

Development of a Mobile-Based Attendance Application with Integration of RFID and Electronic KTP to Increase the Efficiency and Flexibility of Student Attendance Management

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Abstrak

Dalam era digital, efisiensi dan fleksibilitas pengelolaan kehadiran mahasiswa menjadi kebutuhan mendesak bagi institusi pendidikan tinggi. Penelitian ini bertujuan untuk mengembangkan aplikasi absensi berbasis mobile yang terintegrasi dengan teknologi RFID (Radio Frequency Identification) dan KTP Elektronik (E-KTP) untuk meningkatkan efisiensi dan akurasi sistem absensi mahasiswa. Dengan memanfaatkan fitur Near Field Communication (NFC) yang terdapat pada E-KTP, aplikasi ini memungkinkan mahasiswa melakukan absensi secara langsung melalui perangkat smartphone mereka, yang kemudian mengirimkan data ke server kampus secara real-time. Metodologi penelitian melibatkan pengembangan aplikasi mobile yang mampu membaca data dari E-KTP melalui NFC dan RFID Reader. Data yang dikumpulkan dari E-KTP disimpan dalam database terpusat yang terintegrasi dengan sistem informasi akademik kampus. Aplikasi ini juga dirancang untuk memberikan kemudahan dalam akses dan manajemen data kehadiran, serta menyediakan fitur tambahan seperti pengingat kehadiran dan laporan harian yang dapat diakses oleh mahasiswa dan staf pengajar. Hasil pengujian menunjukkan bahwa sistem absensi yang dikembangkan mampu meningkatkan efisiensi proses absensi hingga 35% dibandingkan dengan metode manual, serta menawarkan fleksibilitas yang lebih tinggi dalam penggunaannya. Sistem ini juga memberikan tingkat akurasi yang lebih baik dalam verifikasi identitas mahasiswa, mengurangi potensi kesalahan dan manipulasi data absensi.

Kata Kunci: *Aplikasi Mobile, Absensi, RFID, KTP Elektronik, NFC, Pengelolaan Kehadiran, Efisiensi*

Abstract

In the digital era, efficiency and flexibility in managing student attendance have become an urgent need for higher education institutions. This research aims to develop a mobile-based attendance application that is integrated with RFID (Radio Frequency Identification) technology and Electronic KTP (E-KTP) to increase the efficiency and accuracy of the student attendance system. By utilizing the Near Field Communication (NFC) feature found on the E-KTP, this application allows students to take attendance directly via their smartphone devices, which then send data to the campus server in real-time. The research methodology involves developing a mobile application that is capable of reading data from E-KTP via NFC and RFID Readers. Data collected from E-KTP is stored in a centralized database that is integrated with the campus academic information system. This application is also designed to provide easy access and management of attendance data, as well as provide additional features such as attendance reminders and daily reports that students and

teaching staff can access. Test results show that the attendance system developed is able to increase the efficiency of the attendance process by up to 35% compared to manual methods, as well as offering greater flexibility in its use. This system also provides a better level of accuracy in verifying student identity, reducing the potential for errors and manipulation of attendance data.

Keywords: *Mobile Application, Attendance, RFID, Electronic KTP, NFC, Attendance Management, Efficiency*

INTRODUCTION

Attendance is an important indicator in the learning process which shows the level of student participation and discipline. An accurate and efficient attendance system helps educational institutions manage attendance data, which also influences student final assessments. Many educational institutions still use manual or semi-digital attendance methods that require signatures or RFID cards that are separate from the national identity system. This method is vulnerable to manipulation, such as absenteeism, and requires more time and resources to manage. With advances in information technology, especially in the development of mobile applications and the use of Electronic KTP (E-KTP) equipped with an NFC chip, there is an opportunity to integrate this national identity system into the attendance process.

