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Design of a Mobile-Based Attendance System Integrated with Android-Based Geolocator

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ABSTRACT

The development of information technology has significantly impacted various aspects of life, including employee attendance administration. This study aims to design a mobile-based attendance system integrated with geolocation on Android devices to enhance the efficiency and accuracy of attendance recording. The system utilizes geolocation technology to validate user locations in real-time, reduce data manipulation, and improve employee accountability. The system was developed using the System Development Life Cycle (SDLC) approach with the Waterfall model, which includes analysis, design, implementation, and testing using the Black-box method. Testing results indicate that all features such as login, attendance recording, profile management, employee addition, and location validation function as specified. The implementation of this system offers a modern solution for more transparent and effective attendance management. These findings are expected to serve as a reference for organizations seeking to adopt reliable digital attendance systems aligned with the demands of the information technology era. Future research is recommended to develop additional features such as facial recognition or integration with performance management systems.

Keywords : *Mobile-based attendance system; geolocation integration; real-time location validation*

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1. INTRODUCTION

The development of information and communication technology has brought significant changes to various aspects of human life. In today's digital era, nearly all sectors are required to adapt to technological advancements to improve efficiency, effectiveness, and transparency. Technology has become an integral part of human activities, encompassing various fields such as politics, social affairs, economics, government, and education (Setiawan et al., 2021).

One of the key applications of technology in the professional world is the attendance system. This system functions to record and manage employee attendance in a systematic manner. Regular employee attendance is an indicator of discipline and work responsibility; therefore, accurate attendance tracking is essential in human resource management. Companies thus require a system that enables employees to record their attendance quickly and accurately while generating precise and secure data recaps without relying on traditional manual methods (Pertiwi et al., 2023)

However, many institutions still rely on manual attendance methods, such as signing paper sheets or conventional attendance lists. These conventional systems are increasingly seen as inadequate due to their various shortcomings, including vulnerability to recording errors, data manipulation, delays in information processing, and lack of accuracy in recording attendance time and location (Ayu et al., 2019).

Moreover, manual attendance systems often open opportunities for fraudulent practices, such as proxy attendance or manipulation of check-in and check-out times. This not only reflects a lack of integrity but also undermines employee morale and the sense of fairness. The data recap process also becomes slow and non-real-time, making it difficult for management to generate attendance reports or conduct accurate performance evaluations. The lack of integration between attendance systems and human resource management systems (HRMS) further exacerbates the situation, as attendance data cannot be immediately utilized in decision-making processes.

With the advancement of mobile technology, more modern and efficient solutions are now available, one of which is a location-based attendance information system. This technology integrates mobile devices and internet connectivity to detect and record users' locations in real-time during attendance. As a result, the system can record attendance more accurately, minimize the potential for fraud, and ensure that attendance is conducted at predetermined locations (Bachtiar et al., 2025).

(Fitri Ayu et al., 2019) developed an Android-based barcode scanner attendance system to address the shortcomings of manual systems. However, their system did not include a real-time user location validation feature, which still left room for fraudulent practices such as proxy scanning. Additionally, the system lacked support for dynamic monitoring of attendance locations. Therefore, this study aims to develop a mobile-based attendance system with geolocation integration that can accurately record attendance based on the user's actual location.

The purpose of this study is to design and develop a mobile-based attendance system with integrated geolocation features. This system will be specifically developed for Android devices, considering the high adoption rate of this platform among users. It is designed to record attendance in real-time by validating the user's location, thereby supporting discipline and work responsibility. It is hoped that this research will provide an innovative solution for government agencies and other organizations in need of an accurate and efficient attendance system that meets the demands of the digital era.

2. LITERATURE REVIEW

2.1. Attendance

Attendance is a record of the presence of a group of individuals who are officially part of an organization, institution, or entity and are subject to its rules, regulations, and restrictions. Those involved are bound by these rules (Pertiwi et al., 2023). Attendance systems are designed and managed in a way that allows those who need the data to easily access and utilize it as necessary (Rissa et al., 2024).

Attendance systems can be categorized based on their method of use and level of effectiveness. Generally, attendance systems are divided into two main categories (Vergiawan et al., 2024).

