Development of an Android-Based Online Attendance System as a Learning Support Tool for Students in the Computer and Information Technology Education Study Program UNIMED

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Abstract. Student attendance is a critical component in managing academic activities, serving both administrative purposes and as a tool for evaluating the learning process. However, manual attendance systems commonly used in universities still suffer from several weaknesses, including proxy attendance, slow recording processes, and lack of integration with digital academic systems. This study aims to develop an Android-based online attendance system equipped with QR code scanning, GPS location validation, and face photo documentation to verify student presence. The system is designed to provide ease of use for both students and lecturers while improving the validity and efficiency of attendance data. The research employs a software engineering approach using the Waterfall development model, which includes requirements analysis, user interface design, system implementation, and testing. Test results show that the system functions effectively, features an intuitive interface, and can accurately and in real time record student attendance. Integration with GPS and the Android device^s camera allows the system to validate presence based on both location and facial identity. This system is expected to support a more secure, efficient, and comprehensive digitalization of attendance management in higher education..

Keywords: Online attendance, Android, QR code, GPS, Educational information system.

1 Introduction

Attendance plays a fundamental role in higher education, as it reflects not only student discipline but also their level of engagement and participation in academic activities. Numerous studies have highlighted that regular class attendance is strongly correlated with improved academic performance, knowledge retention, and overall learning outcomes[1], [2]. Consequently, higher education institutions require accurate and efficient systems for monitoring student attendance as part of quality assurance in teaching and learning. Traditionally, attendance has been recorded manually using paper-based sign-in sheets or roll calls. While this method is simple, it is prone to several issues such as time inefficiency, human error, and manipulation practices like proxy attendance [3]. Moreover, manual systems make it difficult for institutions to maintain accurate

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records, generate attendance reports, and integrate the data with broader academic information systems. These limitations highlight the urgency of adopting digital solutions that are both reliable and user-friendly. With the rapid advancement of information and communication technology (ICT), mobile-based systems have become increasingly popular in supporting academic administration. In particular, the Android platform dominates the global mobile market and offers flexibility for developing innovative applications that are accessible to most students [4]. Several researchers have proposed Android-based attendance systems incorporating QR codes, GPS validation, or biometric technologies to enhance accuracy and security [5], [6]. However, existing solutions still face challenges, such as the susceptibility of static QR codes to misuse, the inaccuracy of GPS in certain environments, and the high hardware requirements of biometric systems [7]. In response to these challenges, this study aims to develop an Android-based online attendance system that integrates QR code scanning with dynamic generation and GPS-based location validation. The proposed system is expected to reduce fraudulent practices, streamline attendance monitoring, and provide real-time access to attendance data for both students and lecturers. Furthermore, by aligning the system with the academic processes at the Computer and Information Technology Education Study Program (PTIK), Universitas Negeri Medan (UNIMED), this research contributes to the broader effort of digital transformation in higher education, where technology is increasingly adopted as a learning support tool. The remainder of this paper is structured as follows. Section 2 presents the research methodology and system design approach. Section 3 discusses the results and key findings, including mockup development and initial testing. Section 4 concludes the study and outlines recommendations for future development and implementation.

2 Method

This research employed a system development approach using the Waterfall model, which consists of sequential phases: requirements analysis, system design, implementation, testing, and evaluation. The methodological framework was designed to ensure the systematic development of an Android-based online attendance system that integrates QR code scanning and GPS validation.

2.1 Requirements Analysis

The initial phase involved gathering user requirements from both students and lecturers at the Computer and Information Technology Education Study Program (PTIK), Universitas Negeri Medan. Interviews and document analysis were conducted to identify functional requirements such as login authentication, QR code scanning, GPS-based validation, attendance history, and administrative dashboard. Non-functional requirements, including system security, usability, and compatibility with existing academic information systems, were also defined.

2.2 System Design

In this phase, the system architecture was designed using Unified Modeling Language (UML) tools, including use-case diagrams, activity diagrams, and class diagrams. The front-end interface was designed using Android Studio, while the back-end services were designed to run on a cloud server with a REST API. Data were stored in a relational database (MySQL) and connected through API endpoints to ensure synchronization between mobile clients and the server.

2.3 Implementation

The implementation focused on the development of the Android application prototype. The main modules include:

- Login Module for user authentication.
- QR Code Scanner Module for attendance recording.
- GPS Validation Module to confirm the student's presence within the designated classroom location.
- Attendance Record Module for storing and viewing attendance history.
- Admin Dashboard accessible to lecturers for monitoring attendance data in real-time.

2.4 Testing

System testing was carried out using black-box testing to verify the functionality of each module according to the requirements specification. Usability testing was also planned to evaluate the user experience and interface design by involving a small group of students and lecturers as respondents.

2.5 Evaluation

The evaluation phase aimed to assess the effectiveness and efficiency of the developed system. Mockups and prototype demonstrations were presented to lecturers and students, followed by feedback collection through questionnaires. The evaluation indicators include system accuracy in recording attendance, ease of use, and integration with academic activities.