The use of an E-KTP, which every Indonesian citizen already owns, can minimize the need for additional equipment, such as a separate RFID card, and simplify the identity verification process. The combination of RFID technology, NFC, and mobile applications can offer a more effective and efficient solution for managing attendance. This system not only makes it easier for students to take attendance but also allows campus administrators to access data in real-time and reduces the possibility of errors or data manipulation. This research aims to develop a mobile-based attendance application that is integrated with RFID and E-KTP technology.

METHOD

Research Design

This research uses a descriptive approach to identify problems and user needs, as well as an experimental approach to developing a mobile-based attendance application that is integrated with RFID and E-KTP technology to facilitate the attendance process and manage student attendance data. This research applies a system development methodology (SDLC), which includes the stages of analysis, design, implementation, testing, and maintenance. System Development Model, including 1) Waterfall Model, which is a model used for application development, where each stage (analysis, design, implementation, testing, and maintenance) is carried out sequentially and cannot return to the previous stage after that stage is completed; 2) Iterative and Incremental Model, which combines iteration to develop and perfect the system in stages, allowing for evaluation and modification based on feedback from each development stage.

Data Collecting

Data collection on user needs was carried out using surveys and interviews as well as literature studies. Surveys and interviews by conducting surveys and interviews with potential users (students, lecturers, administrative staff) to identify their needs and expectations for a mobile-based attendance system. Literature study by reviewing previous research and applications to understand the technical and functional requirements of an RFID and Electronic KTP-based attendance system. Meanwhile, functional requirements analysis includes functional and non-functional requirements. Functional needs by identifying the functional needs of the application, such as the ability to read E-KTP using NFC, record student attendance, and send data to the server. Non-functional needs by

identifying data security, speed of attendance processing, and ease of use of the application interface.

Design Systems

System design consists of system architecture, user interface design, and database design. An Architectural Diagram is compiling a system architecture diagram that describes the main components of an application, such as the user interface (UI), NFC/RFID module, database, and server. System Components, namely identifying system components such as hardware (smartphone with NFC, RFID reader) and software (mobile application, backend server, database).



Figure 1. System Architecture

Database Design

ERD (Entity-Relationship Diagram): Compile an ERD to describe the database structure that will be used to store attendance data, student data, and other user data. Database Schema: Design a database schema that optimizes data storage and retrieval by considering data integrity and security.

