

Prototype of an Android Based Online Attendance System at SMA Negeri 1 Sungai Raya

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Abstract

Student attendance at SMA Negeri 1 Sungai Raya has been recorded manually using attendance sheets signed at each meeting. This conventional method often causes various problems, such as the possibility of signature manipulation, attendance proxy, and the risk of data loss when documents are damaged or lost. In addition, the process of recapitulating attendance requires considerable time and effort, making it difficult for teachers and administrative staff. To address these issues, this study developed a prototype of an Android based online attendance system that utilizes QR codes as student attendance identifiers. The system is designed so that students can independently record their attendance by scanning QR codes, while teachers can monitor attendance in real time. Attendance data is stored online using the Firebase Cloud Firestore service, allowing attendance information to be accessed quickly and securely. The attendance system prototype was built using the Java programming language with an XML-based interface in Android Studio. The test results show that the system is capable of processing attendance data efficiently, reducing the potential for fraud, and speeding up recapitulation, making the attendance administration process more practical and accurate.

Keywords

Android; Cloud Storage; Online Attendance; QR Code; Secure Data Management

INTRODUCTION

Educational institutions increasingly recognize that accurate and efficient attendance management is a fundamental component of maintaining student discipline and ensuring the smooth execution of instructional activities. Globally, absenteeism has been identified as a strong predictor of declining academic performance, increased dropout rates, and reduced student engagement. UNESCO (2023) reports that irregular attendance

contributes to a learning loss rate of up to 30% in secondary education, emphasizing the strategic role of attendance as an early indicator of learning challenges. In Indonesia, the Ministry of Education's national evaluation indicates that inconsistent attendance monitoring remains a persistent administrative issue in many secondary schools, affecting both academic accountability and school governance.

Despite the growing demand for digital transformation in education, many schools including public schools in suburban areas continue to implement manual attendance procedures using paper-based forms or handwritten signatures. These methods are often inefficient, prone to data loss, vulnerable to falsification, and require significant time for daily recapitulation. A survey by Pusdatin Kemendikbud (2022) shows that 64% of schools still rely on conventional attendance systems, resulting in administrative workloads that can absorb up to 25% of teachers' non-teaching time. This situation highlights the urgent need for a more reliable, secure, and efficient attendance management solution that aligns with the digitalization agenda in Indonesian education.

The rapid development of mobile technologies has encouraged educational institutions to explore digital attendance systems as an alternative to traditional approaches. Among available technologies, QR code based attendance systems have gained momentum due to their simplicity, automation potential, and reduced risk of manipulation. Studies by Sakti et al. (2025) and Radhitya et al. (2025) indicate that QR-based attendance can decrease fraudulent entries by more than 40% and shorten attendance processing time significantly. However, these systems often lack robust integration with cloud-based infrastructures, limiting their ability to deliver real-time updates and seamless synchronization across devices and stakeholders.

Furthermore, several prototypes developed in prior studies rely heavily on local databases or manual data export, which not only restricts scalability but also introduces vulnerabilities in data consistency and system reliability. Some research has focused solely on student-side functionality without considering teacher and administrator perspectives, resulting in systems that fail to address broader school operational needs. Additionally, features such as online leave request management, automated verification, and offline data handling are frequently absent, reducing the overall practicality of existing attendance applications in real educational settings.

These gaps reveal an urgent need for a more comprehensive and integrated digital attendance solution capable of functioning reliably in diverse school environments. A system that supports real-time monitoring, secure cloud storage, offline resilience, and role-based access is essential to address the multifaceted challenges of attendance management. Moreover, to ensure successful adoption, such a system must be evaluated not only for its functional capabilities but also for its usability, perceived usefulness, and ease of use among both teachers and students. Few existing studies have conducted a dual-perspective evaluation using established theoretical models such as the Technology Acceptance Model (TAM), leaving an important research area insufficiently explored.

Departing from these limitations, this research proposes the development of an Android-based online attendance system prototype that integrates QR code scanning with Firebase Cloud Firestore to enable real-time synchronization and secure data management. The inclusion of features such as autonomous student check-in, teacher-controlled monitoring dashboards, and online leave request submission positions the system as a more holistic solution compared to earlier prototypes. By incorporating both usability testing and user acceptance evaluation, this research aims to produce empirical evidence regarding system feasibility and potential for large-scale implementation.