1. Manual Time Recording

Manual time recording is a traditional method of attendance tracking, in which individuals manually sign an attendance sheet or record their presence by hand. This method has been widely used in various institutions, especially before the advent of digitalization (Arifin et al., 2021).

Although simple and easy to implement, this method has several disadvantages, including vulnerability to data manipulation (such as proxy attendance), delays in information processing, and recording errors due to human negligence (human error). Additionally, data recapitulation takes considerable time as it must be done manually. In large-scale organizations, this system is no longer considered efficient and cannot support the real-time and integrated management of attendance data.

2. Non-Manual Time Recording

Non-manual time recording is a modern method of attendance tracking that utilizes computer-based or electronic devices. This method incorporates various technologies such as access cards (RFID), barcode or QR code scanners, fingerprint scanners, facial recognition, and the use of specific identification codes for attendance. These technologies are designed to record attendance data automatically, accurately, and in real-time.

Unlike manual methods, this system offers higher security and efficiency due to minimal human intervention and resistance to manipulation. Moreover, attendance data can be directly integrated with human resource management systems (HRMS) for reporting, performance evaluation, and even automated payroll processing. This has a direct impact on productivity improvement and the accuracy of data, which is crucial in HR management, as each attendance record can serve as a basis for more precise and objective decision-making. Therefore, non-manual time recording is a relevant solution for organizations that demand accuracy, efficiency, and transparency in managing attendance data.

2.2. System Requirements

The developed attendance system requires support from both hardware and software to enable mobile and real-time attendance processing. This application is specifically designed for Android

devices, with key features including geolocation-based attendance recording, user authentication, and secure and fast data storage in a cloud database.

The application acts as a bridge between users and service providers. As an integrated software system, it supports various activities involving two parties: the service provider and the user (Suryana et al., 2024). Therefore, the system must meet the functional requirements of both parties, be compatible with mobile devices, and be easy to use.

To operate optimally, the system must meet both functional and non-functional requirements, with an intuitive and user-friendly interface. Below is a detailed description of the system requirements:

1. Hardware

a. Android

Android is an operating system for mobile devices that includes the OS, middleware, and applications. The Android SDK provides features and APIs needed to begin developing applications on the Android platform using the Java programming language (Faisal 2021). Developed by the Open Handset Alliance, Android introduces innovation through internet integration and open-source accessibility for mobile devices. Android offers a complete software suite for mobile apps: operating system, middleware, and core applications. The device used for testing this application runs Android 10 with a MediaTek G25 processor and 3GB of RAM.

2. Software

a. Geolocator

Geolocation is the process of identifying a device's geographical position using various methods. In the context of application development, JavaScript enables the retrieval of the device's current position and distance calculation based on latitude and longitude coordinates. This helps minimize the potential for fraud in the attendance process (Romadhon et al., 2025). The version used is 12.0.0.

b. Visual Studio Code

Visual Studio Code is one of the most effective and popular Integrated Development Environments (IDEs) among developers. It offers various features that facilitate the development of mobile applications. By learning to use Visual Studio Code, beginners can easily and efficiently develop mobile apps (Fadzli et al., 2025). The version used is 1.101.0.

c. Dart

Dart is a C-style syntax programming language developed by Google, used to build various types of applications including mobile, desktop, backend, and web. Dart shares similarities with programming languages such as C, C#, Python, Java, and JavaScript (Sitanggang et al., 2024). The version used is 3.6.0-334.3.

d. Flutter

Flutter is a portable UI toolkit developed by Google to build beautiful, natively compiled applications for mobile, web, and desktop from a single codebase (Putra et al., 2025). Flutter is used to develop mobile applications using the Dart programming language for both Android and iOS platforms. It aims to simplify and accelerate mobile app development by allowing developers to build applications that run on both platforms without needing to learn two separate programming languages (Rohayatiningsih, 2024). The version used is 3.27.0-0.1.

e. Firebase

Firebase is an API provided by Google used to store and synchronize data and information for Android, iOS, and web-based applications. It includes a feature called Firebase Realtime Database, which functions as a tool for storing data and enabling faster and more secure data retrieval (Hasibuan et al., 2022).

