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CloudPresence: An Innovative Mobile-Based Teacher Attendance Information System with Firebase Integration

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Abstract: In a dynamic digital era, the efficiency of education management is crucial. This research presents "CloudPresence," an innovative mobile-based teacher attendance information system that integrates Firebase cloud storage technology and location-based attendance features for SMKN 1 Jatiroto. This system is designed to overcome the limitations of conventional attendance systems, improve accuracy, and ensure the physical presence of teachers at school. The methodology includes requirements analysis, system design with UML, and implementation using mobile technology, Firebase, and location services. Results show significant improvements in attendance accuracy, data management efficiency, and attendance process integrity through location verification. The system offers a comprehensive solution with enhanced data security and real-time accessibility. In conclusion, CloudPresence has the potential to transform school management, drive administrative efficiency, and increase accountability in the education system at SMKN 1 Jatiroto.

Keywords: Information System; Teacher Attendance; Firebase; Cloud Storage; Mobile Application; Location-Based Attendance; School Management.

1. Introduction

The advent of the digital era has led to a gradual recognition of the role of efficient education management in improving learning outcomes and school performance. With the increasing demand for making administrative processes more efficient, educational institutions have started adopting technology to streamline their operations more efficiently. Teacher attendance is one of the major challenges faced by any school today. Proper attendance management not only helps in maintaining consistent records; it is also essential in ensuring accountability and transparency of operations in schools. One such institution that struggles with this is SMKN 1 Jatiroto and many others that are ineffective and error-prone. Moreover, the traditional way of recording attendance that is widely used in schools is often lengthy and error-prone, resulting in problems in verifying that teachers are physically present in schools. There has never been a more pressing need for an automated, reliable, and scalable solution.

Patta & Suhartono (2019) argue that a web-based attendance information system can improve school management [1]. Their study shows that such systems serve to reduce time spent on administrative tasks, reduce human errors, and offer real-time data to improve decision-making processes. However, while cloud-based systems demonstrate all these reported benefits, they still suffer from shortcomings, namely accessibility, mobility, and instant verification. As the world continues to rely on mobile technology, there is a significant opportunity to address these limitations with advanced mobile-based solutions, which provide flexibility, mobility, and accuracy; solutions that make a difference and improve the quality of life. In the educational space, such functionality also proves to be important as physical attendance verification can play a significant role in holding each teacher accountable. Firebase is a robust mobile development platform from Google—on a large infrastructure scale. Firebase is tailored to support mobile apps, meaning developers can build high-performance real-time apps [2]. Its key features include cloud storage, real-time databases, and efficient security mechanisms, making it an appropriate solution for applications that require quick data processing and high availability. Its ability to seamlessly mesh with location based services also makes it an even more suitable candidate for a solution for the challenges of verifying that teachers are in attendance. While traditional systems tend to be inefficient, the combination of Firebase and location-based features can facilitate a mobile-based solution to solve this problem. One of the major benefits of these location-based attendance features is the possibility of real-time validation of the teacher's physical presence at the school. Indeed, with this capability, attendance will only be recorded if the attendance takes place and the teacher is actually present at the specified location, which improves the data quality and eliminates the possibility of attendance reporting fraud. Also, the real-time nature of the system both provides immediate attendance data and enables school administrators to monitor teacher performance and optimize administrative workflows.

This study proposed "CloudPresence", a Teacher Attendance Information System based on Mobile application used to solve the teacher attendance management in SMKN 1 Jatiroto. Combining Firebase cloud storage technology and location services, CloudPresence provides a powerful solution that can improve attendance accuracy and efficiency. Since there is no manual data entry in taking attendance, missing data can be eliminated with the help of CloudPresence compared to traditional methods of attendance taking, where this information is entered manually. To further improve interaction, TeacherIn integrates chat rooms for real-time discussions between teachers and administrators to better cooperate and address attendance issues as they arise. The core feature of CloudPresence is its GPS technology which verifies the location of teachers. A geofencing system ensures that teachers are at the school before attendance is marked. The accuracy of the attendance data is further enhanced by this functionality, improving the integrity of the attendance process by ensuring that the data is trustworthy and verifiable. Because all the logs of attendance are securely stored on the cloud using firebase cloud storage, all admins can have the access and real-time checks of the records which can further be used for decision making and reporting.

