector; (3) a contract alert table categorized into important (H-7) and warning (H-30) categories; and (4) a leave history table that can be filtered by status, type, and date range with pagination.

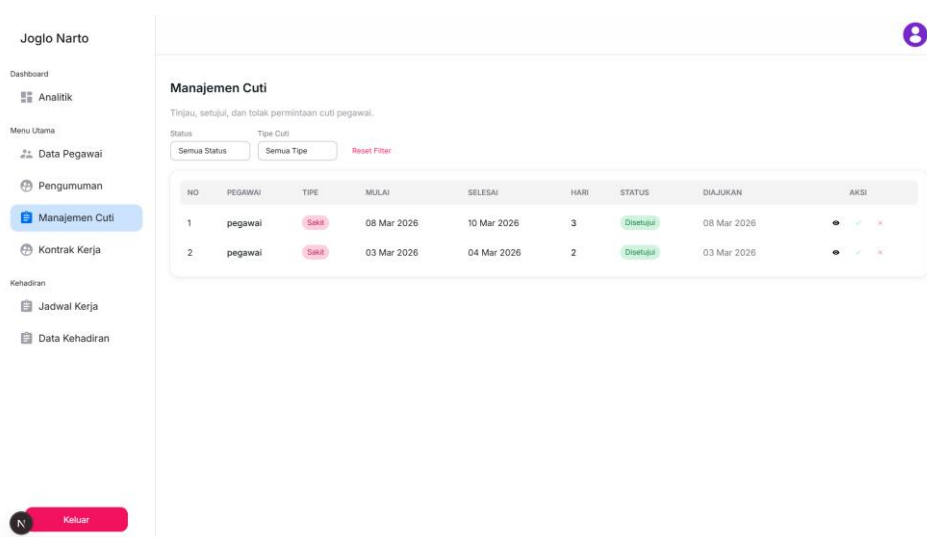


Figure 7. Leave Management Page

The Leave Management page provides an interface for admins to review, approve, or reject leave requests from employees. Each request displays complete information including the employee's name, type of leave (sick/personal/urgent), start and end dates, number of days, and the reason for the application. Admin can provide notes when approving or rejecting the request.

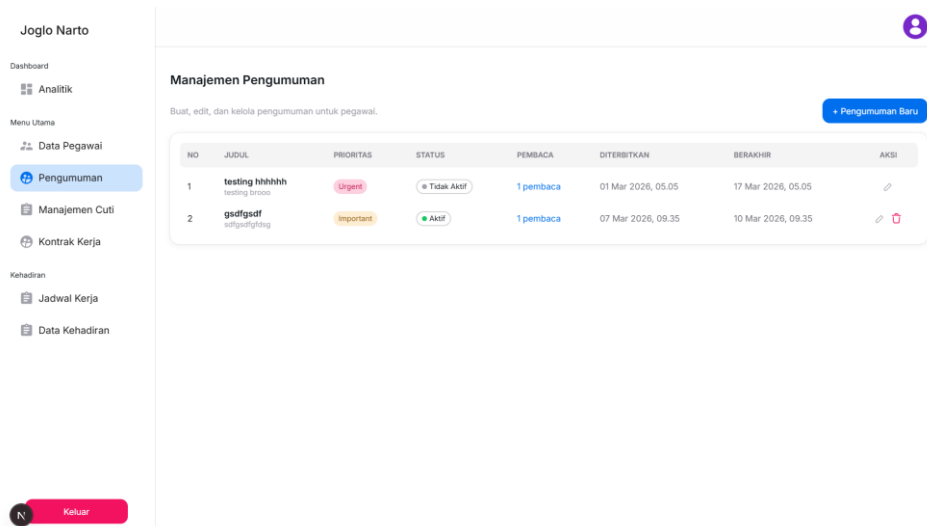


Figure 8. Announcement Management Page

The Announcement Management page allows admins to create, edit, and delete announcements that will be displayed on the employe mobile application. Each announcement has priority attributes (normal, important, urgent), display date, and expiration date. The system also provides reading statistics per announcement to monitor the number of employees who have read it.

