

Development and Evaluation of an Employee Attendance System Based on Expo React Native Using the PIECES Method

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Abstract– PT Taqwa Cahaya Semesta (Taqwa Travel), a Hajj and Umrah travel bureau with over 25 years of experience in South Tangerang, faced inefficiencies in manual attendance recording that hindered HR administration. This study aims to develop a mobile-based attendance application using Expo React Native and evaluate its quality using the PIECES method. The system integrates GPS Geofencing and QR Code technology as dual validation instruments to ensure real-time location accuracy. Key features include multi-level authentication, digital leave management, automated attendance recapitulation dashboard, report export, and push notifications. The system was developed using the Waterfall model. PIECES evaluation of 25 respondents (20 employees, 3 supervisors, 2 HRD admins) using a Likert scale 1–5 showed an average score of 4.09 (Good category), with Control as the highest dimension (4.46) and Service as the lowest (3.69). Expo Managed Workflow reduced native configuration complexity with cross-platform code reuse reaching ±85%. GPS geofencing validation achieved a 99.0% success rate.

Keywords: Expo; React Native; Attendance System; GPS Geofencing; QR Code; PIECES

1. INTRODUCTION

PT Taqwa Cahaya Semesta (Taqwa Travel) is a licensed Hajj and Umrah travel bureau that has been operating since 1998 through a consortium system and was officially established as an independent entity on April 29, 2015. With over 25 years of experience, the company has served more than 10,000 pilgrims to the Holy Land. Taqwa Travel holds an official license from the Ministry of Religious Affairs of the Republic of Indonesia (SK U.268/2021) with 'A' accreditation from Sucofindo and is a member of the SAPUHI association, affirming its position as a trusted travel bureau in Indonesia.

The organizational structure of Taqwa Travel consists of six divisions: President Director, Operations Manager, Worship Guide (Muthawwif), Administration and Finance Division, Marketing and Partnership Division, and Customer Service. This diversity of divisions demands a reliable human resource management system, particularly for attendance recording, as field employees in marketing and operational roles are frequently outside the office. Currently, attendance is still conducted manually and centrally, requiring employees to return to the main office solely for attendance purposes, resulting in time inefficiency and potential data manipulation.

Previous studies have developed various digital attendance systems. Face recognition, liveness detection, GPS, and QR Code technologies have been integrated using the Research and Development (R&D) Waterfall method, achieving geofencing accuracy above 99% (Muslim, 2025). A React Native-based attendance system was designed at PT Medigo using the PIECES analysis framework (Andwiyani et al., 2021). A QR Code-based attendance system utilizing React.js and Express.js was subsequently developed (Alief & Rianto, 2025). Furthermore, an Android-based attendance system was implemented using React Native (Nugraha & Hikmawan, 2023). A smart attendance system integrating QR Code and GPS technologies was also developed (Kanapathy et al., 2026), while Firebase Cloud Messaging (FCM) push notifications were implemented in a shift scheduling system (Kurniawan & Wicaksono, 2023). In addition, face recognition combined with GPS verification has been applied to improve attendance validation accuracy (Pradana et al., 2026).

However, these studies have not comprehensively evaluated the quality of an Expo React Native-based attendance system using the PIECES framework, which encompasses both technical and non-technical aspects. Moreover, PIECES was primarily employed as a preliminary analysis tool in previous research, whereas the present study utilizes PIECES as a comprehensive post-implementation evaluation framework (Andwiyani et al., 2021). The selection of Expo as the development platform is based on its capability to simplify native configuration requirements and accelerate cross-platform application development cycles (Jain, 2025).

Therefore, this study aims to design and develop a mobile attendance application using Expo React Native integrated with GPS geofencing, QR Code, and push notification technologies, as well as to evaluate the quality of the developed system using the PIECES framework.

2. RESEARCH METHODOLOGY

2.1 Research Stages

This research was conducted at PT Taqwa Cahaya Semesta using the Research and Development (R&D) method with the Waterfall model, comprising four main stages: requirements analysis through observation and interviews with



management and HRD staff; system design using UML (Use Case, Activity, Sequence, and Class Diagrams) and Entity Relationship Diagram (ERD); implementation using Expo React Native for the mobile frontend, React.js for the web admin panel, Node.js Express.js for the REST API backend, and MySQL for the database; and testing, including black-box testing, geofencing validation, and PIECES evaluation.