CloudPresence can switch the method of managing teacher attendance for schools. The proposed system serves as a solution for a comprehensive system by integrating advanced mobile technologies with cloud storage and location-based features to address the existing problem SMKN 1 Jatiroto and educational institutions. Additionally, The system helps the administrators and faculty keep track of the students attendance, punishment and attendance reports without the need of keeping a track of paper sheets. These results help fill the knowledge gap regarding the application of mobile-based solutions in education management, and provide a concrete case for the implementation of such systems in other schools.

2. Research Method

This research adopts a modified Design Science Research Methodology (DSRM) approach, focusing on the development and evaluation of technological solutions to specific organizational problems. The research method includes problem identification through interviews with SMKN 1 Jatiroto stakeholders, objective definition of solutions based on needs analysis, and system design using the Unified Modeling Language (UML). Application development was carried out with a focus on the Android platform and Firebase integration for data management and authentication. The location-based attendance feature was implemented using the Android location API and geofencing to limit the attendance area. System evaluation was conducted through functional and non-functional testing, as well as collecting feedback from users through surveys and interviews.
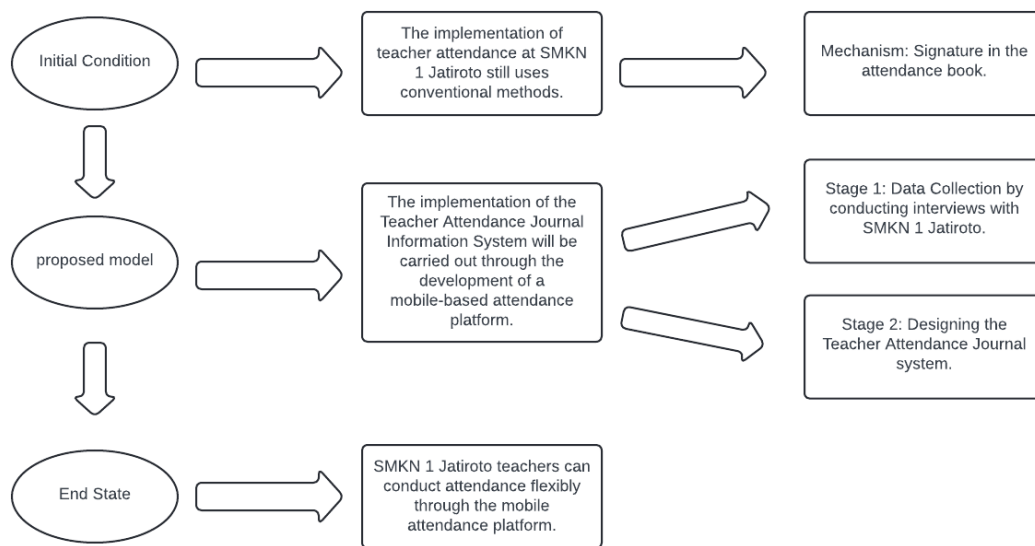

Figure 1. Research Framework for Mobile-Based Teacher Attendance Journal Information System

The figure above shows the research framework for the development of a mobile-based Teacher Attendance Journal Information System at SMKN 1 Jatiroto. This framework illustrates the transformation from the conventional attendance method (signature in the book) to a mobile-based digital system. This process involves data collection through interviews and system design, with the ultimate goal of enabling teachers to take attendance flexibly through a mobile platform.

3. Result and Discussion

3.1 Results

CloudPresence has been successfully implemented as an Android mobile application with Firebase integration for SMKN 1 Jatiroto. The system includes an integrated attendance feature with real-time synchronization using Firebase Cloud Firestore, allowing teachers to check-in and check-out via their mobile devices. Key features include the ability for users to view personal attendance history with filter options for today, last 7 days, and last 30 days, using optimized Firebase queries. A key innovation is the implementation of a location-based attendance feature, which ensures that teachers can only take attendance when within range of the school location, improving the accuracy and integrity of the attendance process. The application is also equipped with a chat room feature that utilizes Firebase Realtime Database, facilitating communication between teachers. System security is guaranteed through Firebase authentication with end-to-end encryption and role-based access management.