The primary objective of this study is to develop, validate, and evaluate a mobile-based attendance system tailored for SMA Negeri 1 Sungai Raya, addressing administrative inefficiencies and enhancing attendance transparency. The results of this study are expected to contribute theoretically by enriching the literature on digital attendance systems, particularly regarding QR-based authentication and cloud-driven educational applications. Practically, the prototype offers a scalable solution that can help schools streamline administrative tasks, strengthen data accuracy, and improve accountability in student attendance management. Through these contributions, the research seeks to support ongoing digital transformation initiatives in Indonesian secondary education.

METHOD

This study employed a Research and Development (R&D) approach using the ADDIE development model, which includes five stages: Analysis, Design, Development, Implementation, and Evaluation (Permana & Alkadri, 2025). The model was selected to

ensure a systematic process in designing, testing, and validating the Android-based online attendance system prototype.



Figure 1. ADDIE Development Model

Research Design

The ADDIE model guided the development process to identify user needs, design system workflows and interfaces, develop the prototype, conduct usability testing, and perform evaluations for improvement.

Research Subjects

The research involved two groups of participants. In the development phase, homeroom teachers assessed the system's feasibility in terms of usability, functionality, and interface quality. And in the testing phase, a small-scale test with 5 students and a large-scale test with 30 students to measure system usability, accuracy, and efficiency.

Materials and Tools

The prototype was developed using Android Studio version 2023.2 with Firebase Cloud Firestore as the database platform. Development and testing were carried out on a computer with Intel Core i5, 8 GB RAM, and an Android smartphone (Android 13) for testing the mobile interface.

Data Collection and Analysis

Data were collected through observation, interviews, and questionnaires distributed to teachers and students. Qualitative data (from interviews and open responses) were

analyzed using thematic analysis to identify user perceptions and improvement suggestions. Quantitative data (from usability and satisfaction questionnaires) were analyzed using descriptive statistics to determine mean scores and percentage levels of system acceptance. Instrument validity was ensured through expert validation involving two informatics lecturers who assessed content relevance, clarity, and construct accuracy. Instrument reliability was tested using Cronbach's Alpha, resulting in a coefficient of 0.91, indicating a high level of internal consistency and reliability.

Research Procedure

The research procedure followed the ADDIE stages, that are Analyze (identifying user needs and system requirements), Design (creating use case diagrams, activity diagrams, and Firestore database schemas), Development (building and integrating features such as QR code attendance, schedule management, and leave permission requests), Implementation (conducting trials in a classroom setting with real student data to test performance and usability) and Evaluation (assessing each development phase and refining the system based on feedback and testing outcomes).

RESULT AND DISCUSSION

Analysis Stage Results

Preliminary analysis and interviews with homeroom teachers confirmed that the manual attendance system was time-consuming during the recapitulation stage and prone to manipulation. The priority features identified included QR code scanning for attendance, lesson schedule features, permission requests, and real-time access to attendance data by homeroom teachers and students.

Design Phase Results

Design of the Use Case Diagram

The system prototype is designed with three actors: Admin, Homeroom Teacher, and Student. The admin is responsible for data management (homeroom teacher accounts, schedules, QR code generation), while Students register accounts, scan QR codes for attendance, and submit permission requests. This separation of roles is important to maintain control blocks and system security. The design of the use case diagram for the

Android-based Online Attendance System Prototype at SMA Negeri 1 Sungai Raya is as follows:

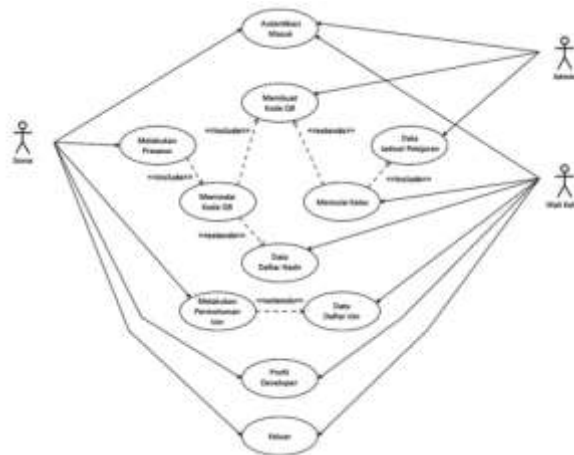


Figure 2. Use Case Diagram Design

Activity Diagram Design

An activity diagram visualizes the workflow in detail. This flow is designed to minimize delays and errors in the attendance process. The activity diagram design for the Android-based Online Attendance System Prototype at SMA Negeri 1 Sungai Raya is as follows:



Figure 3. Activity Diagram Design

Firestore Cloud Firestore Database Schema Design

The database schema includes User Data, Lesson Schedule, Attendance, and Permission Requests. The database schema for the Android-based Online Attendance System Prototype at SMA Negeri 1 Sungai Raya is as follows:

