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Development of a GPS and QR Code Based Mobile Attendance Application to Improve Employee Discipline at PT Merpati Mahardika

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ABSTRACT

Information technology serves as a driver for software innovation at PT. Merpati Mahardika, which faces challenges regarding employee attendance tracking. Existing flaws in the system allow employees to manipulate QR codes; for instance, absent employees can still "clock in" by submitting a photo of the QR code via the app or sharing it through WhatsApp. Furthermore, the Global Positioning System (GPS) functionality is unreliable, allowing employees to use the attendance system from remote locations, such as their homes. Monitoring attendance is crucial for the company, given the vital role employees play in organizational growth and the implementation of innovations for corporate advancement. This research aims to develop a smartphone-based attendance application integrated with GPS and QR code scanning capabilities. The development process follows the Waterfall methodology, while data collection involved observation, interviews with the Personnel Manager, a literature review, and the distribution of online questionnaires. The system was designed using Use Case Diagrams and implemented with a main interface featuring registration, login, a dashboard, check-in/check-out menus, and a camera scanning function. Research results indicate that the GPS accurately determines employee locations while the system is in use. Consequently, the company has innovated by developing a mobile attendance system based on GPS and QR code technology, a solution highly anticipated by the organization. The system is expected to improve attendance discipline, enable real-time recording, and provide accurate attendance data, ultimately enhancing operational efficiency and employee discipline. The development process encompassed requirements analysis, workflow mapping, and User Interface (UI) design for PT. Merpati Mahardika's attendance application.

1. Introduction

In the era of globalization, many companies leverage information technology to innovate and develop applications tailored to their specific needs. One rapidly evolving technology in this field is mobile-based attendance tracking utilizing the Global Positioning System (GPS) and QR codes. Employee attendance recording plays a crucial role in corporate growth by serving as a system for tracking presence. However, there are shortcomings in these applications, particularly regarding QR codes. Since a QR code is often printed once for use at an attendance kiosk, it is easily manipulated, photographed, and distributed via social media (such as WhatsApp groups); this allows employees who are absent from work to use the code to register their attendance. Furthermore, geofencing validation often fails to verify the GPS location within the workplace radius, and device security issues undermine the established system, leading to low employee adoption of the company-developed application.

In today's global environment, such systems are often inefficient due to issues like static QR codes (which do not update every second) and the lack of radius-based verification when GPS is active. There are also concerns regarding the inaccuracy of real-time information (Seran et al., 2023). Failure to address these problems or to use them as a basis for improvements that drive company progress and application development can ultimately lead to the company's decline.

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The Global Positioning System (GPS) is a satellite-based navigation system that enables users to accurately determine their location (coordinates), speed, and time anywhere on Earth's surface. This system has been integrated into attendance applications and has proven highly effective for employee tracking; furthermore, internet connectivity allows for real-time data collection, which can drive further innovation (Lestari et al., 2022). GPS based attendance offers numerous advantages, particularly regarding distance accuracy if the distance from a designated point exceeds one meter, employees are unable to clock in (Toyyiba and Amalia, 2023).

Human Resources (HR) play a crucial role in ensuring that work is performed effectively and responsibly; employees are required to follow procedures that serve as a record of their eight-hour workday and adhere to mandatory company policies or Standard Operating Procedures (SOP) (Romadhon et al., 2023). The purpose of this attendance tracking is to enable the company to monitor employee whereabouts and ensure compliance with established regulations. The system also allows the company to identify instances of late arrivals or early departures. While the company may grant exemptions such as on national holidays or during approved leave frequent absences are not tolerated, as the consequences can be severe and potentially disrupt both production and overall company performance. Work morale can be assessed through factors such as employee discipline, cooperation with management and colleagues, and productivity levels (Syahril et al., 2023).

A lack of employee discipline makes it difficult for a company to develop or achieve rapid growth. Conversely, by recognizing the importance of attendance, a company is far more likely to thrive, driven by the support and active participation of its employees in work processes (Fachrizal et al., 2025; Saputra et al., 2025). The objective of this research is to develop, design, and test a mobile-based (android) attendance system that integrates geofencing and time-based dynamic QR code methods to enhance the security and accuracy of attendance recording. This research offers both academic and practical contributions; from an academic perspective, it yields results that advance and expand upon existing research, while from a practical perspective, it provides a reference for implementing GPS technology in attendance information systems as a solution to enhance employee discipline.

