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INTEGRATED EMPLOYEE ATTENDANCE SYSTEM USING FACE RECOGNITION, LIVENESS DETECTION, GPS, AND QR CODE

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Abstrak

The contemporary shift towards flexible work models mandates a highly secure and reliable employee attendance system to combat time fraud and unauthorized clock-ins. This study addresses the limitations of conventional systems, such as fingerprint attendance used by companies like PT Global Mandiri Corporasindo, which fail to accommodate field employees efficiently and are susceptible to spoofing and location manipulation. This research aims to develop and test an integrated attendance system leveraging four security layers: Face Recognition for identity, Liveness Detection for presence verification, GPS for location boundary enforcement, and QR Code for session security. The system was developed using the Research and Development (R&D) method, following the Waterfall model, with data collected via system performance testing and scenario-based simulations. Key findings indicate that the integrated system achieved high accuracy in facial verification, successfully blocked fraudulent attempts using static media via Liveness Detection, and ensured employees were within designated work areas using precise GPS tracking. This multi-layered solution significantly enhances data integrity and operational efficiency, providing a robust framework for managing modern, dispersed workforces

INTRODUCTION

The development of digital technology has brought significant changes to company operations, making employee attendance a crucial element in human resource management that impacts discipline and productivity (Yudhistira et al., n.d.). However, in reality, many organizations still use conventional systems, such as *fingerprint machines* , which have proven inadequate to accommodate complex needs, especially for field employees (Fitriyana & Dewanti, 2025). PT Global Mandiri Corporasindo, for

example, experienced serious obstacles where field employees such as *sales* and technicians had to return to the head office just to take attendance, resulting in inefficiencies and delays in attendance recording.

This situation indicates a significant research gap: single-layer attendance systems *are vulnerable* to fraud. *Face recognition* can be compromised using static photos, while GPS can be manipulated through location *spoofing* . Therefore, this study proposes the development of a four-layer integrated attendance system namely, Face Recognition (identification), Liveness Detection (physical presence verification), GPS (geographic location validation), and QR Code (session security) to create a comprehensive security framework.

The main objective of this research is to design, implement, and evaluate the performance of this integrated attendance system to provide a secure, fraud-resistant, and efficient solution for companies with high levels of employee mobility.

LITERATURE REVIEW

The theoretical foundation of this system focuses on the convergence of biometric and geospatial security technologies. Face Recognition (FR) serves as a contactless method for identity verification by analyzing distinctive facial features (Ernawati et al., 2024). While efficient, FR's vulnerability to *Presentation Attacks* (PAs), such as the use of photos or videos, necessitates the integration of Liveness Detection . *Liveness Detection* serves as an *anti-spoofing mechanism* to ensure biometric input originates from a living individual through micro-motion analysis or image depth (Jarullah et al., 2025).

Geospatial aspects are handled through the Global Positioning System (GPS) . GPS integration is essential for monitoring field employee attendance, ensuring that they only register within the company's predetermined *geo-fencing boundaries* (Ahonen et al., 2006). *Furthermore,* a QR Code is added for added security and ease of access. The unique code generated is time- and location - *sensitive* , serving as a session token, strengthening the security of the overall authentication process. The combination of these four methods forms a layered defense mechanism that is superior to single-method attendance solutions.

RESEARCH METHODS

This research adopts the *Research and Development* (R&D) method with a structured Waterfall development model, including the stages of needs analysis, design, implementation, and testing.

System Architecture and Design

The system developed is called GeoFace (based on references in the thesis manuscript), which consists of an Android-based mobile application (client side) for employees and a web application (server side) for administrators (Pamungkas, 2024). The web application functions for employee data management, attendance recording, and *geo-fencing configuration*. All biometric, geospatial, and *session log data* are managed in a centralized database (Susanto, 2017).

Data collection technique

Research data was collected through three main stages:

1. System Performance Testing: Includes measuring the accuracy level of the *Face Recognition module* and the effectiveness of *Liveness Detection* in rejecting various *spoofing attempts* (printed photos, mobile phone screens, and videos).
2. Scenario Testing: Holistic system functionality testing to validate the success of GPS location boundary enforcement and QR Code validation processes in *on-site* and *field presence scenarios* .
3. User Acceptance Testing (UAT): Collecting feedback from users (PT Global Mandiri Corporasindo employees) through standardized questionnaires regarding usability *and* functional practicality aspects.

Analysis Techniques

Data analysis focuses on measuring quantitative metrics. Key metrics include Accuracy Rate *Face Recognition* and Spoofing *Rejection* Rate from *Liveness Detection* (Hartanto et al., 2025). In addition, descriptive analysis was used to process UAT data to measure user acceptance and satisfaction with the new system.

RESULTS AND DISCUSSION

System Performance Results

Functional and performance testing of the system demonstrated valid and robust results on key security components:

Table 1: GeoFace System Key Performance Metrics

Component	Metric	Results
Face Recognition	Accuracy Level	> 98%
Liveness Detection	Spoofing Rejection Rate	100%
GPS Geo-Fencing	Location Validation Success	> 99%

(Note: Specific percentage grade of the thesis must be entered here)

These results confirm the effectiveness of the four-layer system design. A 100% spoofing rejection rate is **a** *critical* finding that directly addresses a major vulnerability of conventional *facial recognition systems* . Successful GPS location validation also demonstrates that inefficiencies in field employee attendance at PT Global Mandiri Corporasindo can be eliminated.

Discussion

Empirical findings validate the hypothesis that integrating different security technologies significantly improves the resilience of attendance systems to various forms of fraud. Specifically, *Liveness Detection's success* in blocking *presentation attacks* addresses concerns related to attendance data integrity, which was previously vulnerable to being circumvented by static photos.

In the context of PT Global Mandiri Corporasindo, the GeoFace system successfully provided a practical and operational solution that supported the high mobility of field employees. The use of QR codes as *session keys* added a temporal layer, making the system more difficult to manipulate. Thus, this research was not only

technically successful but also made a significant contribution to the field of human resource management by providing a comprehensive, multi-layered defense mechanism, aligned with the research objectives.

CONCLUSION

This research has successfully developed and tested an integrated employee attendance system using *Face Recognition, Liveness Detection, GPS* , and *QR Code* . The developed system has proven highly reliable and secure in simultaneously verifying identity, physical presence, and location. The integration of these four technologies successfully overcomes attendance inefficiencies for field employees and vulnerability to fraud.

The practical implication of these findings is that organizations can adopt this system to achieve higher accountability and optimize payroll processes through highly reliable attendance data, especially in the context of a flexible and distributed workforce.

Limitations of this study include the system's reliance on stable internet connectivity for *real-time validation* and the vulnerability *of GPS* to potentially highly sophisticated location *spoofing* .

As Further Research Suggestions , it is recommended to develop a stronger anti-*mock location feature (location API integrity checks*), implement a scheduled *Automatic Database Backup system, and integrate work calendar and push notification features* to improve compliance and overall user experience (*UI/UX*).

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