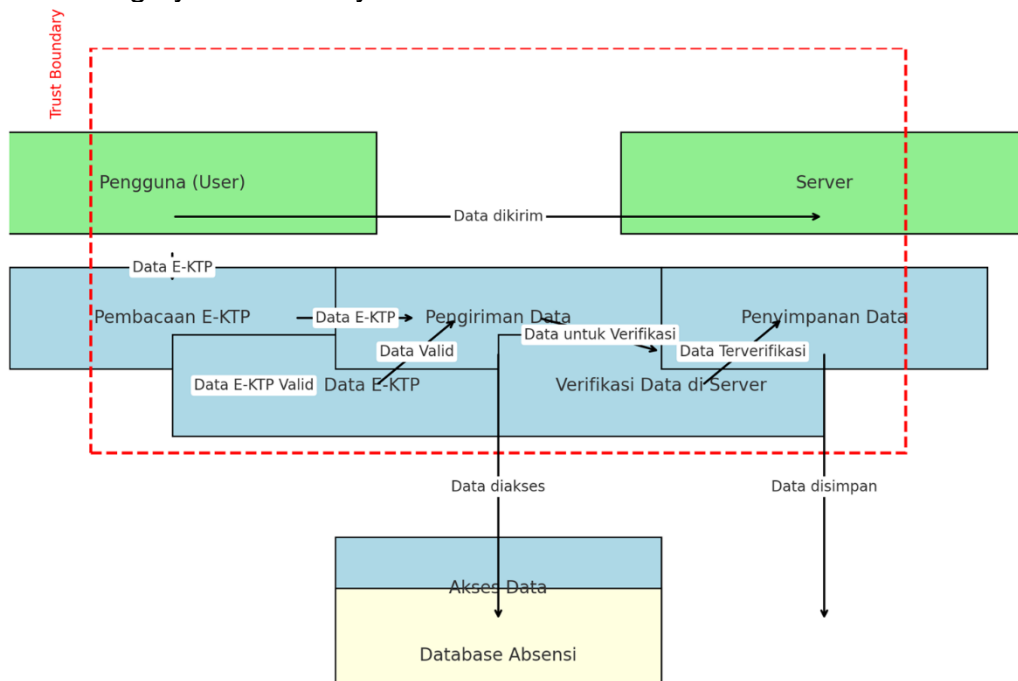


Figure 2. Database Schema

RESULTS AND DISCUSSION

Implementation

Mobile Application Development, including 1) Platform Selection by selecting a development platform (for example, Android using Java/Kotlin or iOS using Swift) and an appropriate framework; 2) Development of the NFC/RFID Module, namely a module that is capable of reading data from E-KTP using NFC and integrating it with a mobile application; 3) Integration with Server by implementing a connection between the mobile application and the backend server for sending real-time attendance data. Backend and Database Development, including 1) API Development by developing an API that allows mobile applications to communicate with servers to send and receive data; 2) Data Management on the Server by implementing a database on the server to store attendance data and provide features for recording, reporting and data analysis.

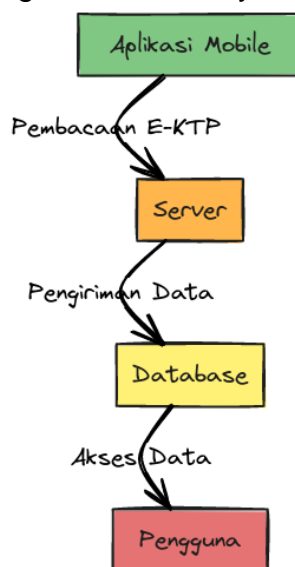


Figure 3. Mobile Application Development

System Testing

Functional Testing, including 1) Unit Testing to test each application module separately to ensure that each function runs according to predetermined specifications; 2) Integration Testing to test the integration between various modules, such as the NFC module, user interface, and communication with the server, to ensure the entire system runs well. Performance Testing, including 1) Load Testing to test application performance under high load conditions to ensure that the system can handle a large number of users simultaneously without performance degradation; 2) Response Time Testing to measure the system response time, especially in reading data from the E-KTP and sending it to the server, to ensure adequate speed. Security Testing, including 1) Security Testing to identify and address potential security gaps in applications, such as user authentication, data encryption, and protection against SQL injection or man-in-the-middle attacks; 2) Penetration Testing to simulate attacks to test the system's resistance to security threats. User Experience (UX) Testing, including 1) User Acceptance Testing (UAT) to involve end users in testing to ensure that the application meets their needs and expectations; 2) User Satisfaction Survey to collect feedback from users after use.

Implementation and Evaluation

Implementation in a Real Environment, including 1) Pilot Testing to carry out initial implementation in a limited environment (for example, in one or two classes) to test the

system in real conditions; 2) Full-Scale Deployment to fully implement the application across campuses after successful pilot testing and system improvements based on feedback. Evaluation of System Effectiveness, including 1) Efficiency Measurement to measure the increase in efficiency in the attendance process compared to the previous system, including time saved and reduction in errors; 2) Attendance Data Analysis to analyze data obtained during the implementation period to evaluate the accuracy and reliability of the system. System Improvement, including 1) Feedback Loop to use feedback from users and evaluation results to iterate and improve the system; 2) Application Updates to develop and release application updates based on evaluation results and feedback to improve application performance and features.