3.1.1 Program Implementation

The CloudPresence implementation involves Android application development using Kotlin and Android Studio, with Firebase SDK integration for data management and authentication. The application architecture adopts the Model-View-ViewModel (MVVM) pattern to improve maintainability and testability. Key features

include an integrated attendance system using Firebase Cloud Firestore for real-time synchronization, a chat room feature with Firebase Realtime Database, and location-based attendance using Android's Geofencing API. System security is guaranteed through Firebase authentication with end-to-end encryption and role-based access management, ensuring user data integrity and privacy.
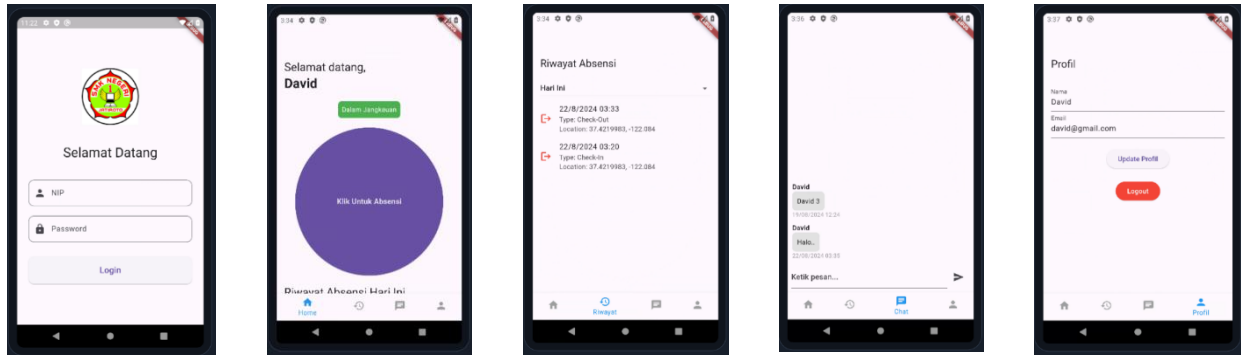

Figure 2. System Interface of the Mobile-Based Teacher Attendance Information System

3.1.2 Testing

Testing of the CloudPresence system was conducted through a series of functional tests covering all the main features of the application. Table 1 summarizes the test results, showing that all application functions are successfully implemented and run as expected. Tests included login verification, location-based attendance functionality, management of attendance history with various time filters, user profile management, and chat features between teachers. All of these components performed satisfactorily in testing, with "Accepted" results for each function tested.

Table 1. Application Function Testing

Function	Expected	Observation	Result
Login (Valid)	Access granted	User authenticated	Accepted
Login (Invalid)	Access denied	Error displayed	Accepted
Location Indicator	Show status	Status correct	Accepted
Attendance Button	Record attendance	Recorded successfully	Accepted
History (Today)	Show today's record	Displayed accurately	Accepted
History (7 Days)	Show 7-day records	Displayed correctly	Accepted
History (30 Days)	Show 30-day records	Displayed correctly	Accepted
View Profile	Display info	Info shown	Accepted
Update Profile	Save changes	Changes saved	Accepted
Logout	Return to login	Logged out	Accepted
Chat Access	Load interface	Interface loaded	Accepted
Send Message	Display sent message	Message shown	Accepted
Receive Message	Show incoming message	Message received	Accepted
Chat History	Load past messages	History loaded	Accepted

Table 2. Application Testing on Various Smartphones

Smartphone	Specifications	Remarks
Google Pixel 5	RAM 8GB, Android 12, Snapdragon 765G	Passed
Xiaomi Redmi Note 5	RAM 4GB, Android 9, Snapdragon 636	Passed
Samsung A05	RAM 4GB, Android 13, Exynos 850	Passed
IDX Emulator (Pixel 4)	RAM 6GB, Android 11, Snapdragon 855	Passed