3 Results and discussion

The development of the Android-based online attendance system produced a prototype in the form of high-fidelity mockups that visualize the main functionalities of the application. This prototype was created to support student learning activities at the Computer and Information Technology Education Study Program (PTIK), Universitas Negeri Medan, focusing on usability, security, and operational efficiency. The results demonstrate the design concept, key functional features, and their relevance to previous studies on digital attendance systems.

3.1.User Interface Mockups

The system interface was designed using a user-centered approach, ensuring that each screen is simple, accessible, and aligned with user tasks. The mockups were developed for several main screens as follows:

- **Login Screen**

The login screen (Fig. 1) is the first interface encountered when opening the application. It contains input fields for email and password, followed by a login button. This layout ensures secure user authentication before accessing the system. Its minimalistic design improves accessibility and reduces potential login errors.

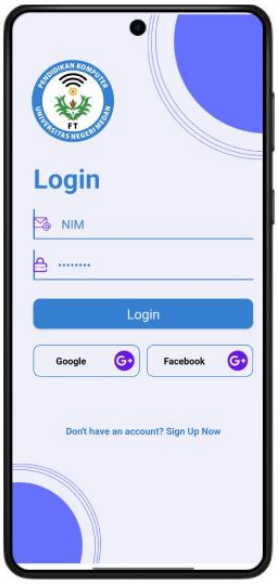

Fig. 1. Login screen of the android-based online attendance system.

- **Dashboard**
  After successful authentication, users are directed to the dashboard (Fig. 2), which serves as the main hub. It provides a personalized welcome message and quick access to essential features such as Scan QR, Attendance History, and Profile. The dashboard layout emphasizes clarity, consistency, and task efficiency.

Fig. 2. Dashboard screen of the android-based online attendance system.

- **QR Code Scanner**
  The QR code scanner screen activates the device's camera for attendance validation. Once a QR code is scanned, the system automatically performs GPS validation to verify that the student is within the designated classroom location. The design of this interface prioritizes speed and accuracy, with a simple layout that highlights the scanning process.

Fig. 3. QR code scanner screen of the android-based online attendance system.

- **Attendance History**
  The attendance history screen (Fig. 4) displays past attendance data, including date, time, and attendance status (present, late, or absent). The structured list format enhances clarity, allowing students to monitor participation and lecturers to review attendance patterns..

Fig. 4. Attendance history screen of the android-based online attendance system.

3.2 Functional Features

The prototype integrates several key functions to ensure secure and reliable attendance recording:

- Login authentication to verify user credentials.
- QR code scanning for fast and precise attendance recording.
- GPS validation to confirm the physical presence of students in the designated classroom.
- Attendance history for student self-monitoring and lecturer tracking.

The system architecture connects the Android front-end, a RESTful API, and a relational database server to handle attendance transactions. This design allows seamless synchronization between devices and ensures data integrity.

3.3 Discussion

The designed system aims to overcome weaknesses in manual attendance systems, which are often prone to proxy attendance and time inefficiencies. By integrating QR code and GPS validation, the proposed system introduces a dual-layer verification process that significantly increases accuracy and security. Previous research often focused on single-technology approaches either QR-based systems [3], [4] or GPS-only models [5] which have limitations such as code sharing or inaccurate geolocation. The present prototype addresses these issues through combined verification. In addition, the focus on user-centered design ensures that the system is easy to navigate and minimizes the learning curve for students and lecturers. From a pedagogical perspective, reliable attendance monitoring contributes to adaptive learning management by providing real-time participation data. This supports instructors in evaluating student engagement and correlating attendance with academic performance trends.

Although the current results are limited to mockups and design validation, the proposed system provides a strong foundation for further development. Future work will involve prototype implementation, usability testing, and pilot deployment in classroom environments. Evaluation metrics will include system usability (SUS), GPS validation accuracy, and user satisfaction scores. These results are expected to validate the effectiveness of the proposed system as a learning support tool in higher education..

4 Conclusion

This study presented the development of an Android-based online attendance system designed to support student learning in the Computer and Information Technology Education Study Program at Universitas Negeri Medan. The system prototype, illustrated through a series of mockups, incorporates essential features such as login authentication, QR code scanning, GPS validation, attendance history, and user profile management. The proposed system addresses several challenges associated with traditional manual attendance methods, particularly in terms of efficiency, transparency, and security. By combining QR code technology with GPS-based location validation, the design minimizes the risks of proxy attendance and provides more accurate records for both students and lecturers. Although the current results are limited to mockups and conceptual design, this research lays the foundation for a more comprehensive system to be implemented and tested in real classroom environments. Future work will focus on developing a functional prototype, conducting usability testing, and integrating the system into

the university's academic information platform. The expected outcome is a reliable and adaptive attendance solution that enhances teaching and learning processes in higher education.

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