2.2 System Architecture

The system consists of two frontend applications: an Expo React Native mobile application for employees, supporting attendance recording, leave requests, and attendance history; and a React.js web admin panel for HRD administrators and supervisors, supporting dashboard monitoring, attendance recapitulation, and approval management. Both applications connect to a REST API built with Express.js and a MySQL database. Key technologies include Expo Location for GPS-based geofencing, Expo Camera for QR Code scanning, Firebase Cloud Messaging (FCM) for push notifications, and JSON Web Token (JWT) for authentication and authorization.

2.3 PIECES Evaluation Method

System quality evaluation was conducted using the PIECES framework, which assesses six dimensions: Performance (response time), Information (data accuracy and completeness), Economy (cost efficiency), Control (security and access control), Efficiency (operational efficiency), and Service (user satisfaction). The evaluation involved 25 respondents consisting of 20 employees, 3 supervisors, and 2 HRD administrators using a Likert scale questionnaire ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire contained 24 statements distributed equally across the six PIECES dimensions. Data analysis included calculating average scores for each dimension, which were categorized from Very Poor (1.00–1.80) to Very Good (4.21–5.00), as well as measuring black-box testing success rates and geofencing validation accuracy.

3. RESULTS AND DISCUSSION

3.1 System Implementation

The application was successfully developed with seven main features covering the entire attendance management cycle: multi-level authentication using JWT with three roles (employee, supervisor, and administrator); GPS geofencing attendance using Expo Location with a 100-meter radius and selfie photo verification as visual evidence; QR Code attendance with time-sensitive tokens; leave and absence requests integrated with a supervisor approval workflow; a recapitulation dashboard with period filters and graphical visualizations; report export functionality to Excel and PDF formats; and push notifications via Firebase Cloud Messaging (FCM) for attendance reminders, approval notifications, and organizational announcements.