3. METHOD

The method applied in developing this application system uses the SDLC (System Development Life Cycle) approach with the waterfall model. The waterfall method is a software development model that provides a sequential or ordered approach to the software lifecycle, starting from analysis, coding, testing, and support (Shofi et al., 2021).

The stages of the waterfall method are outlined as follows:

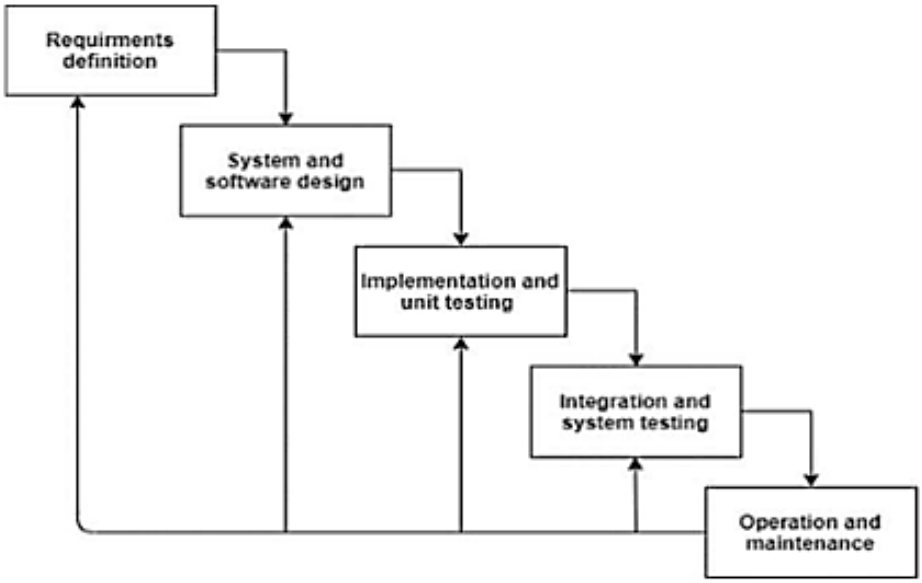

Figure 1. Method waterfall (Dhelo et al., 2025)

3.1. Analysis

The requirements gathering process is carried out intensively to specify the software needs, ensuring a clear understanding of the type of software required by the user. These software requirement specifications must be documented. System requirement analysis is essential to comprehend the foundation of the program to be developed, the scope of information, and the necessary functionalities. Therefore, an analysis of the online attendance management system's requirements is needed.

3.2. Design

At this stage, the design is implemented into a software program. The new system is developed as an Android-based application, utilizing Firebase as a storage solution for attendance history data.

3.3. Testing

The program testing is conducted using the Black-box method to ensure the outcomes align with the initial design expectations. Black-box testing of the application provides insights into the conformity of the program's performance with the intended design.

4. RESULTS AND DISCUSSION

From the analysis of the system created based on the identified needs, the implementation of the student attendance application integrated with a geolocator on the Android platform is as follows:

4.1 Flowchart

A flowchart is a diagram using specific symbols that illustrates the sequence of processes in detail and the relationships between processes within a program.