2. Research Methods

The research methodology section presents a comprehensive and detailed description of all materials used and procedures carried out during the study. This section begins by listing all materials, including equipment and software. The researcher aims to transform the existing attendance system which currently leaves significant room for manipulation into a more controlled process; this transition promises substantial benefits for both the company and its employees. This method is used as a reference for employees to be more active in absenteeism, so employee attendance becomes a benchmark for developing problems in the company, to increase employee attendance at a company (Santhose et al., 2023), shown in Figure 1.

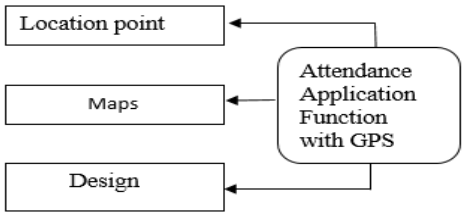

Figure 1.Use of absence

2.1 *Location Point*

The location point feature is implemented to verify whether employees are physically present within the designated workplace area before attendance is recorded. By utilizing GPS coordinates, the system compares the employee's current location with the predefined company location to minimize attendance fraud and location manipulation. This mechanism improves transparency and enables the company to monitor employee attendance more accurately while ensuring compliance with organizational attendance policies.

2.2 *Maps*

The maps feature provides visual confirmation of the employee's geographical position during the attendance process. Before recording attendance, the application displays the employee's current location on a digital map, allowing both employees and administrators to verify the accuracy of the detected location. This functionality enhances user confidence while supporting the validation process of location-based attendance records.

2.3 *Design*

The application interface was designed using a user-centered approach to ensure ease of use and accessibility for employees with different levels of technological proficiency. The interface emphasizes simplicity, intuitive navigation, and minimal operational complexity so that users can complete attendance activities efficiently (Wahyuni et al., 2022). A clear and responsive interface is expected to improve user acceptance and reduce operational errors during attendance recording.

2.4 *Attendance Application Function with GPS*

The proposed attendance application integrates GPS technology and QR Code authentication to improve employee discipline and ensure the authenticity of

attendance records. GPS functionality verifies that employees are located within the permitted attendance area, while QR Code scanning provides an additional verification mechanism to prevent fraudulent attendance practices. By combining these technologies, the system enhances attendance accuracy and supports real-time employee monitoring. The online attendance system operates through several integrated components:

a. GPS (Geolocation): Determines the latitude and longitude of the user's device.
b. Geofencing: Determines the radius from the front door to the point where the attendance system is used (approximately 10 meters).
c. Barcode Scan: Ensures employees are clocking in at the designated location.
d. Network: The attendance application also requires a smartphone network; if a data connection is not activated, the attendance system cannot be used.
e. Real-Time Reports: Make it easier for HR or superiors to monitor employee attendance directly.

The development of this attendance application follows the Waterfall software development methodology, which provides a systematic and sequential approach to application development.

2.5 Data Collection

This study employs several data collection techniques to obtain comprehensive information regarding the existing attendance process and user requirements at PT Merpati Mahardika. The collected data were used as the basis for system analysis, application design, and system development. Multiple data collection techniques were adopted to improve the validity and completeness of the research findings.

2.5.1 Metodologi Waterfall

The application was developed using the Waterfall software development model, which consists of sequential stages including requirements analysis, system design, implementation, testing, deployment, and maintenance (Saravanos et al., 2023). Each development stage must be completed before proceeding to the next stage, ensuring systematic documentation and minimizing development errors. The Waterfall model was selected because the functional requirements of the attendance system were clearly defined and relatively stable throughout the development process.

2.5.2 Data Collection Method

To obtain accurate data regarding attendance-related issues, PT Merpati Mahardika gathers information concerning problems within the scope of the company.

A. Observation

Direct observations were conducted to examine the existing attendance procedures, identify operational problems, and understand employee attendance workflows. This activity enabled researchers to identify weaknesses in the current manual attendance system and determine functional requirements for the proposed application.

B. Interviews

Semi-structured interviews were conducted with the Personnel Manager and several employees involved in the attendance process. The interviews aimed to gather detailed information regarding attendance policies, existing operational challenges, user expectations, and system requirements needed for the proposed attendance application.