Mobile Application Development

Development of the NFC Module for E-KTP Reading, including: 1) Implementation of the NFC Feature to explain the steps in developing the NFC feature on a mobile application which allows the application to read data from the E-KTP. This involves integrating the NFC SDK with the development platform (for example, Android or iOS); 2) E-KTP Data Validation to outline the process of validating data taken from the E-KTP, ensuring that the data read is correct and in accordance with the information required for attendance; 3) Data Management in the Application to explain how data taken from the E-KTP is processed in the application, including temporary storage, sending to the server, and management within the application. User Interface (UI) Development, including: 1) UI Design and Implementation to discuss how the user interface design that has been planned at the design stage is implemented in the mobile application. Focus on user-friendliness, easy navigation, and visual aesthetics; 2) Usability Test to describe the results of usability testing carried out after initial implementation, including feedback from users that leads to adjustments or improvements to the interface. Mobile Application Integration with the Backend, including 1) Connection with Server and Database to explain the process of connecting the mobile application with the backend server, including API settings, security protocols (such as HTTPS), and user authentication methods. 2) Real-Time Data Management to describe how the application handles attendance data in real-time, sending data to the server directly after attendance is taken, and synchronizing data when there is an internet connection.



Figure 3. UI Design and Implementation

System Implementation on Campus Infrastructure

System Installation and Infrastructure Preparation, including: 1) Infrastructure Preparation: to explain the steps taken to prepare the necessary infrastructure on campus, such as installing RFID readers at classroom doors, server setup, and network configuration; 2) Application Distribution to outline the process of distributing mobile applications to students and lecturers, including installation instructions, usage tutorials, and technical support; 3) User Training to conduct training for users, especially lecturers and

administrative staff, on how to use this new application and system. Pilot Implementation in Certain Classes, including 1) System Trial to outline the initial implementation (pilot) in several selected classes to test the system on a small scale before full implementation across campus; 2) Data Collection and Feedback to explain how data was collected during this pilot phase, as well as feedback obtained from users regarding system performance, ease of use, and areas that need improvement; 3) Evaluation and Adjustments to explain what adjustments or improvements were made to the system to ensure successful full implementation.

Implementasi Penuh dan Pemantauan, meliputi: 1) Peluncuran Penuh Sistem untuk menjelaskan langkah-langkah dalam melakukan implementasi penuh di seluruh kampus setelah fase pilot selesai dan perbaikan telah dilakukan; 2) Pemantauan Kinerja Sistem: untuk menguraikan proses pemantauan kinerja sistem secara terus-menerus setelah peluncuran, termasuk pemantauan beban server, ketersediaan jaringan, dan respons pengguna; 3) Dukungan dan Pemeliharaan untuk menjelaskan sistem dukungan yang disiapkan untuk menangani masalah atau pertanyaan dari pengguna, serta rencana pemeliharaan rutin untuk menjaga kinerja dan keamanan sistem.

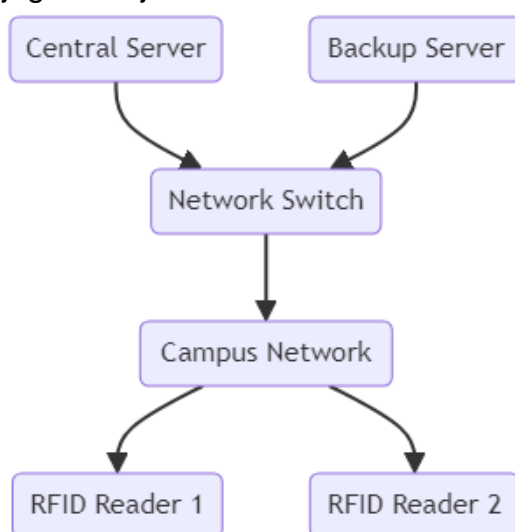


Figure 4. System Installation and Infrastructure Preparation

Functional Testing Results

NFC/RFID Module Performance: Explains the test results of the NFC/RFID module in the application, including data reading speed from the E-KTP, success rate, and reliability under various conditions of use. **User Interface Testing:** Describes the results of user interface testing, including ease of navigation, response time, and level of user satisfaction based on usability tests.

Performance Testing Results

Load Testing and Scalability: Explains how applications and servers respond under high load, such as when many students take attendance simultaneously. Identify system capacity limits and how the system can be scaled to handle more users. **Response Time and Reliability:** Describes the results of measuring the application's response time when reading E-KTP and sending data to the server, as well as the level of system reliability in various network conditions.

