



## Research article

# Application of Geolocation Methods in Student Attendance System Design

Yoga Rizya Pratama <sup>1</sup>, Apri Siswanto <sup>2\*</sup>

<sup>1</sup> Department of Informatics, Universitas Islam Riau, Pekanbaru, Indonesia

<sup>2</sup> Department of Informatics, Universitas Islam Riau, Pekanbaru, Indonesia

email: <sup>1</sup>[yogarizya.p@student.uir.ac.id](mailto:yogarizya.p@student.uir.ac.id), <sup>2\*</sup>[aprisiswanto@eng.uir.ac.id](mailto:aprisiswanto@eng.uir.ac.id)

\* Correspondence

## ARTICLE INFO

### Article history:

Received 16 January, 2024

Revised 22 February, 2024

Accepted 24 February, 2024

Available online 28 February, 2024

### Keywords:

Presence System

Geolocation

Student Presence

Coordinates

Radius

### Please cite this article in IEEE style as:

A. Siswanto and Y.Z. Pratama,  
"Application of Geolocation  
Methods in Student Attendance  
System Design", *Data Science  
Insights*, vol. 2, no. 1, pp. 1-8, 2024.

## ABSTRACT

Universitas Islam Riau is one of the universities in Riau province that is of interest to high school graduate students as a place to continue their studies at a higher level. Implementing the student attendance process at the Universitas Islam Riau is still done manually; this causes less efficiency and effectiveness of attendance activities, starting from data collection, processing presence data, and storing and searching processes, which take time. In some cases, fraud may occur, such as falsifying the presence of someone represented by another party. Then, we need a system that can record the attendance of students whose positions are within the scope of the class radius. Geolocation can capture device coordinates by utilizing latitude and longitude, which will be used to measure the distance between classes and students. If the student's position is outside the class radius determined by each lecturer, then the student cannot fill in attendance. If the student's position is within the scope of the class radius that has been determined, students can fill in attendance. In the research, we succeeded in designing a student attendance system based on the geolocation method. Security to overcome fake GPS managed to function properly, and fingerprints to take attendance can work properly. From the results of Black box testing, the system can run well and is free from syntax and functional errors.

Correspondence:

Apri Siswanto  
Department of Informatics,  
Universitas Islam Riau, Pekanbaru,  
Indonesia

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## 1. Introduction

Presence collects data and reports employee attendance at an organization, agency or company. Presence is structured and organized so that it is easy to find and use when needed by interested parties [1]. In this research, the system that has been developed is based on Android with React Native and Web with React JS. Android is an operating system designed for Linux-based mobile devices. This operating system was initially developed by Android Inc., which was later bought by Google in 2005 [2]. React, often written as React.js or ReactJS, is a JavaScript library developed by Facebook to facilitate the creation of interface components that are interactive, stateful, and easy to reuse. ReactJS is very suitable for rendering high-performance, complex interfaces [3]. React native is a free platform for developing native mobile applications, mostly produced by Facebook [4]. The system uses a NoSQL database. A database is a collection of data stored systematically on a computer that can be processed or manipulated using software (application programs) to produce information [5]. NoSQL stores documents, key values, graphics, or wide columns [6]. MongoDB is a document-based database system (Document Oriented Database) and is a database system that adheres to NoSQL [7]. This system will also be built with the JavaScript programming language. JavaScript is a web programming language that is a client-side programming language [8]. This system will also use rest-api with express js; Express.js is one of the most popular web frameworks in the world, Node. Js [9]. The Haversine method is a method for calculating the distance between two points by considering that the Earth is not just a flat plane but by considering that the Earth has degrees of curvature [10].

In several related studies, for example, Yusut et al.'s research, they designed an Android-based application using the geolocation method as a media for employee attendance by validating location coordinates and cellphone numbers to avoid direct contact during the attendance process. They can be done anywhere in real-

time [11]. Then, research [12] produced an Android-based application using Bluetooth signals to carry out the presence process. Next, in research [13], they had an Android-based application using the geolocation method, which can capture employee locations when carrying out the attendance process to improve employee performance and discipline in real time. In line with research, [14] produced a web-based application using the geolocation method so that employees can carry out the attendance process in real time according to coordinates determined to avoid fraud. Furthermore, research [15] produced a web and Android-based attendance system as a presence media by utilizing fingerprint sensors so that employees can carry out the attendance process in real-time and monitor the location of employees while working..