3.2 Discussion

The implementation of CloudPresence at SMKN 1 Jatiroto has demonstrated significant improvements in the efficiency of teacher attendance management. One of the key innovations, the location-based attendance feature, has proven highly effective in ensuring teachers' physical presence at the school, thus improving the accuracy and integrity of attendance data. By utilizing geofencing technology, the system ensures that attendance is only recorded when the teacher is physically within the designated school premises, thereby eliminating fraudulent attendance and minimizing errors associated with manual systems. This feature significantly enhances the reliability of attendance data, ensuring that records are accurate and trustworthy.

Another important feature of CloudPresence is the ability to view attendance history with flexible time filters. This provides transparency and facilitates efficient monitoring of attendance by both teachers and school administrators. The ability to track attendance patterns and generate reports based on specific time periods allows administrators to have a more dynamic and detailed overview of teacher attendance, promoting better decision-making and accountability. The integrated chat feature in CloudPresence has also been a significant addition, providing a digital communication platform that supports collaboration among teachers. This feature aligns with the findings of Verma *et al*. (2020), who emphasize the importance of digital collaboration in improving performance within educational [10]. By enabling real-time communication, the chat feature fosters a collaborative environment, which enhances problem-solving and information sharing among teachers and school staff.

However, the implementation process was not without its challenges. One of the primary obstacles was the user adaptation to the new system, particularly as many teachers and administrators were unfamiliar with the mobile-based platform. To address this, ongoing training sessions and technical support were provided, helping users become more comfortable with the system. The adaptation process, while initially slow, improved as teachers became more familiar with the system's features. Furthermore, another challenge encountered during implementation was optimizing the application's performance in areas with inconsistent or low network connectivity. This issue was particularly relevant in remote areas where internet access is limited. However, through continuous testing and improvements, the performance of the application was optimized, ensuring that it operates smoothly even in low-bandwidth environments.

These challenges highlight the importance of thorough training and ongoing support when implementing new technological solutions in educational institutions. Despite the initial obstacles, the system's successful deployment and its subsequent positive impact on attendance management demonstrate the effectiveness of mobile-based solutions in modernizing educational administration. CloudPresence has proven to be an effective tool in improving teacher attendance management at SMKN 1 Jatiroto. The system's ability to provide accurate and real-time attendance data, along with features like location-based verification and digital communication, has resulted in improved accountability, transparency, and collaboration. The research aligns with previous findings on the benefits of digital tools in education (Verma *et al*., 2020), demonstrating the potential for similar systems to revolutionize attendance management in other schools [10]. Although challenges were encountered, they were successfully addressed through training and optimization, making CloudPresence a promising solution for other educational institutions seeking to improve administrative efficiency and accountability.

4. Related Work

Several studies have explored the development of digital attendance systems in educational institutions, addressing various aspects such as mobility, real-time data management, and the use of advanced technologies. These studies have provided valuable insights, each contributing to the evolution of attendance systems in education. Saputra *et al*. (2023) developed a web-based student attendance system using the Extreme Programming (XP) method. Their study emphasized the effectiveness of the agile development process, particularly in its ability to adapt to changing requirements. By using XP, the system was continuously refined, allowing for greater flexibility in responding to user needs and improving the overall functionality of the attendance system [3]. Christina *et al*. (2019) focused on an Android-based student attendance application, highlighting the importance of mobility in modern attendance systems. Their research demonstrated how mobile platforms can provide real-time tracking, which improves accessibility and efficiency. This is a significant step beyond traditional methods, offering the ability to update and monitor attendance on-the-go [4]. Rahayu *et al*. (2019) developed a web-based attendance system for staff and teachers, addressing the need for an integrated solution that can accommodate multiple roles within an educational institution. By incorporating staff and teacher categories into a single system, the study aimed to improve administrative management and reduce the complexity of handling attendance across different staff groups [6].