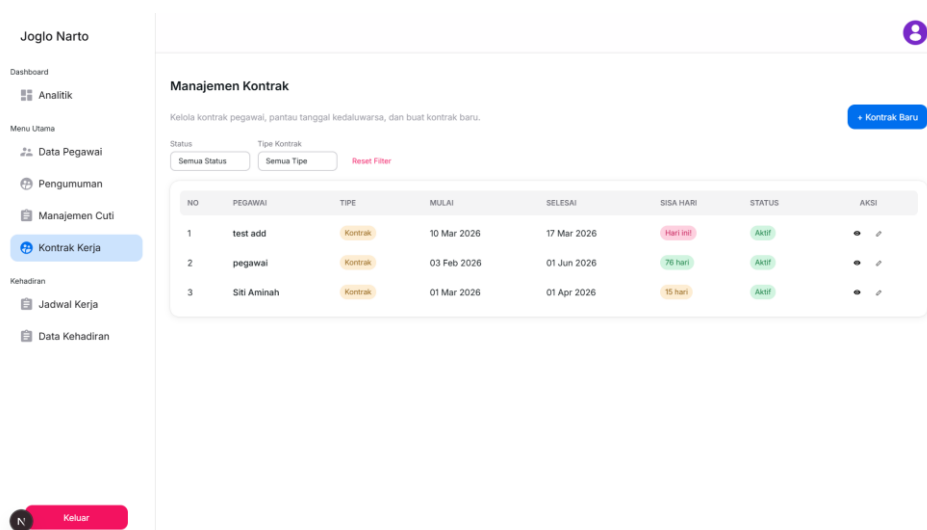


Figure 9. Contract Management

Page The Contract Management Page provides features for managing employe work contracts with three types: permanent, contract, and probation. Admin can create new contracts, update contract information, and monitor contracts that are about to expire thru the "expiring soon" filter, which displays contracts within the H-30 and H-7 range.

### **Implementation of Mobile Application Interface (Employee)**

The mobile application is built using Flutter and specifically designed for Joglo Nartoatmojo employes. This application uses the Clean Architecture Lite with a clear separation of layers between core (configuration and utilities), data (model and repository), and presentation (pages and provider state).

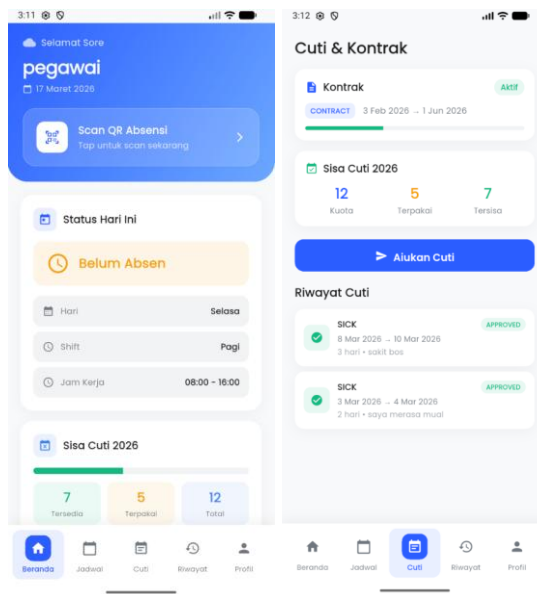


Figure 10. Home Page & Leave & Contract Page

The Home page of the mobile application provides comprehensive information for employes. The top section displays a dynamic greeting ("Good Morning/ Afternoon/ Evening/ Night") along with the employee's name and today's date. The today's status card displays work schedule information (day, shift name, and working hours) along with attendance status (present, not yet clocked in, or absent) with color indicators. The leave balance card displays the remaining leave for the current year in the form of a progress bar with statistics on quota, used, and remaining. The announcement section displays a list of the latest announcements with colored priority icons and badges for unread announcements, which, when clicked, will open the announcement details in a bottom sheet.

The Leave & Contract page combines two v2.0 features into one integrated view. The contract card at the top displays the contract type, start and end dates, status (active/expired/remaining days), and a progress bar for the contract duration. The leave balance card displays information about the annual leave quota. The "Apply for Leave" button directs to an application form with options for leave types (sick/personal/urgent), a date range picker, and a reason column. Leave history is displayed in a list with colored status icons (yellow for pending,

green for approved, red for rejected) and supports infinite scroll to load data gradually.

**System testing**

System testing is conducted using the black box testing method, which focuses on the application's functionality from the user's perspective. The testing is carried out on all main features of the web dashboard and mobile application, covering core features and v2.0 features.

Table 3. Results of Employee Page Testing

No .	Testing Scenario	Expected Results	Actual Results	Result
1.	Click the Employee menu	Displaying the list of all employes	Employee list displayed	Successful
2.	Add new employes	Employee data is stored in the database.	Data has been successfully saved.	Successful
3.	Edit employe data	Employee data has been successfully updated.	Data has been successfully updated.	Successful
4.	Delete employe data	Employee data has been deleted from the system.	Data has been successfully deleted.	Successful

Table 4. Results of Testing the Work Schedules Page

No .	Testing Scenario	Expected Results	Actual Results	Result
1.	Create a new work schedule	The schedule is saved with a name, time, and tolerance.	The schedule has been successfully saved.	Successful
2.	Edit work schedule	Schedule data has been successfully updated.	Data has been successfully updated.	Successful
3.	Delete the work schedule	The schedule has been deleted from the system.	Schedule successfully deleted	Successful
4.	Assign the schedule to the employes.	Employes are registered on a specific schedule.	The assignment was successful.	Successful