C. Literature Review

Relevant books, scientific journals, conference proceedings, and previous studies related to attendance systems, GPS technology, QR Code authentication, mobile applications, and software development methodologies were reviewed. The literature review provided the theoretical foundation supporting the proposed system design and research methodology.

2.5.3 Research Workflow

To ensure the proper functioning of this attendance system, a research workflow comprising several stages must be carried out shown in Figure 2.

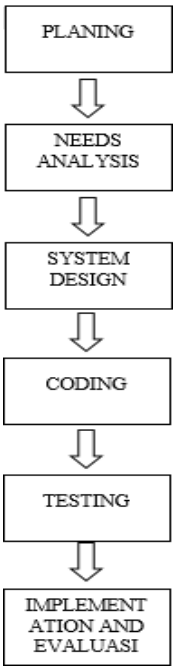

Figure 2. System Development

A. Planning

Planning that focuses on specific issues allows for their evaluation. Additionally, project-focused planning ensures the system functions effectively.

B. Needs Analysis

A requirements analysis has been conducted to ensure the new system operates according to specific needs.

- Functional Requirements: The attendance system is expected to function effectively, featuring capabilities such as GPS-based location tracking when employees clock in or out, and QR code scanning while at the office location. The system is expected to record employee clock-in and clock-out times with real-time data accuracy.
- Non-functional Requirements: Attendance operations will be subject to a proximity constraint, requiring the user to be within a maximum distance of 5 meters from the designated attendance location.

C. System Design

Designing the mobile application to ensure an attractive and user-friendly interface, so that employees do not encounter difficulties when using the application.

D. Coding

To create the software, implementation is carried out using a programming language; specifically, the Flutter framework (Dart) is used, with development performed in Visual Studio Code. Finally, the laptop is connected to a mobile phone to enable the application to run.

E. Testing

Following the completion of several development stages, application testing must be conducted to ensure smooth operation and the absence of bugs that could cause errors. The method employed is Black Box Testing, involving:

- Testing the application during operation by performing clock-in and clock-out actions while data is input into the database in real-time.
- Testing QR code response speed.
- Testing GPS accuracy when positioned within the designated radius.

F. Implementation and evaluation

Once the application has successfully passed the testing phase and is error-free, a trial implementation is conducted within the company environment, involving testing by several employees. Upon the successful completion of this trial, the impact of the digital-era system on employee discipline can be determined.

3. Result and Discussion

The results of this study present a structured explanation of a dynamically designed GPS and QR code-based attendance system, which can serve as a workflow for software development.

3.1 Location Centralized System vs. Device Security

This system is highly centralized, utilizing a client-server architecture based on mobile applications and a server to facilitate data input and output; the cameras and GPS serve as tools to monitor activity during system usage within the application.

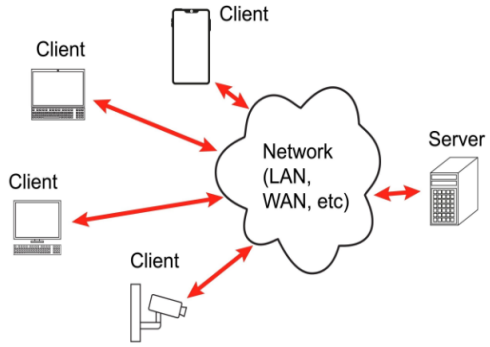

Figure 3. Client Server Model (Architecture)

3.2 Class Diagram

Designing data diagrams using database methodology specifically UML (Unified Modeling Language) class diagrams provides a structured representation of the design. These diagrams display data groups organized in a structured manner, where these groups can be linked or integrated with one another.