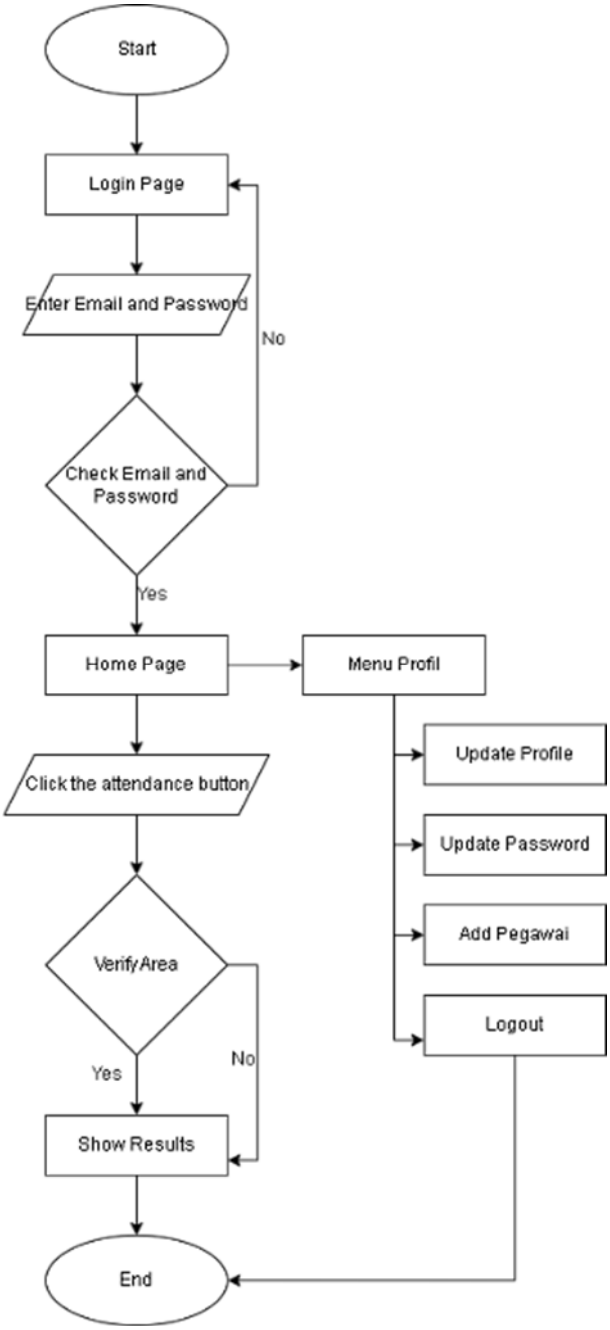

Figure 2. Application Flowchart

In Figure 2, the flowchart shows that when a user logs in through the application, the process proceeds to the Home menu. In the Home menu layout, the user has full access to all available menu sections. This includes functions such as user, period, class, attendance, grades, and student data. Full access rights are granted to the user.

4.2 Activity Diagram

An Activity Diagram is a diagram that illustrates the step-by-step workflow of a system component's functionality. At the business modeling stage, an activity diagram can be used to demonstrate the business workflow and can also describe the flow of events (Pernando, 2021).

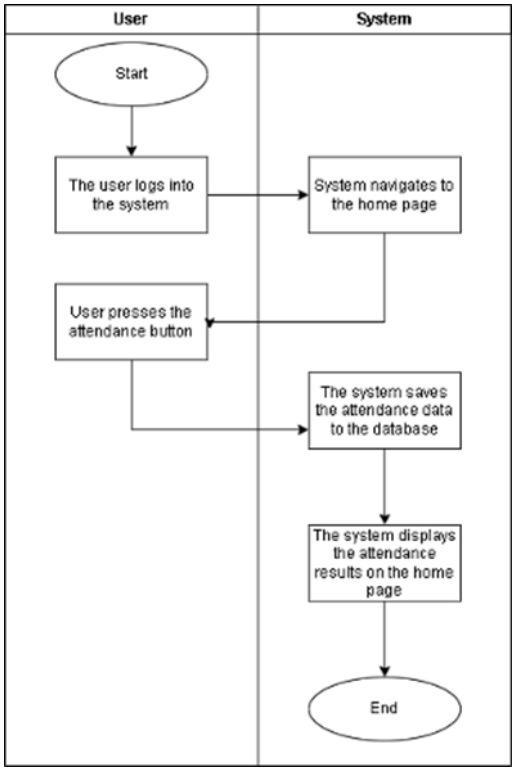

Figure 3. Attendance Activity Diagram

In the activity diagram of this attendance system, the process begins when the user logs into the system. Once the login is successful, the system automatically redirects the user to the application's main page. On this page, the user presses the attendance button to record their presence. This action is then responded to by the system by saving the attendance data into the database, which typically includes information such as time, user identity, and possibly location if the system is integrated with geolocation features. After the data is successfully stored, the system displays the attendance result on the main page as feedback to the user. This entire process demonstrates a sequential interaction between the user and the system in executing the attendance function in real-time, aimed at improving the efficiency, accuracy, and accountability of attendance recording within a workplace or organizational environment.