Table 5. Results of Attendance Feature Testing

No.	Testing Scenario	Expected Results	Actual Results	Result
1.	Employee login	Log in to the homepage if the credentials are correct.	Login successful	Successful
2.	Scan QR Code valid	Attendance is recorded and a notification appears.	Attendance recorded with notification	Successful
3.	Scan QR Code is not valid.	Error message displayed	Error message appears	Successful
4.	View history presensi	Attendance history list displayed	History displayed correctly	Successful

Table 6. Results of the Analytical Dashboard Testing

No.	Testing Scenario	Expected Results	Actual Results	Result
1.	Access the Analytics Dashboard page	KPI cards display total employees, today's attendance, pending leave, contracts ending, active announcements.	All KPIs are displayed according to the data.	Successful
2.	See the monthly leave trend graph.	The bar chart displays monthly leave data.	The graph displays the correct data.	Successful
3.	Lihat tabel peringatan kontrak H-7/H-30	The table displays contracts that will expire in 7 and 30 days.	Contracts are displayed according to category.	Successful
4.	Filter riwayat cuti berdasarkan status	The table is filtered according to the selected status.	The filter is functioning correctly.	Successful

Table 7. Leave Management Testing Results

No.	Testing Scenario	Expected Results	Actual Results	Result
1.	Submit leave via mobile	The leave request is saved with the status "pending."	Leave has been successfully submitted.	Successful
2.	Admin menyetujui permintaan cuti	Status changes to "approved" and the leave balance decreases.	Approval successful, balance updated	Successful
3.	Admin menolak permintaan cuti	Status changed to "rejected" with an admin note.	The rejection was successful with a note.	Successful
4.	Lihat saldo cuti pada mobile	Menampilkan kuota, terpakai, dan tersisa	Leave balance displayed correctly	Successful

Table 8. Announcement Management Testing Results

No.	Testing Scenario	Expected Results	Actual Results	Result
1.	Make a new announcement with priority.	Announcement saved with priority and release date	The announcement was successfully made.	Successful
2.	See the announcement on mobile.	The announcement list displays with an unread badge.	Announcements appear according to priority.	Successful
3.	Mark the announcement as read.	Badge missing and status changed to "read."	Updated reading status	Successful
4.	Delete the announcement thru the web dashboard.	Announcement deleted (soft delete) and not displayed on mobile	Announcement successfully deleted	Successful

Table 9. Results of Contract Management Testing

No.	Testing Scenario	Expected Results	Actual Results	Result
1.	Create a new contract for the employe.	The contract is stored with type, start date, and end date.	The contract was successfully made.	Successful
2.	View active contracts on mobile	Displaying contract type, duration, and remaining days	The contract appears with a progress bar.	Successful
3.	Filter kontrak "expiring soon" di web	Displaying contracts that expire in 30 days	The filter is functioning correctly.	Successful
4.	Status kontrak berubah otomatis saat expired	The contract automatically changes to "expired" status.	Auto-expire works	Successful

Based on the results of the black box testing, all tested features function as expected. By using the calculation formula in equation (1), the success rate of the testing was obtained as:

$$\text{Result} = (24 / 24) \times 100\% = 100\%$$

The test results show that all 24 test scenarios – covering core features (attendance, employes, schedules) and v2.0 features (leave, announcements, contracts, analytics dashboard) – were successfully executed without any functional errors found, thus the system is declared ready for use.

## DISCUSSION

Based on the research results that have been presented, the developed mobile-based integrated HR management system successfully addressed the issues faced by Warung Makan Joglo Nartoatmojo. This system provides a comprehensive solution that not only includes attendance and scheduling but also leave management, announcements, contracts, and operational analytics, thereby replacing the entire manual process that previously hindered efficiency.

The implementation of QR Code-based digital attendance has proven capable of addressing the issues of manual attendance recording. This finding aligns with research (Felix et al., 2024) which shows that QR Code-based attendance systems on mobile applications can provide contactless, effective, and affordable attendance monitoring. Unlike the manual attendance system, which requires a long recording time and is prone to data inaccuracies, the digital system developed in this study is capable of recording attendance instantly thru QR Code scanning and automatically calculating employe attendance status.

The digital work scheduling feature on the web dashboard provides convenience for business owners in flexibly managing employe work schedules. Admins can create various types of work shifts with specific time settings and assign them to employes individually. This addresses the scheduling issues that were previously unorganized because they were communicated verbally. These

findings support the opinion of (Faizin Ridho & Mahendra Syahputra, 2022) that digitalized scheduling helps improve productivity and reduce scheduling conflicts among employees.