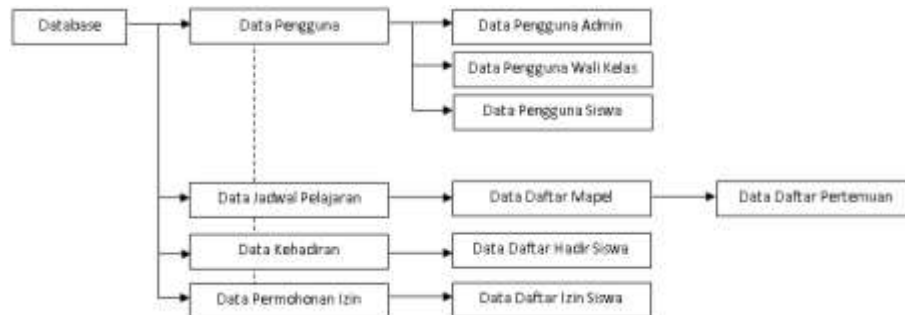


Figure 4. Cloud Firestore Database Schema Design

Development Stage Results

After the initial coding of the interface display and functional instructions, the prototype was tested by the homeroom teacher. The prototype was developed and revised based on teacher feedback that are improved authentication feedback, password validation, separation of teacher and student application roles, auto-fill permission data, and logout confirmation to prevent accidental logouts. These revisions improved access control and reduced manual input errors.

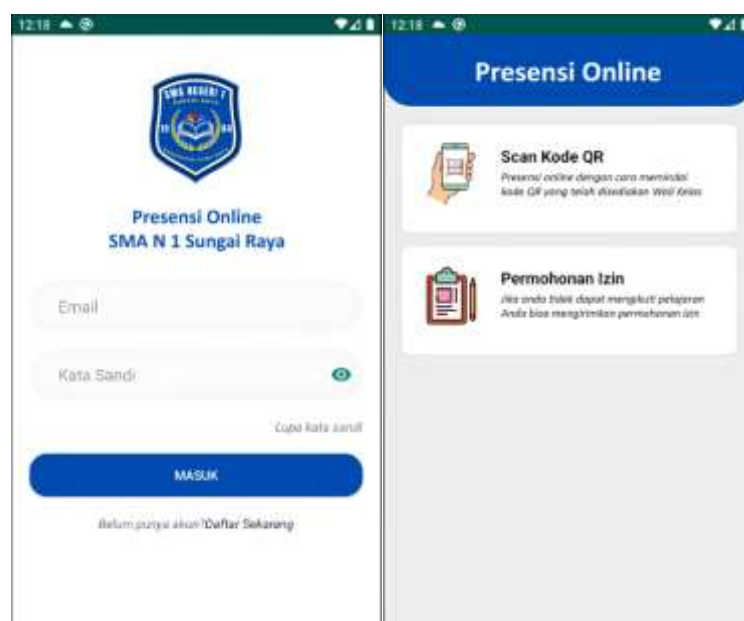


Figure 5. Login and Online Attendance Menu

Student Response Test Results

Student response testing was conducted in two stages, small scale (N = 5) and large scale (N = 30), focusing on the aspects of Navigation, Ease of Use, and Display. In a small-scale trial involving 5 students, the product achieved an average total score of 4,33 and was classified as Excellent. These results indicate that the prototype system was well received at the beginning of implementation, allowing it to proceed to the large-scale trial stage. The large-scale trial involved 30 students and the average large-scale trial result achieved a score of 4.51 (total score of 2434 out of a maximum of 540 frequencies), which also placed the system in the Excellent category.

Table 1. Summary of Large-Scale Trial Results (N = 30)		
Test Aspects	Average Score (Scale of 5)	Qualitative Categories
Navigation (Q-1 to Q-3)	4,6	Excellent
Ease of Use (Q-4 to Q-11)	4,5	Excellent
Information Display & Quality (P-12 s/d P-18)	4,6	Excellent
Overall Average	4,51	Excellent

DISCUSSION

The findings of this study demonstrate that the development of the Android-based online attendance prototype effectively addresses the core problems identified during the analysis stage. The initial needs analysis confirmed that the manual attendance process was not only inefficient but also susceptible to manipulation, particularly in signature-based attendance. The identification of priority features such as QR code scanning, digital lesson schedules, online permission submission, and real-time data access was directly aligned with the administrative challenges faced by homeroom teachers. These findings reinforce the importance of transitioning from manual procedures to technology-assisted mechanisms, consistent with studies that emphasize the role of digital automation in enhancing school administrative accuracy and efficiency (Sari et al., 2024)

The design stage further indicates that the separation of roles among Admin, Homeroom Teacher, and Student contributes significantly to strengthening system security and functional clarity. By placing data management responsibilities exclusively on the Admin, while limiting Students to attendance logging and permission submissions, the prototype ensures that access rights are appropriately tiered. This role-based structure aligns with standard software engineering principles regarding access control, which state that well-defined user roles reduce the risk of unauthorized modifications and improve data

integrity. The use case and activity diagrams illustrate a logically streamlined workflow, minimizing unnecessary steps and reducing opportunities for user-generated errors an important consideration in systems that require consistent daily usage.