In contrast, Nurhadi (2019) explored the integration of Android and web platforms in an attendance system. This multi-platform approach allowed seamless synchronization of data across devices, ensuring real-time updates and consistent information, which enhanced both user experience and system reliability [7]. Moroney *et al*. (2017) explored Firebase for Android app development, focusing on its strengths in real-time data management and secure authentication. The authors highlighted Firebase's capability to handle large volumes of data efficiently while ensuring high security, making it an ideal platform for developing attendance management systems that require robust real-time data synchronization [9]. Verma *et al*. (2020) examined

the impact of mobile learning on student engagement and performance, demonstrating how mobile applications can enhance both educational experiences and administrative tasks, including attendance management. Their study pointed to the growing significance of mobile technology in modern educational environments, suggesting that it could increase both engagement and operational efficiency [10]. Putri *et al*. (2023) incorporated biometric technology into school attendance systems, aiming to address the issues of proxy attendance and improve identity verification. This study introduced an advanced level of security, which ensured that attendance could only be marked by the registered individual, thus improving data accuracy [11].

Kumar *et al*. (2022) explored the use of blockchain technology in education management systems, demonstrating how blockchain can improve data security and integrity by making attendance records tamper-proof. This ensures transparency and trust in the management of sensitive educational data, offering a higher level of security than conventional systems [12]. The AttendEase system also exemplifies the trend of utilizing mobile platforms for attendance tracking in educational settings. By incorporating mobile technologies, it simplifies the attendance process, offering an efficient solution for both teachers and students [14]. One key area where location-based features in attendance systems have proven valuable is in verifying the teacher's presence. This is particularly relevant in preventing proxy attendance. Systems like CloudPresence use location-based tracking to ensure that attendance is marked only when the teacher is physically present, offering a more secure and accurate solution compared to traditional methods. Research by Dixit (2023) found that location-based features not only improve security but also ensure compliance with institutional attendance policies [19][9]. In addition, the use of machine learning and cloud computing in attendance management has shown promise in optimizing data processing and identifying trends. CloudPresence, for instance, aims to provide more than just automated attendance tracking. By leveraging cloud computing, it offers valuable insights into attendance patterns, helping schools make informed decisions based on real-time data analysis [16].

While previous studies have focused on various aspects of attendance management—such as mobile platforms, real-time data processing, and security features—none have integrated Firebase with location-based attendance features specifically for teacher attendance management. This research distinguishes itself by combining these two technologies to address both the efficiency of attendance tracking and the need for physical verification of teacher presence. Unlike other systems that rely on either mobile platforms or web-based solutions, CloudPresence integrates both location verification and real-time data synchronization through Firebase, offering a more secure and accurate solution. While systems like those developed by Saputra *et al*. (2023) and Christina *et al*. (2019) focus on student attendance, this research specifically targets teacher attendance, an area where verifying physical presence is crucial for accountability [3][4]. Additionally, the integration of Firebase and location-based features provides CloudPresence with a level of accuracy and security that is not present in other systems that only focus on mobile or web technologies without location verification [20]. This study aims to fill a gap in the existing research by offering a solution that not only improves attendance management efficiency but also addresses the challenge of verifying teacher presence through location tracking. The use of Firebase for real-time data processing and location-based features makes CloudPresence a unique solution in the landscape of digital attendance systems.

5. Conclusion and Recommendations

CloudPresence has successfully transformed the teacher attendance system at SMKN 1 Jatiroto from conventional methods to an efficient and accurate digital platform. The integration of Firebase technology with location-based attendance features and real-time communication has improved not only the accuracy of attendance recording but also collaboration among teachers. This system demonstrates how mobile technology and cloud computing can effectively address administrative challenges in educational environments. The enhanced efficiency, accuracy, and transparency in attendance management have the potential to positively impact the overall quality of education. For future development, it is recommended to integrate the system with existing digital learning platforms and implement predictive data analysis to further optimize educational resource management. The successful implementation of CloudPresence at SMKN 1 Jatiroto opens up opportunities for the adoption of similar systems in other educational institutions, with customization according to the specific needs of each institution.

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