4.3 Sequence Diagram

A sequence diagram is a type of interaction diagram used to describe the behavior of objects within a use case by illustrating the lifetimes of objects and the messages sent and received between them in chronological order (Damanik, 2025). This diagram visualizes all objects involved in a use case and shows the interactions that occur among these objects. Additionally, the sequence diagram represents the dynamic collaboration between objects and displays the sequence of messages and interactions taking place within the developed system (Putri, 2025).

4.4 Sequence Diagram

A flowchart is a diagram using specific symbols that illustrates the sequence of processes in detail and the relationships between processes within a program (Kuswanto et al., 2021).

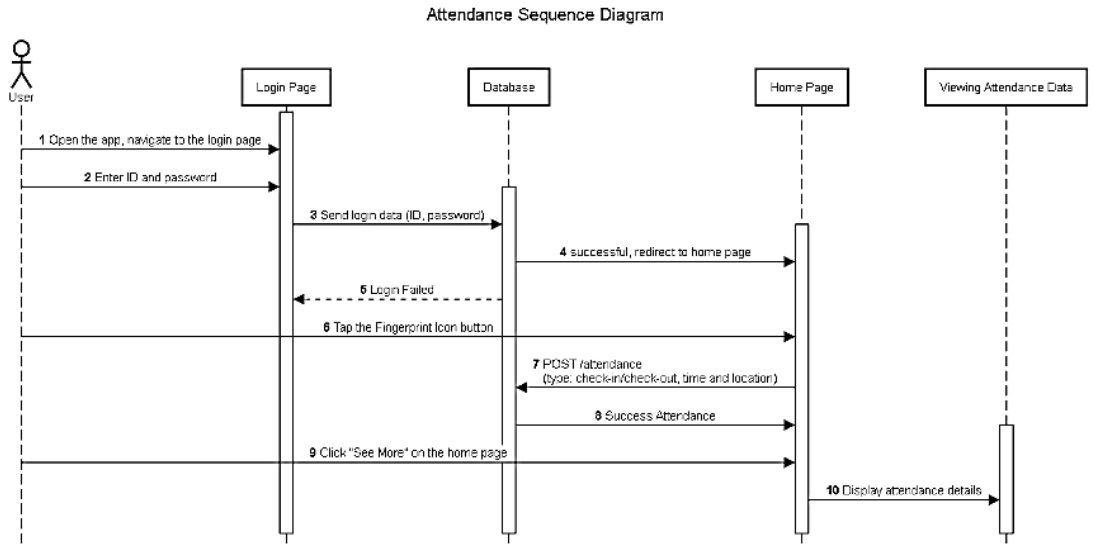

Figure 4. Attendance Sequence Diagram

This sequence diagram illustrates the order of interactions between objects in the attendance system process, starting from login to the display of attendance data. The process begins when the user opens the application and is directed to the login page. On this page, the user enters their email and password, which are then sent to the database for verification. If the login fails, the system provides an error notification. As an alternative, users can use the fingerprint scanning feature to log in. If authentication is successful, the system redirects the user to the main page of the application.

Once logged in, the user can perform attendance by pressing the designated button. The attendance request is sent to the database, which verifies the time and location in real-time before storing the attendance data. If the attendance process is successful, the system displays a success status on the main page. Furthermore, if the user selects the “See More” option, the system accesses and displays detailed attendance data on a dedicated page for viewing attendance history.

This diagram emphasizes the sequence of communication between system components, such as the login page, database, main page, and attendance data display, and shows how each request and response occurs synchronously. With this sequence diagram, developers can clearly understand the interaction order between objects to ensure the system functions as intended.

4.5 Implementation

4.5.1. Login Menu Display

Based on the image, the initial page of the application displays a login menu that allows users to access their accounts by entering their email address and password in the provided fields labeled "Email" and "Password." Below the login form, there is a "Login" button to submit the information, as well as a "Forgot Password?" option that users can click if they have forgotten their password, directing them to the recovery process. The design of this menu is simple and intuitive, making it easy for users to log in or initiate password recovery if needed.