## 2. Research Methods

### 2.1 Geolocation Method

Geolocation is the identification of the geographic location of an object in the real world. In geolocation, we get more specific data from location coordinates, addresses, and street names for level 1 to level 3 protocols, while positioning only includes a set of values for latitude and longitude. Geolocation refers to identifying a user's or computing device's geographic location through various data collection mechanisms [16].

### 2.2 SDLC (Software Development Lifecycle)

SDLC (Figure 1) is a phase of work by systems analysts and programmers in developing information systems and methods for developing these systems. SDLC Waterfall develops systematically from one stage to another like a waterfall. The Waterfall model is "a model that provides a sequential or ordered software life flow approach starting from analysis, design, coding and testing" [17].

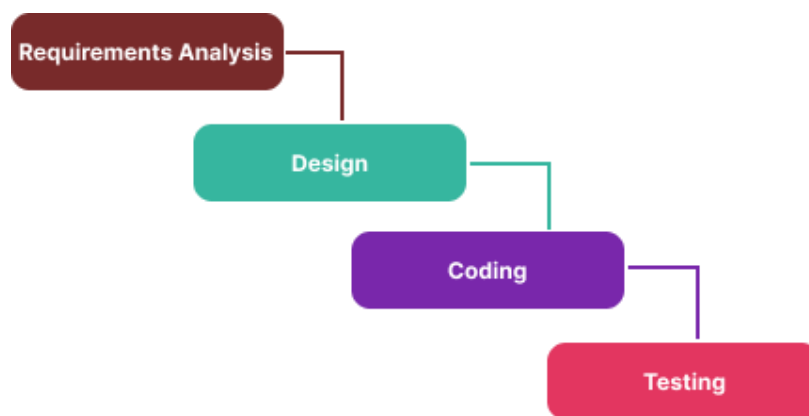


Figure 1. Waterfall Model

1. Requirements Analysis, At this step, system developers need to communicate to understand the software and the limitations of the software required by users. This information can be obtained through interviews, surveys or discussions.
2. Software design is a process of several steps in designing a software program, including data structures, software architecture, interface representation and coding procedures. This stage translates software requirements from the requirements analysis stage to a design representation to be implemented into a program at the next stage. At this stage, the results of the existing software design are documented [18] .
3. In coding step, the design must be translated into a software program. The result of this stage is a computer program according to the design created at the design stage. Or the author's stages of creating a program using programming languages such as PHP, HTML, SCC and others [19].
4. In this step, the author tests the program created to find its shortcomings. Such as validating the login page and whether it meets expectations.

System design starts from designing a context diagram. Context diagrams are part of the DFD, used to determine a model's context and system boundaries. The context diagram for the student attendance system based on geolocation methods that will be built can be seen in Figure 2.

Next is designing a hierarchy chart. A hierarchy Chart describes the system and sub-subsystems that explain the processes in the central system where all sub-systems located within the scope of the central system are interconnected. The difference is the level of the process. The hierarchy chart of student attendance system can be seen in Figure 3.