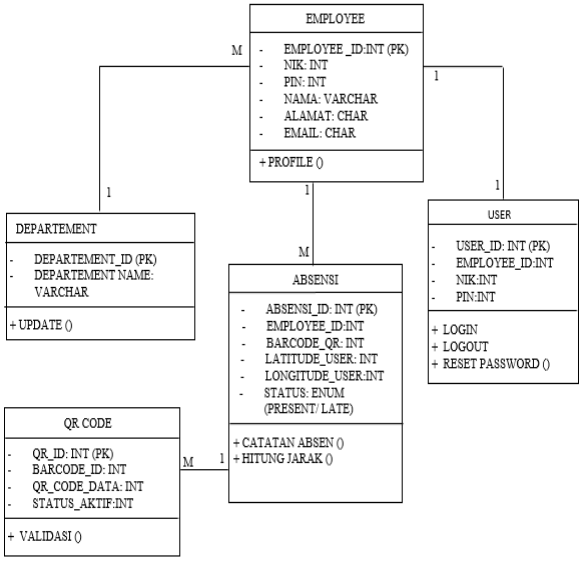

Figure 4 Class Diagram

3.3 *API Communication*

This API (Application Programming Interface) utilizes the Flutter programming language. The .Dart development process involves creating an `api.service` to configure the mobile system to connect with the destination IP address located at the workplace.

```
import 'dart:convert';
import 'package:http/http.dart' as http;
import 'api_config.dart'; // Import konfigurasi IP tadi

class ApiService {
  // Fungsi untuk mengirim data absensi (GPS & QR Code) ke server
  Future<Map<String, dynamic>> submitAttendance({
    required String employeeId,
    required double latitude,
    required double longitude,
    required String qrCodeData,
  }) async {
    try {
      // Menggunakan IP yang sudah ditanam di ApiConfig
      final url = Uri.parse(ApiConfig.attendanceEndpoint);

      final response = await http.post(
        url,
        headers: {
          'Content-Type': 'application/json',
          'Accept': 'application/json',
        },
        body: jsonEncode({
          'employee_id': employeeId,
          'latitude': latitude,
          'longitude': longitude,
          'qr_code': qrCodeData,
        }),
      );

      if (response.statusCode == 200) {
        return jsonDecode(response.body);
      } else {
        return {
          'status': false,
          'message': 'Gagal absensi. Status code: ${response.statusCode}'
        };
      }
    } catch (e) {
      return {
        'status': false,
        'message': 'Terjadi kesalahan koneksi ke server: $e'
      };
    }
  }
}
```

Figure 5. API Communication

3.4 *Use Case Diagram*

The Use Case Diagram illustrates the roles of employees and the administrator regarding application usage. It depicts how employees utilize the attendance system, while the administrator (Database Administrator) acts as a user with the authority to access, create, and monitor the database.

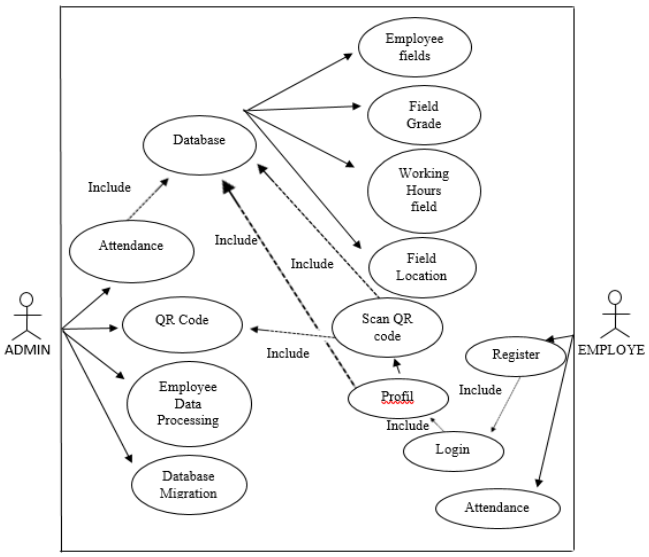

Figure 6. Use Case Diagram

3.5 *Activity Diagram*

An activity diagram is a type of Unified Modeling Language (UML) diagram used to model the flow of an application, thereby making the system more structured and directed.