The implemented leave and permission management module significantly contributes to the efficiency of HR administration. Thru the mobile application, employees can independently apply for leave by selecting the type (sick, personal, or urgent), date range, and reason for the application. The system automatically calculates the leave balance and updates the quota after admin approval. This digital approval workflow eliminates the need for paper forms and verbal communication, which were previously prone to miscommunication. This feature is also equipped with an application history that allows employees to transparently monitor the status of their leave requests.

The digital announcement board integrated into the system facilitates one-way communication from the admin to all employees. Each announcement has priority attributes (normal, important, urgent) and a publish window that allows for content scheduling. The read tracking feature thru the `announcement_reads` table provides visibility for admins to ensure that important information has been read by all employees. On the mobile side, the badge on unread announcements increases employee engagement with the conveyed information, in line with the findings of Naboureh et al. (2022) regarding the effectiveness of notifications in delivering time-sensitive information.

Contract and tenure management become important features for monitoring the employee work cycle. Admins can create and update contracts with three types (permanent, contract, and probation), while the system automatically detects contracts that will expire within the H-7 (important/urgent) and H-30 (warning) windows. The auto-expire feature automatically changes the contract status to "expired" when the end date is reached. On the mobile side, employees can monitor the status of active contracts along with a visual progress bar that shows the remaining contract period, thereby increasing transparency in the employment relationship.

The developed analytical dashboard provides simple yet effective business intelligence for business owners. By displaying six key KPIs, leave statistics in the form of interactive graphs (monthly trends, distribution by type and status), and contract alerts on a single integrated page, admins can obtain a comprehensive operational overview without needing to check each module separately. The implementation of data visualization using the Recharts library on the web frontend allows for the presentation of data that is intuitive and easy to understand.

The use of a three-tier client-server architecture with the separation of API routes into two versions (v1 for core features and v2 for advanced features) has proven effective in ensuring system scalability and ease of maintenance. This API versioning approach allows for the addition of new features without disrupting existing functionality, in line with modern application development practices that emphasize backward compatibility (Stošović et al., 2022). Performance optimization on the backend side is carried out thru column indexing on the v2.0 table and the use of `joinedload` to avoid N+1 query issues in table relationships.

The use of the Agile method in the development process has proven effective in accommodating gradual changes in user needs. The v2.0 features (leave, announcements, contracts, analytics) were developed in separate sprints after the core features stabilized, allowing for evaluation and adjustments based on direct feedback from the owners and employees of Joglo Nartoatmojo. This approach ensures that each module developed truly addresses the operational needs on the ground, as recommended by (Tetteh, 2024) that Agile allows for the gradual delivery of products that are valuable to users.

The results of the black box testing with a 100% success rate across 24 scenarios indicate that all system features both core features and v2.0 features are functioning according to the specified requirements. Nevertheless, further testing using usability testing methods and a larger respondent scale needs to be conducted to measure the system's effectiveness more comprehensively, as suggested by (Muhamad et al., 2022) who used the System Usability Scale in the evaluation of similar systems.

## **CONCLUSIONS AND RECOMMENDATIONS**

Based on the research and discussion that have been conducted, several conclusions can be drawn. First, the integrated mobile-based HR management system was successfully designed and built using a three-tier client-server architecture consisting of a web dashboard (Next.js) for admins, a mobile application (Flutter) for employees, a backend API (Flask) with 8 blueprint routes, and a MySQL database with 11 interrelated tables. This system includes six main modules: digital attendance, work scheduling, leave management with approval workflow, digital announcement board, contract management with automatic reminders, and an analytics dashboard. Secondly, the system successfully provides ease of access for admins thru a web dashboard equipped with data analytics visualization, as well as for employees thru a mobile application that enables QR Code attendance, self-service leave requests, contract monitoring, and digital announcement access. Third, the results of black box testing on 24 scenarios showed a success rate of 100%, proving that all features function according to specifications and the system is suitable for improving the operational efficiency of HR management at Joglo Nartoatmojo.

## **ADVANCED RESEARCH**

This research has several limitations that can become opportunities for future studies. First, the current system does not yet provide a performance review feature or periodic employee performance assessment that can serve as a basis for managerial decision-making. Second, the system does not yet support integration with third-party services such as push notifications based on Firebase Cloud Messaging (FCM) for real-time notification delivery outside the application. Third, usability testing using the System Usability Scale (SUS) method with a larger number of respondents needs to be conducted to obtain a more in-depth evaluation of the user experience. Fourth, the addition of geolocation or geofencing features for attendance location validation can enhance the accuracy and security of the attendance system. Therefore, it is recommended

that future research develop these modules to make this system an increasingly comprehensive HR management platform.

## ACKNOWLEDGMENT

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