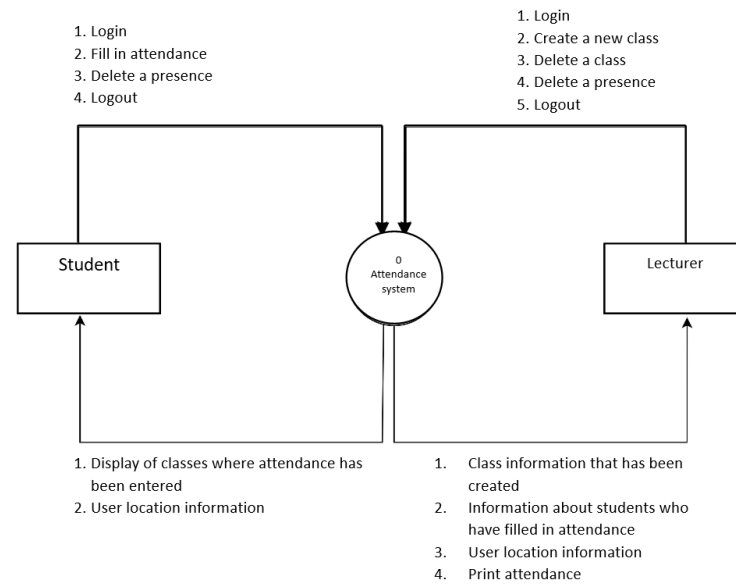


Figure 2. Context Diagram

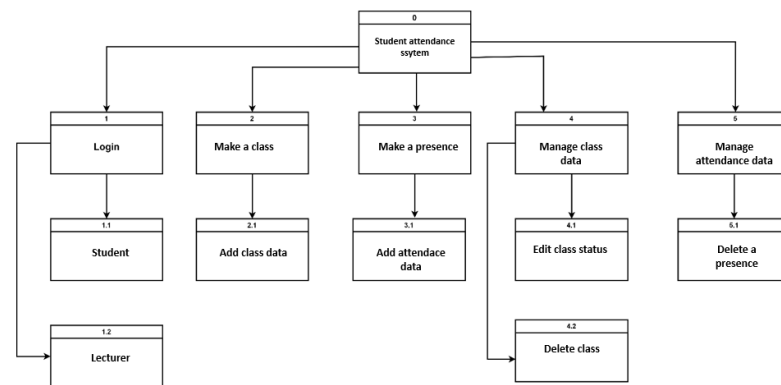


Figure 3. Hierarchy Chart

Then, the next step is design data flow diagram (DFD). DFD is the overall process in the system. The processes depicted in the DFD are only in the form of certain symbols. The DFD system can be seen in Figure 4.

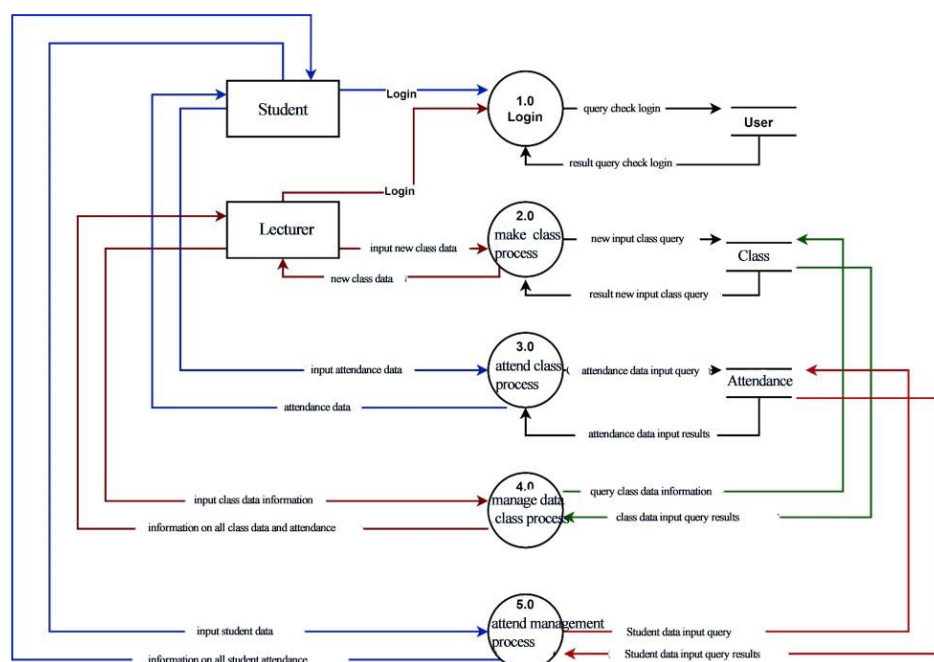


Figure 4. Data flow diagram (DFD)

After completing the software design, the next stage is coding the program. At this stage the programming languages used are react js framework . After the coding is complete, the testing stage is carried out. The testing stage was carried out using the black box testing method. Black box testing is the process of testing the function of software or applications from the user's perspective, without knowing the internal structure or design of that structure. Simply put, black box testing only assesses whether the system can provide output or results in accordance with the input (information or instructions received by the system). If the results are appropriate, then the system is declared to be functioning properly. If the system fails to carry out the requested procedures, it is declared to need repair. Because of this, black box testing is also called behavioral testing, closed-box, or specification-based testing [20].

### 3. Results and Discussion

#### 3.1 Application Implementation

The login page is where the user logs into the Riau Islamic University student attendance application. Using a Google account in the built application, there are two access rights: lecturers and students. Lecturers must use a Google account with lecturer status with the Islamic University of Riau Google email, and students must use a Google account with student status with the Islamic University Google email. Riau. The login display can be seen in Figure 5 below.