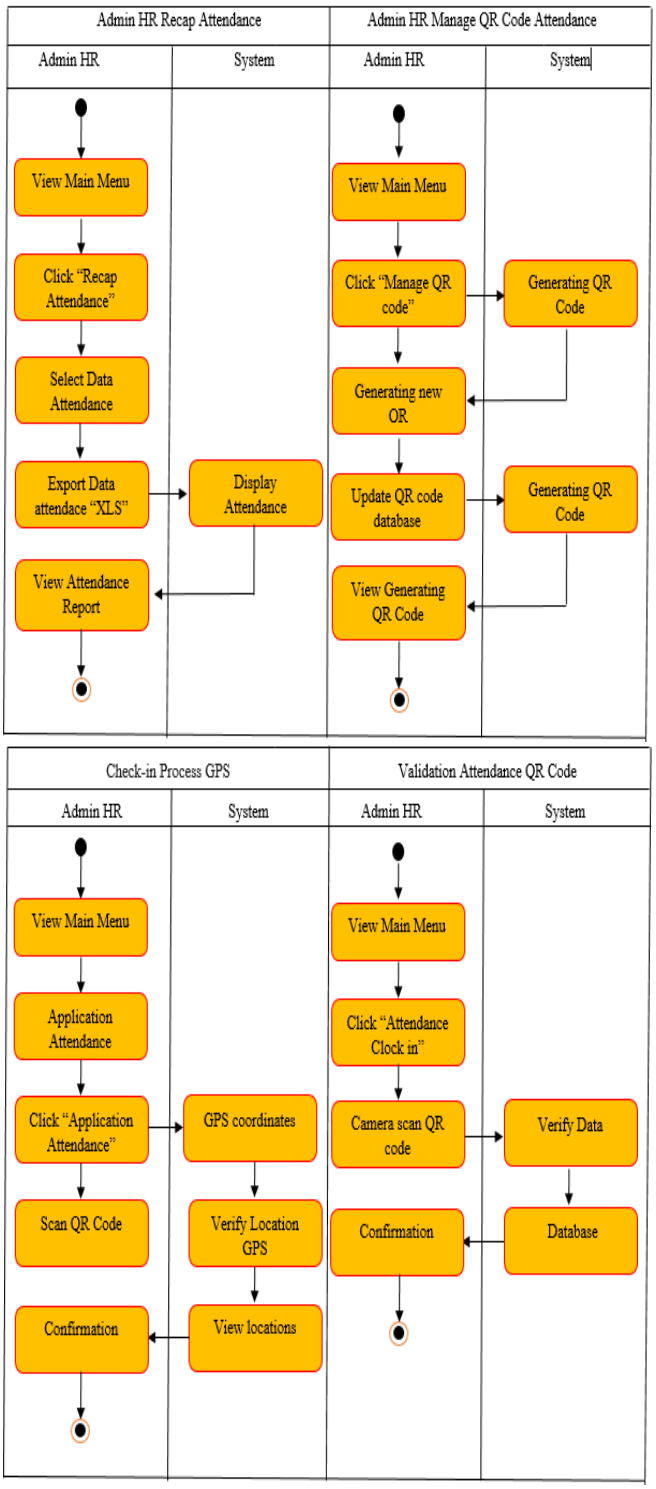

Figure 7 Activity Diagram

When the application transmits data to and receives data from the server, the server stores the synchronized attendance data for instance, when an employee checks in by scanning a QR code, with the scan validated against the office's geographical location (latitude and longitude).

3.6 QR Code Generation Process

Figure 8 presents the QR Code generation process adopted by the proposed system. The application generates a time-based QR Code token that is only valid within a predefined time interval. This mechanism prevents the reuse of previously generated QR Codes and minimizes unauthorized attendance attempts (Ferdiansyah et al., 2023). The integration of dynamic QR Codes with GPS validation creates a dual-authentication mechanism. Employees are required to be physically present within the designated location while simultaneously scanning the active QR Code. This approach significantly enhances attendance authenticity compared with traditional QR Code-based attendance systems that rely solely on barcode scanning.

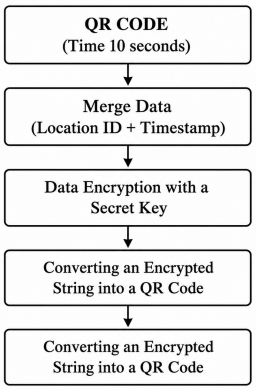

Figure 8. QR Code Generation Process

3.7 Questionnaire

Prior to the implementation of the proposed attendance application, a questionnaire survey was conducted to evaluate employees' perceptions and readiness toward the adoption of a GPS and QR Code-based mobile attendance system. The survey aimed to assess user acceptance of the proposed application and to identify whether the system could effectively improve employee discipline, attendance accuracy, and operational efficiency within the company. The questionnaire consisted of five statements related to the proposed attendance system, including:

1. If the company implements attendance management for employee attendance?
2. Implementing a barcode-based attendance system will improve employee discipline and attendance data accuracy in the office?
3. Implementing the system using an Android system that will be installed on each employee's mobile phone?
4. Using an Android-based attendance system can minimize the risk of fraud among employees?
5. Implementing this attendance system will reduce long lines in front of the office during work hours?