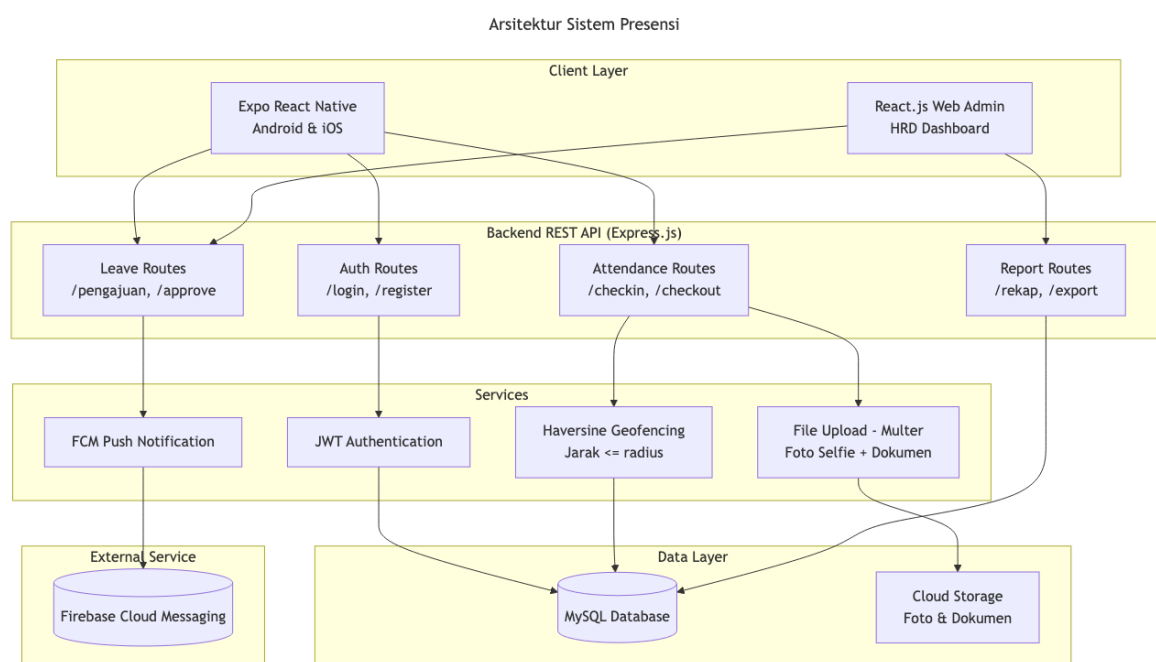


Figure 1. System Architecture

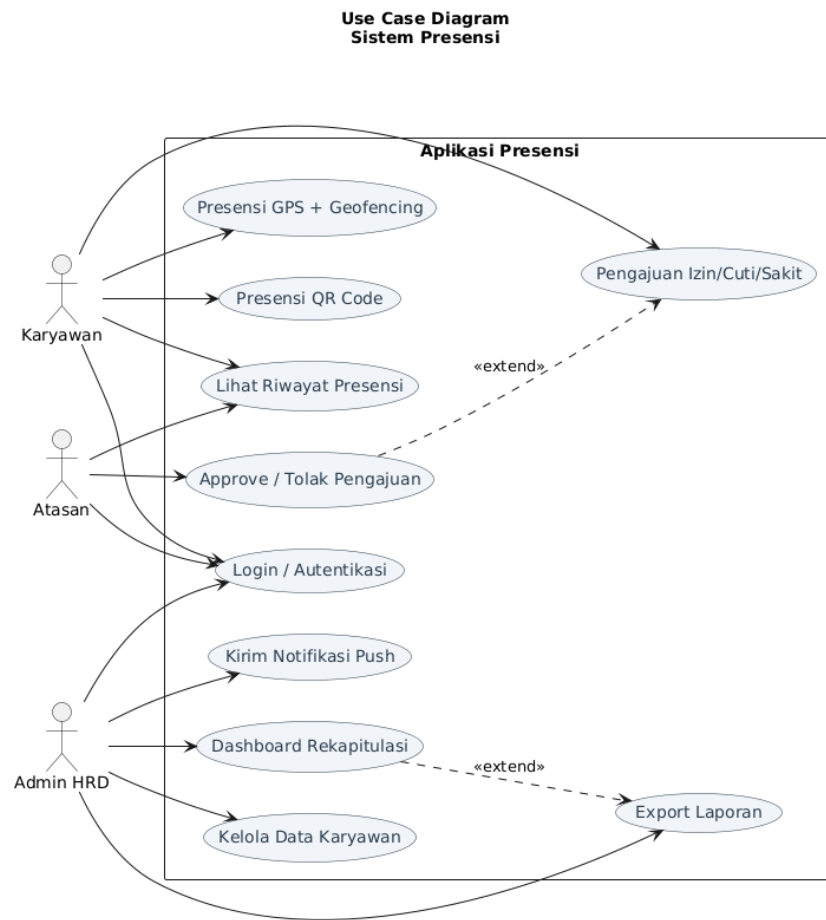


Figure 2. Use Case Diagram

3.2 Geofencing Attendance Flow

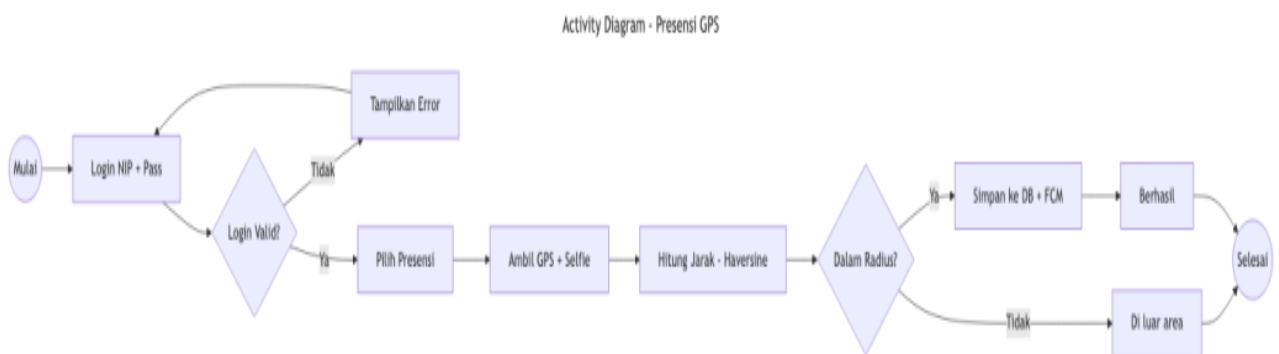


Figure 3. Activity Diagram of GPS Geofencing Attendance

Geofencing testing results (Table 1) showed an average success rate of 99.0%, consistent with findings by Muslim (2025). Attendance within the radius was 100% successful, outside the radius was 100% rejected, and the boundary edge (105m vs 100m threshold) was 95% rejected.