Figure 5. Application login page

The home page is the page that appears first when the user has successfully logged into the application. There is user location information and also two menus, namely the class menu, which can only be accessed by lecturers, and the absence menu, which can only be accessed by students; on this page, the system will Check if the user is using fake GPS, a warning will appear to turn off fake GPS, and the page will be redirected to the login page. The home display can be seen in Figure 6 below.

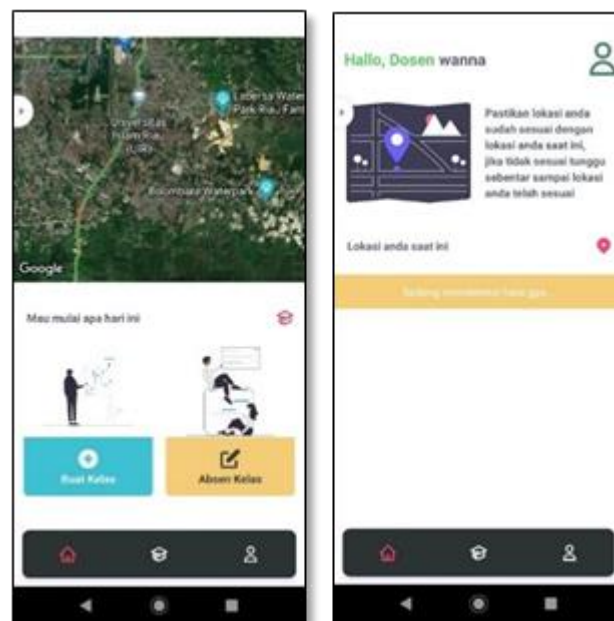


Figure 6. Application home page

The home page has a create-a-class menu that lecturers can use to develop new classes. When the lecturer presses the create a class menu, a pop-up form will appear to input the data for the class you want to make. On the home page is a class absence menu that students can use to carry out the attendance process. When a student presses the class absence menu, a pop-up form will appear to input student data, which will be used to be absent from the intended class. Students can fill in the form appropriately and press the save button. Then, a pop-up will appear to enter the student's fingerprint, and the new absence data will be saved to the database. The pop-up menu display can be seen in Figure 7 below.

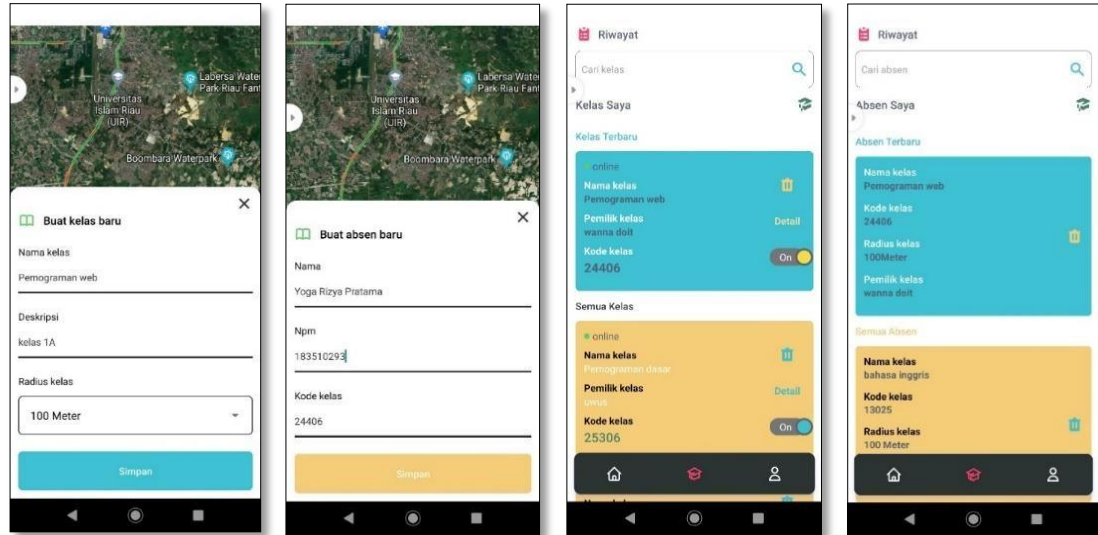


Figure 7. Menu for classes, menu for absences, and history page

The system login page can only be accessed by lecturers using the Riau Islamic University Google account. After logging in, lecturers will be directed to the dashboard page. The system login display can be seen in Figure 8 below.