Figure 5. Login Menu

4.5.2. Home Menu Display

After the user enters a valid email and password, the main screen (home screen) will be displayed. This view shows the main menu consisting of Attendance and Profile. On the home screen, users can see information such as their name, attendance status, student ID number, and activity history from the last 5 days. This menu is designed to provide quick access to attendance features and the user's profile.

Figure 6. Home Menu

4.5.3. Profile Menu Display

The Profile menu screen displays user information, including their name and email address, and provides several functional options such as Update Profile to edit profile data, Update Password to change the password, Add Employee to add new employees, and Logout to sign out of the account. This design enables users to easily manage their personal information and account settings.

Figure 7. Profile Menu

4.5.4. Update Profile and Update Password Displays

The Update Profile and Update Password screens allow users to modify their personal information. In the Update Profile menu, there are fields for "Name" to edit the user's name, "Email" displaying the email address, "Phone" for the phone number, and an option for "Profile Photo" to upload or change the profile picture, followed by an "Update Profile" button to save the changes. Meanwhile, the Update Password menu (although not shown in this image) enables users to change their password, ensuring their account security is maintained.

Figure 8. Update Profile

Figure 9. Update Password

4.5.5. Add Employee Display

The Add Employee menu screen allows administrators to add new employee accounts by filling in information such as "Name" for the employee's name, "Job" for their role or position, and "Email" for the employee's email address. After all fields are completed, the "Add Employee" button can be pressed to save the employee data, simplifying the management of employee accounts within the system.

Figure 10. Add Employee

4.5.6. Attendance Details Display

The Attendance Detail screen displays the user's attendance information, such as the "Check-In" on Wed, Jun 18, 2014, at 08:12:02 AM with a status of "Present". It includes details like the address (Jalan Cendrawasih No. 123, Jakarta), GPS coordinates (Latitude: -6.175110, Longitude: 106.865036), and the distance from the designated location (175 meters). For the "Check-Out" on the same day at 17:05:43 PM, the status is also "Present", with the same address and coordinates, but a closer distance of 11 meters. Users can verify whether they are within the required area set by the application; if not, they can move closer to the designated location to meet the attendance requirements.

Figure 11. Attendance Details 1

Figure 12. Attendance Details 2

4.6 Testing and Trial

Blackbox testing is a software testing technique that focuses on the functional specifications of the software and works by ignoring the control structure, thus concentrating on the information domain.In this attendance application, several tests were conducted. Based on the Blackbox testing, the results are as follows:

Table 1 Testing Blackbox

No	Testing	Case	Expected Result	Remarks
1	Login Menu	Perform login and reset password	If the account is incorrect, an error message will appear, and if correct, it will redirect to the home screen.	Valid

			The reset password function works successfully	
2	Home Menu	Perform attendance, view attendance details	Attendance is successfully marked, and the attendance details are displayed clearly	Valid
3	Update Password Menu	Change password	Password is successfully updated	Valid
4	Update Profile Menu	Change name and job title	Name and job title are successfully changed and displayed on the home screen	Valid
5	Add Employee Menu	Add employee	Employee is successfully added without errors	Valid

5. CONCLUSION

This research has successfully developed a mobile-based attendance application for Android with integrated geolocation features using Flutter and Firebase. Implemented through the Waterfall model, the system fulfills the demands of modern attendance administration by offering key features such as user authentication, real-time location-based attendance recording, profile management, employee registration, and location validation.

The geolocation feature ensures that attendance is marked only within designated areas, minimizing fraud and enhancing employee accountability. The integration with Firebase facilitates centralized, real-time data storage and management, allowing organizations to monitor and recap attendance efficiently.

Testing with the Black-box method confirmed that all application features function as expected, aligning with system requirements and demonstrating stability and reliability.

In conclusion, the proposed system offers a viable and efficient alternative to conventional manual attendance methods by improving accuracy, transparency, and operational effectiveness. It is well-suited for adoption in institutions and organizations seeking a digital attendance solution. Future development may explore additional functionalities such as facial recognition and integration with broader human resource management systems.

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