A total of 408 employees participated in the survey. Their responses were collected using a five-point Likert scale ranging from Strongly Agree to Strongly Disagree. The survey results were used as one of the considerations for evaluating user acceptance and improving the proposed attendance application before its implementation.

Table 1.
Questions to employees about absenteeism

No	Opinion	No. of Respondence
1	Strongly agree	300
2	Agree	100
3	Neutral	5
4	Disagree	1
5	Strongly disagree	2

Each employee is required to provide an assessment of absenteeism, so that it can be seen how many employees agree and strongly disagree.

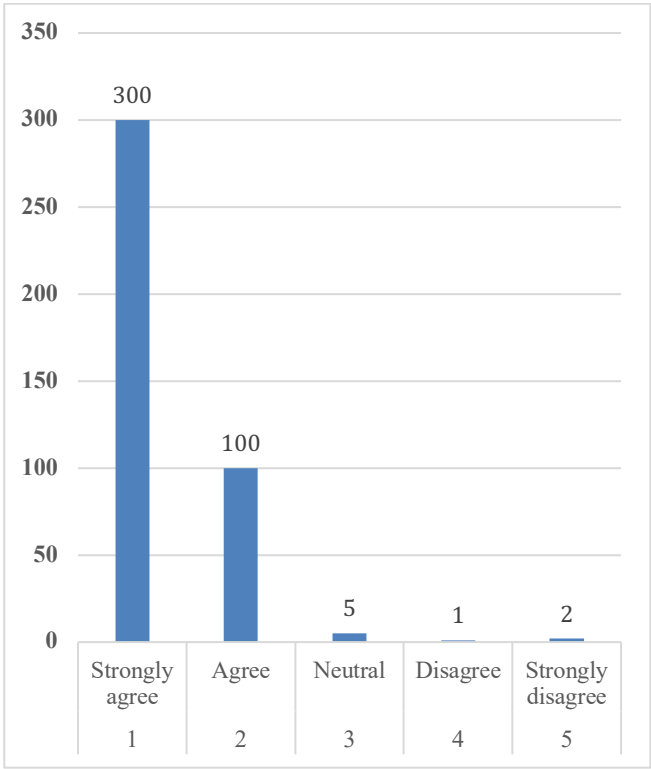

Figure 9. Diagram Respondent

Figure 9 illustrates the distribution of responses collected from 408 employees regarding the implementation of the proposed GPS and QR Code-based attendance application. The majority of respondents expressed positive perceptions

toward the system, with 300 employees (73.5%) selecting Strongly Agree and 100 employees (24.5%) selecting Agree. Meanwhile, 5 respondents (1.2%) selected Neutral, 1 respondent (0.2%) selected Disagree, and 2 respondents (0.5%) selected Strongly Disagree. To better understand employee acceptance, the response percentages were calculated using the following equation:

$$\text{Percentage} = \frac{\text{Total Respondents}}{\text{Number of Responses}} \, x \, 100\%$$

Accordingly,

- Strongly Agree $\frac{300}{408} \times 100\% = 73.5\%$
- Agree $\frac{100}{408} \times 100\% = 24.5\%$

Overall, 98.0% of respondents (Strongly Agree and Agree) expressed positive support for implementing the proposed attendance application. This finding indicates a high level of employee acceptance and organizational readiness to adopt a GPS and QR Code-based attendance system. Employees perceive the proposed solution as capable of improving attendance accuracy, enhancing transparency, minimizing attendance fraud, and supporting more effective attendance management within the company (Nopriansyah et al., 2026). Furthermore, the strong positive response suggests that mobile-based attendance systems integrated with location verification can contribute to improving employee discipline while facilitating digital transformation in organizational attendance management.