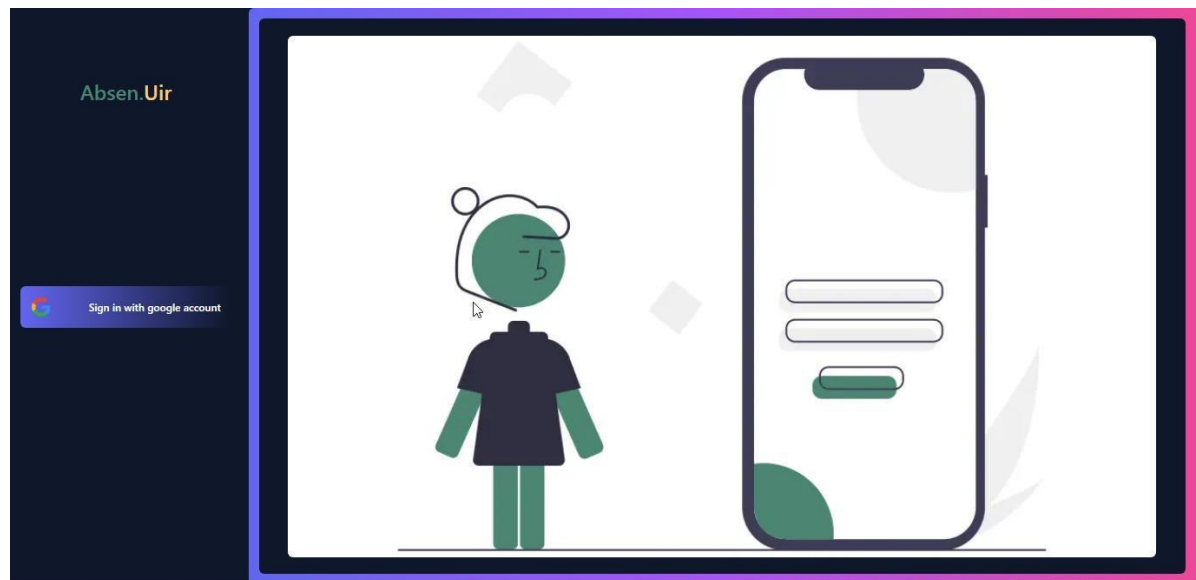


Figure 8. System login page

The dashboard page will display class data that the lecturer has created via the application. The dashboard display can be seen in Figure 9.