Table 1. GPS Geofencing Test Results

Scenario	Distance	Status	Success Rate
Within 50 m	12 m	Accepted	100%
Within 100 m	78 m	Accepted	100%
Outside 250 m	250 m	Rejected	100%
Outside 500 m	500 m	Rejected	100%
Boundary 105 m	105 m	Rejected	95%
Average			99.0%

3.3 Leave Request Flow

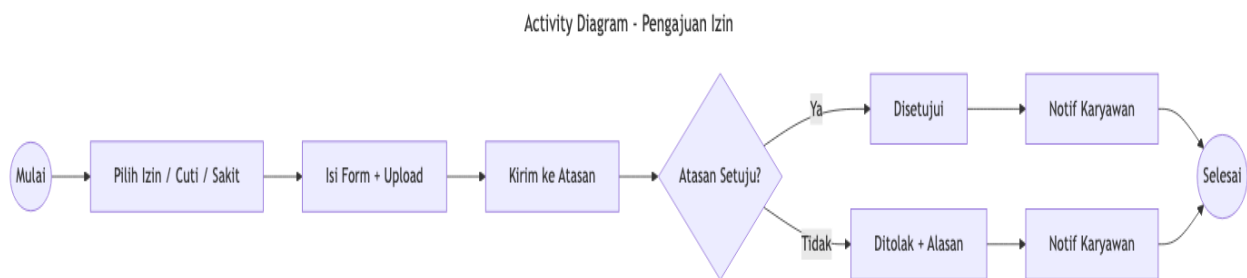


Figure 4. Activity Diagram of Leave Request Process

The leave request process begins with selecting the type of leave (permission, annual leave, sick leave), filling out the form, and uploading supporting documents (doctor's certificate for sick leave). The system then sends a push notification to the supervisor for approval or rejection. The request status (Pending, Approved, Rejected) can be monitored by employees in real-time. This feature directly addresses the problem identified by Andwiyani et al. (2021) regarding the lengthy leave application process using spreadsheets.