The database schema designed using Firebase Cloud Firestore provides a scalable and reliable backend capable of supporting real-time synchronization, which was one of the main functional requirements identified during the analysis stage. The schema's segmentation into collections such as Users, Lesson Schedule, Attendance, and Permission Requests ensures efficient data retrieval, supports offline caching, and enables fast updates. These characteristics align with research asserting that cloud-based databases are essential for mobile applications that require low-latency responses and continuous availability (Wahyuni et al., 2025). The integration of Firestore thus positions the system as a more advanced alternative compared to traditional QR-based attendance systems that rely solely on local storage.

The development phase results further demonstrate the iterative nature of prototype refinement, a key principle of the ADDIE model. Feedback from homeroom teachers facilitated meaningful system improvements, including enhanced authentication feedback, strengthened password validation, and clearer separation of application interfaces for teachers and students. The addition of auto-fill functionality for permission submissions and logout confirmation mechanisms also reflects an emphasis on usability and error reduction. These revisions are consistent with usability engineering guidelines (ISO 9241-11), which highlight the importance of clarity, efficiency, and error prevention for high-frequency system interactions such as daily attendance logging (Widagdo, 2025).

Student response test results offer strong empirical support for the system's usability and acceptance. The small-scale trial provided an early indicator of system feasibility, with an average score of 4.33 falling in the Excellent category. This suggests that the prototype was intuitive even during initial exposure, supporting its readiness for broader testing. The large-scale trial reinforced this result with an overall average score of 4.51, also categorized as Excellent. Across three key dimensions Navigation, Ease of Use, and Information Display the system consistently received high ratings. These findings align with the Technology Acceptance Model (TAM), particularly the constructs of Perceived Ease of Use (PEOU) and Perceived Usefulness (PU), which suggest that intuitive navigation and efficient interaction processes increase user willingness to adopt new

technology (Rahmawati, 2025). The uniformly high evaluation across all aspects indicates that the system has successfully met the expectations of student users in terms of functionality and interface quality.

The strong usability scores also imply that the interface design effectively supports efficient action pathways, contributing to shortened attendance completion time and reducing cognitive load for users. With navigation receiving the highest score (4.6), it can be inferred that the prototype's interface design is clear, coherent, and consistent with standard Android user experience principles. The equally high score for information display suggests that visual clarity, layout arrangement, and information hierarchy are well-optimized, which is critical for school-based applications used across varying levels of digital literacy.

Overall, the discussion of these results demonstrates that the system prototype not only fulfills the functional requirements identified during the analysis stage but also achieves strong usability performance across user groups. The alignment between system design principles, usability evaluation outcomes, and user expectations reflects a successful development cycle under the ADDIE model. More importantly, these findings highlight the prototype's potential for broader implementation at SMA Negeri 1 Sungai Raya and its scalability for use in other educational institutions seeking efficient, secure, and user-friendly digital attendance solutions.

CONCLUSION

Based on the results and discussion, it can be concluded that the Android-based online attendance system prototype developed in this study has proven to be effective and feasible to support the teaching and learning process at SMA Negeri 1 Sungai Raya. The system was well received by both teachers and students, demonstrating high usability, functionality, and visual appeal, which indicates strong user acceptance and readiness for practical implementation. The scientific novelty contribution of this study lies in integrating QR code-based attendance with real-time cloud synchronization, enhancing transparency and reducing opportunities for data manipulation, a significant improvement over traditional manual systems. Practically, this innovation streamlines administrative processes, saves teachers' time, and increases accountability in attendance recording. For future research, it is recommended to conduct broader-scale testing involving multiple

schools and diverse educational settings to ensure generalizability of the results. Further development should focus on integrating the attendance system with existing school academic management platforms, such as Learning Management Systems (LMS) or Student Information Systems (SIS), to enable automated attendance reporting and analytics. Additionally, future studies could explore the implementation of data analytics and machine learning to identify attendance patterns, predict student behavior, and support data-driven decision-making in digital education environments.

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