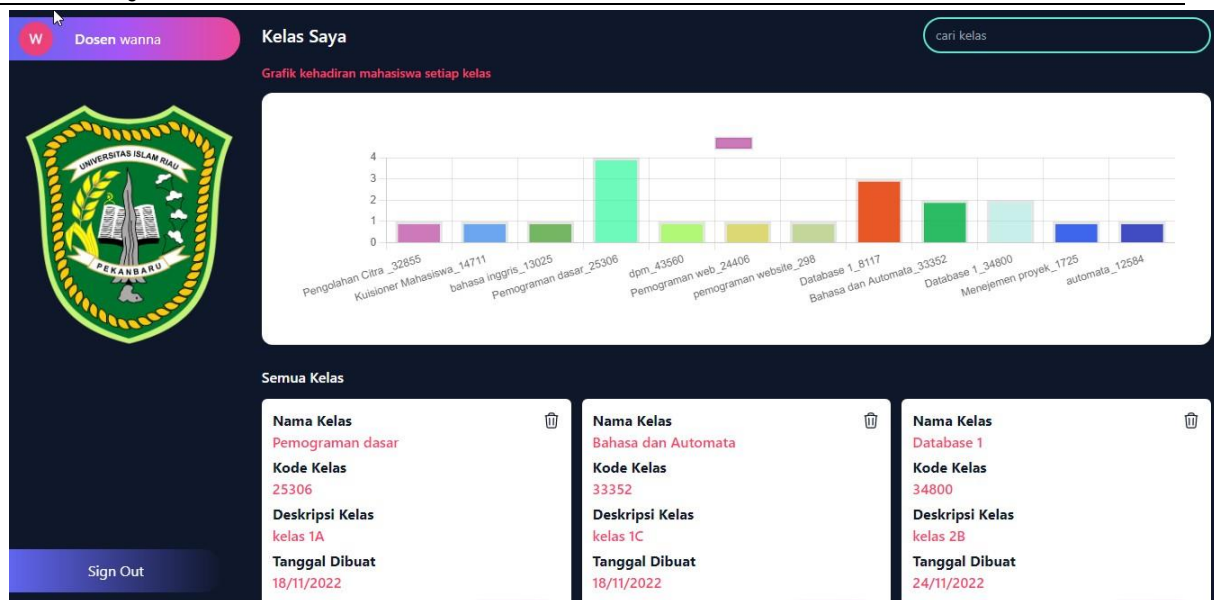


Figure 9. System dashboard page

The class details page can be accessed when the lecturer presses the detail button on the dashboard page; on this page, the lecturer can see students who have attended class in table form, and the lecturer can also get data according to the date of absences that have been made. There is a button to export attendance data to students into Excel format. The class detail page display and the results of data export to Excel can be seen in Figures 10 below.

No	Nama Mahasiswa	Npm	Jam Masuk	Tanggal Hadir
1	Dwi shana	183510257	09:25:31	2/2/2023
2	Stevy singgih wibowo	183510338	09:26:19	2/2/2023
3	Arlan	183510332	09:27:00	2/2/2023
4	Muhammad Hafizh	183510326	09:27:52	2/2/2023
5	Zainal Arifin	183510269	09:28:26	2/2/2023
6	Gyvari tulus	183510271	09:29:22	2/2/2023
7	Fathur Attariq Alfath	183510340	09:30:11	2/2/2023
8	Geo Fanny Penalem	183510298	09:31:05	2/2/2023
9	Agung dwi sapto wibowo	183510312	09:31:57	2/2/2023
10	Atmala Sari Harahap	183510341	09:32:55	2/2/2023
11	Oktafia Kurnia Santi	183510319	09:33:42	2/2/2023
12	Khairun Fajri	183510244	09:35:04	2/2/2023
13	Nurfajri	183510269	09:35:32	2/2/2023

Figure 10. Class details page and excel data export results

### 3.2 Application Testing

This stage is tested to see whether the login function is running properly or not using a scenario using a Google UIR account. Next, test the menu for class creation and class absences. This test aims to test each menu feature component and determine whether lecturers can create classes and students can take attendance. Then, testing the login system, this test aims to test the login system on the website system with a login scenario with a Google account. Lastly, testing the export to Excel feature, the testing feature is carried out to find out whether the attendance data export feature into Excel format normally runs according to the scenario [21]. Testing was carried out on users, 5 lecturers and 20 students. Testing is carried out by answering the questionnaire provided via Google form with the link :

[https://docs.google.com/forms/d/e/1FAIpQLSfr\\_qTyH2DRzkS1oxRSzkdAqLZ4ru47Kwquz3tLca1ZHBuLw/viewform](https://docs.google.com/forms/d/e/1FAIpQLSfr_qTyH2DRzkS1oxRSzkdAqLZ4ru47Kwquz3tLca1ZHBuLw/viewform).



Users can run the application provided via the link <https://antech.vercel.app/>. For more details, see Table 1.

Table 1. Application testing

Tested Components	Testing Scenarios	Expected results
Login with UIR Google account	Use the appropriate email	The system accepts access
Login with non-UIR Google account	Using inappropriate email	The system denies access
Press the Create Class Menu Button	Add new class data to the form	A message appears that the data has been successfully saved and is directed to the lecturer history page
Press the Class Absence Menu Button	Add student data to the form	A message appears that the data has been successfully saved and is directed to the student history page
System google login button	Using the UIR lecturer's Google account	Enter the system dashboard
Export table to excel	Press the Export to Excel button	Download excel file

#### 4. Conclusion

The following can be concluded based on the analysis of the Student Attendance System using the Geolocation Method. The Student Attendance System using the Geolocation Method can run on the Android platform and website, the attendance process can run as expected on the Android application, the Geolocation method has been successfully implemented in the student attendance system, security to overcome fake GPS has been able to function properly, and the use of fingerprints to take attendance can be achieved. Running properly, from the results of Black box testing, the system can run well and is free from syntax and functional errors. In future research, it is hoped that applications can be developed on the iPhone device platform.

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