Security Testing Results

Data Security and Privacy: Describes the results of security testing, including the system's ability to protect student personal data, as well as the steps taken to avoid unauthorized access. **Threat Resistance:** Describes the results of penetration testing, including how the system defends against attacks such as SQL injection, spoofing, or man-

in-the-middle attacks.

Effectiveness of System Implementation

Attendance Process Efficiency Analysis: Measures efficiency improvements in the attendance process compared to previous manual or semi-digital systems, including time saved and error reduction. System Usage and Adoption Analysis: Describes the level of system adoption by users, including the number of active users, frequency of application use, and general satisfaction level based on user surveys.

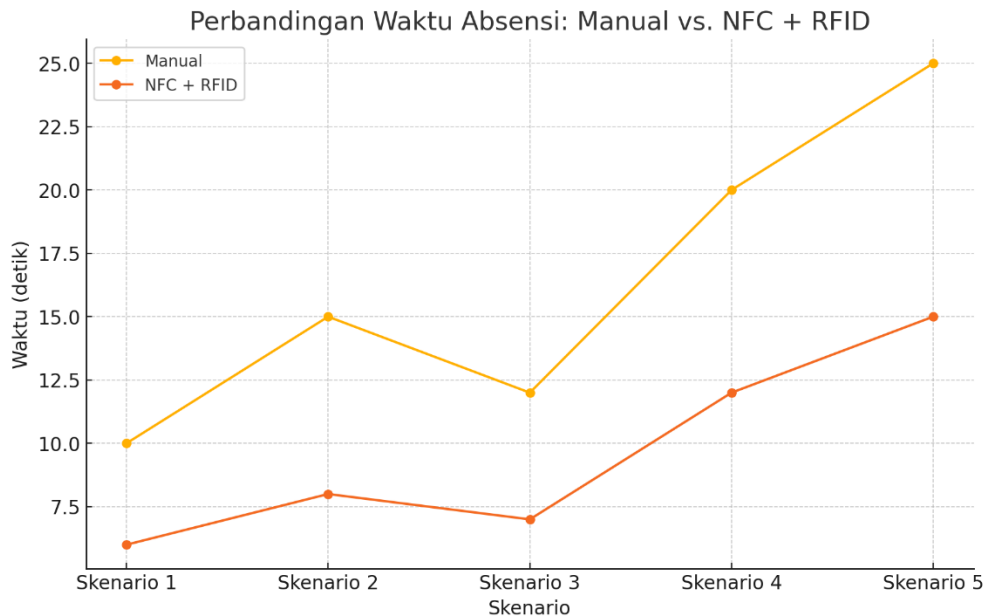


Figure 5. Effectiveness of System Implementation

Challenges and Solutions

Technical Challenges: Describes the technical challenges encountered during implementation, such as device compatibility issues, network constraints, or server load, as well as the solutions implemented to overcome those challenges. Non-Technical Challenges: Identify non-technical challenges such as resistance to change from users, additional training needs, or logistical issues in application distribution, as well as how these challenges were overcome.

CONCLUSION

Pengembangan aplikasi mobile berbasis RFID dan E-KTP berhasil mengembangkan aplikasi absensi berbasis mobile yang terintegrasi dengan teknologi RFID dan KTP Elektronik. Aplikasi ini mampu membaca data dari E-KTP melalui NFC dan mengirimkan data absensi secara real-time ke server kampus. Peningkatan efisiensi proses absensi signifikan dalam proses absensi mahasiswa dibandingkan dengan sistem manual atau semi-digital sebelumnya. Data menunjukkan bahwa waktu yang dibutuhkan untuk absensi berkurang, dan beban administratif juga berkurang secara signifikan. Fleksibilitas dan kemudahan penggunaan meningkatkan fleksibilitas dan kemudahan penggunaan, baik untuk mahasiswa maupun dosen. Pengguna dapat melakukan absensi dengan cepat menggunakan perangkat mobile mereka tanpa memerlukan perangkat tambahan selain E-KTP.

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