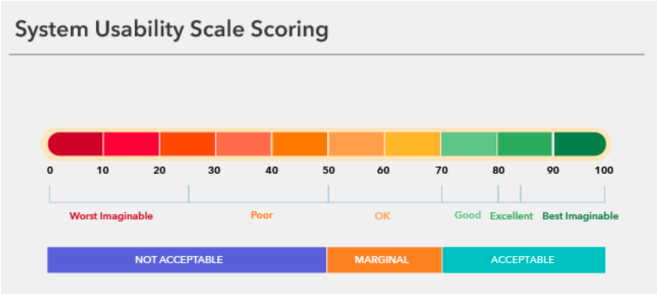

Figure 10. Determination of Assessment Results
(Source: Putri et al., 2024)

From the System Usability Scale Scoring image for determining the assessment 90 -100 = Best Imaginable, 70 - 90 = Good Excellent, 50 - 70 = Ok, 25 - 50 = Poor, 0 – 25 = Word Imaginable . From the research title " Employee attendance greatly company performance and must be support edd by attendance using the gps methode". Based on table 2 for the results obtained from the System Usability Scale is 88. Based on the System Usability Scale.

3.8 Registration Page

The registration page serves as the initial interface for employee enrollment into the attendance system (see Figure 11). Users are required to enter their Employee Identification Number (NIK), Personal Identification Number (PIN), and department information, which are subsequently stored in the centralized database for authentication purposes.

Figure 11. Register Page

The registration mechanism ensures that each employee possesses unique login credentials, thereby improving data security and preventing unauthorized access to the attendance system. This authentication process establishes the foundation for secure attendance management.

3.9 Login Page

The Login page is used to access the attendance application; enter the NIK (Employee ID Number) and PIN (Personal Identification Number) that were registered via the registration menu (see Figure 12). The authentication process ensures that only authorized users can access attendance services. This mechanism enhances data confidentiality while reducing the possibility of unauthorized attendance submissions.

Figure 12. Login Page

3.10 Dashboard Page

The dashboard page shown in the image displays the initial interface for an employee attendance application (see Figure 13). The dashboard provides employees with quick access to attendance functions, attendance history, and account information. A simple and user-friendly interface was designed to improve usability and reduce the time required to perform attendance activities.

Figure 13. Dasbord Page

3.11 Dashboard Page

This page provides options for checking in and checking out. The "Check-In" button is used to register attendance at the start of the workday by scanning a QR code, while the "Check-Out" button is used to register departure upon completing work, also by scanning a QR code. Once either button is used, the check-in and check-out records are displayed based on real-time data.

Figure 14. Check-In and Check-Out Page

3.12 Camera View Screen

The camera view for scanning QR codes indicates user activity in operating the attendance system, utilizing QR code scanning to validate employee attendance.

Figure 15. Camera View Screen

3.13 Attendance Simulasion

Based on the architectural image above, the user accesses the barcode scan monitor, after access the barcode scan, then the barcode scanned data is then stored in the database, the database can display the data via each employee's smartphone.

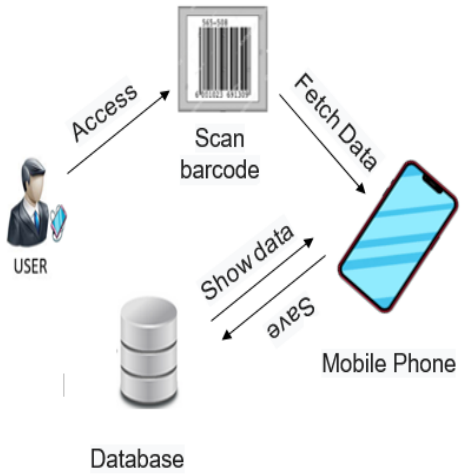

Figure 16. Attendance Simulation

4. Conclusion

An analysis of the QR code-based employee attendance system designed for PT Merpati Mahardika concludes that the system reduces errors during the QR code scanning

process. Employees utilize the QR code attendance system more effectively than manual methods, making this technology an ideal solution for attendance management within the company. The system was developed using the Waterfall methodology. This highly structured Waterfall approach is suited for long-term projects with fixed requirements; the design incorporates features such as GPS tracking, QR code scanning, data validation, and reporting capabilities. Based on the development, design, and analysis of this mobile-based attendance system for PT Merpati Mahardika, the application digitizes the process and stores attendance data by validating GPS coordinates and QR codes to verify each employee. This mobile application fosters innovation, effectively preventing attendance fraud such as the unauthorized photographing and sharing of QR codes. The system enhances discipline and enables real-time data recording, offering significant benefits to the company; notably, the HR department can monitor employees more effectively. Regarding data security, the system utilizes the NIK and a PIN to facilitate the attendance process, while overall security management is handled by a DBA.

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The authors declare that no funding was received for this research

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