3.4 Sequence Diagram

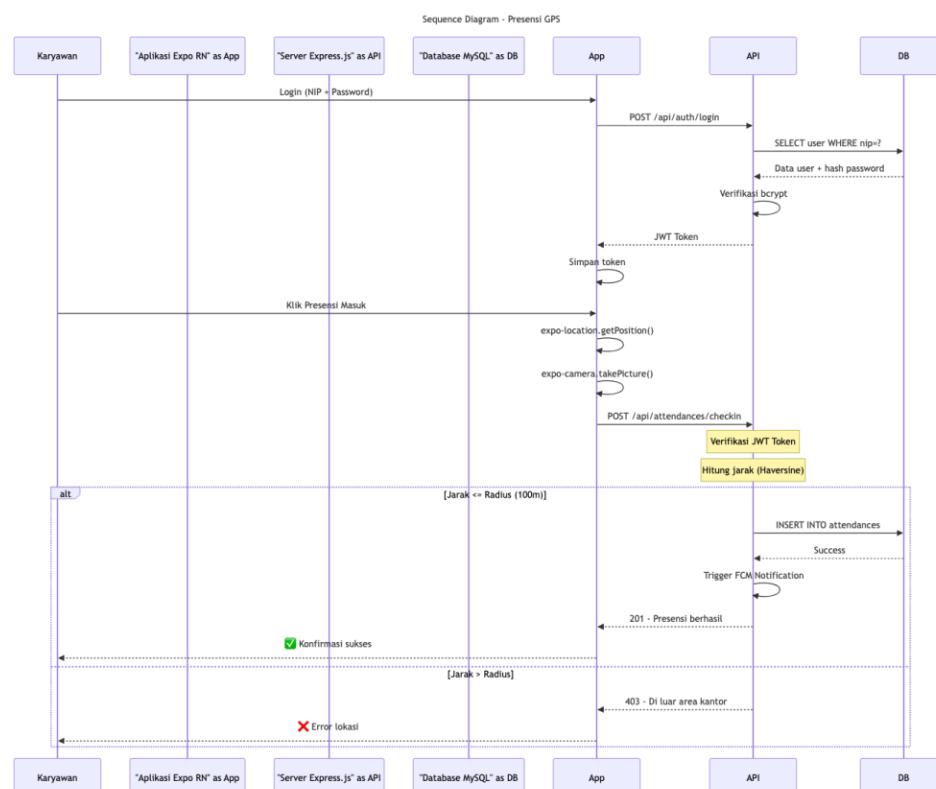


Figure 5. Sequence Diagram of GPS Attendance

3.5 PIECES Evaluation

Table 2 presents the PIECES evaluation results from 25 respondents.

Table 2. PIECES Evaluation Results

Dimension	Score	Category
Performance	3.89	Good
Information	4.13	Good
Economy	4.26	Very Good
Control	4.46	Very Good
Efficiency	4.12	Good
Service	3.69	Good
Average	4.09	Good

Control (4.46) emerged as the highest dimension because the system implements five layers of security: JWT authentication for every API request; GPS geofencing for location validation; time-sensitive QR Code as session tokens; role-based access control (RBAC) for feature authorization; and bcrypt password encryption. This finding is consistent with Pradana et al. (2026), who emphasized the importance of multi-layer validation for preventing time fraud and data manipulation. The Economy dimension (4.26) achieved a Very Good score because the system eliminates fingerprint device procurement and maintenance costs, while reducing development time by 38% compared to React Native CLI due to the shared codebase (Jain, 2025). Efficiency (4.12) recorded a reduction in attendance time from an average of 5 minutes (manual: walking to machine, queuing, scanning) to just 15 seconds (opening the app, GPS, selfie, submit) — a 95% efficiency gain. Information (4.13) was rated Good with 100% data storage accuracy and complete reports verified through black-box testing. Performance (3.89) recorded an average login response time of 1.6 seconds and attendance synchronization of 1.0 seconds, equivalent to native applications, confirming the advantages of the React Native Bridge architecture (Nugraha & Hikmawan, 2023). Service (3.69) was the lowest dimension (3.69) because some respondents still required adaptation to the new interface, which is a natural occurrence during transitions from manual to digital systems. This aligns with Muslim (2025)'s findings on the importance of intuitive UX design in attendance systems.

3.6 Expo Contribution to Development Efficiency

Expo Managed Workflow provided measurable contributions: elimination of native configuration — only 2 items (app.json + plugins) vs. ~12 items for React Native CLI (Xcode, build.gradle, AndroidManifest, Info.plist); integrated SDK (expo-location, expo-camera, expo-notifications) without native linking; Expo Go for real-time testing on physical devices without rebuilding; EAS Build for Android/iOS deployment without native development environments; cross-platform code reuse of ±85% reducing maintenance and update costs. Hofmann & Riemer (2024) found that Expo eliminates up to 70% of build-related bugs. Code reuse directly correlates with lower maintenance overhead (Hakim & Hidayat, 2024).

3.7 Black-Box Testing

From 60 test cases across 8 modules, 59 passed (98%). One failure occurred in the document upload module (incorrect file format) and was resolved by adding MIME type validation on both frontend and backend before release. This result aligns with Alamsyah et al. (2024), who demonstrated that React Native-based attendance systems achieve a 97% functional success rate.

4. CONCLUSION

This research successfully developed an employee attendance application based on Expo React Native, integrating GPS geofencing, QR Code, and push notifications. PIECES evaluation of 25 respondents showed an average score of 4.09 (Good), with Control (4.46) as the highest dimension and Service (3.69) as the lowest. Expo Managed Workflow reduced native configuration and accelerated the development cycle by 38% with cross-platform code reuse of ±85%. GPS geofencing achieved a 99.0% success rate and black-box testing reached 98%. Practical implications: the system is ready for implementation to digitize company attendance management. Limitations include the relatively small sample size (25 respondents) and single-company scope. Future research recommendations: comparative study between Expo and Flutter using COCOMO II metrics; development of anti-mock location features to prevent GPS spoofing; integration with payroll modules for automated salary calculation; and production-scale load testing to validate backend scalability.

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