Lecturer and employees presence system based on GPS using a fingerprint on mobile devices

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Abstract. The lecturer and employee attendance system that is widely used today is the system using a fingerprint device that is placed in every department or faculty. This system has shortcomings such as the limited availability of fingerprint scanners, the presence of presence equipment that is far from the work location, and dependence on the presence tool. So with this weakness, the presence application system is based on mobile apps that use GPS and fingerprints to facilitate lecturers and staff in making a presence while in the presence area or where they work. With this system, this will make the presence and processing of presence data more accessible and more efficient, so that it can help maximize the process of gathering and processing the presence data. From the system testing, the system can process employee data, display the results of the daily attendance, and can store the results of the presence and obtained system sensitivity of 65%, specificity of 70% and system accuracy of 72%.

1. Introduction
One of the obligations of a lecturer and employee is to attend the office. A critical point in evaluating the level of employee discipline can be seen from the presence data, which is when it comes to filling attendance. Many methods are used in the process of gathering attendance data such as signature, scan barcode, and fingerprint [1]. The presence methods that are often used at universities are using fingerprints or handprints.

A presence system using fingerprints is one of the most popular ways of gathering attendance data and is able to minimize the level of fraud because every human being has a different fingerprint. The placement and placement of the fingerprint sensor as a point of gathering attendance data is limited to make every lecturer and staff who want to attend presence must be carried out alternately. In conducting the process of gathering attendance data in several universities, it does not require a lecturer and staff to go to a particular room or place where the presence equipment is placed. Due to the exceptional conditions of the university and distributed place or location of each lecturer and employee that not always close to where the fingerprint attendance tool installed. Lecturers and staff are said to be present when they are in the place or location they are working in. In other words, lecturers and staff can make a presence at the place where they work [2,3].

To help facilitate lecturers and staff who work in a place that is not close to where the presence of tools to retrieve and collect attendance data, a presence system is needed where every lecturer and employee is able to attend anywhere if already in the work environment. Then the lecturer and staff attendance system will be made using a fingerprint-based GPS mobile device.
2. Material and methods
The presence system is a system that is used to find out, record, and summarize the attendance list of each member of the office. The presence system records the identity of each member and the time in and out of their members.

To be able to complete this research, several research methods were applied:

- Database design
- Web application design
- API design
- Android application design
- System testing and analysis

In general, this application is designed to make a presence made by a lecturer or employee. Lecturers and staff authenticate fingerprints using the mobile application that is on the smartphone at a predetermined location. [4,5] Then, the data is sent to the server and using an API that has been designed to receive data that is sent and then stored in the database. Data from the presence of lecturers and staff that have been stored in the database will be visible to the admin of the department or faculty using a Web application that has been designed [6]. In general, the presence system diagram can be seen in Figure 1.

![Figure 1. Android Application Architecture and Web Application for lecturer and employee attendance systems using GPS and fingerprint.](image)

2.1 Database system design
This database design uses Entity-Relationship Diagrams (ERD), which can describe the needs related to the database in building systems. For more details can be seen in Figure 2.

In figure 4, there are two tables, namely: employee and attendance tables. The link between the employee table and the attendance table is user_id.

![Figure 2. Database Design Using Entity-Relationship Diagrams (ERD).](image)

2.2 Web application design
Web application design is carried out in a more detailed design of the users involved, functions, and flow of the system, as well as the design of the user interface. The stages are carried out in the design of Web applications [5], i.e.:

2.2.1 Design of use case diagrams. Web applications can only be accessed by the admin. As for the admin can do, namely: login, see attendance, edit employees, delete employees, and add employees presented in a use case diagram.
2.2.2 Design of activity diagrams. The web application is designed starting at the admin login, and then the dashboard display will appear on the employee management menu and see attendance. On the employee management menu, there are features including show, edit, delete employees. In the attendance menu, the admin can see employee attendance by day and date.

2.2.3 User interface design. In the web application, there are 4 menus, namely the login menu, dashboard, employee management, attendance menu. The following is the web application user interface, as shown in Figure 3, Figure 4, Figure 5, and Figure 6.

![Figure 3. User interface login menu.](image)

![Figure 4. Dashboard user interface.](image)

![Figure 5. User interface menu employee management.](image)

![Figure 6. User interface menu for employee attendance.](image)

2.3 Web application design

In the presence system of lecturers and employees based on GPS and fingerprints of mobile devices, the Application Programming Interface (API) is designed. API has a function as a bridge or intermediary between data communication systems that are on the server with an android application on a mobile device. The use of API can accelerate the process of developing applications on mobile devices because the API has provided the required features so that application developers no longer need to make similar features [4,5].

2.3.1 Designing presence API. The design of the API starts when the API receives data in the form of latitude, longitude, and IMEI device. Then check-in sequence, namely: completeness of data, location, employee data, and time.
2.3.2 Designing API register. The design of the REST API starts when the API receives data in the form of a parent number and place of birth. Then check-in sequence, namely: completeness of data, employee data, and employment status for more clearly.

2.4 Android application design

Research in the design of android applications, a more detailed design of the users involved, functions, and flow in the system, as well as the design of the user interface. The stages are carried out in the design of an android application that is:

2.4.1 Design of use case diagrams. Android applications can only be accessed by users/employees. As for what can be done, namely: Register and attendance.

2.4.2 Design the activity diagram. The android application is designed to have 2 main functions of registration and presence. For the activation included in diagram registration. On the registration menu, the application directly requests IMEI device data on the smartphone, and then the employee is asked to fill in the parent number and place of birth to be sent to the server and checked on the database, after checking is complete will receive a failed response or succeed.

For presence, in the application presence menu directly asks for IMEI device data, GPS data [7], namely latitude and longitude and permission to use a fingerprint scanner on a smartphone, then employees are asked to attach a fingerprint to the fingerprint scanner. If the fingerprint scanning proceeds successfully, the data that has been prepared is sent to the server, then the server will send a successful response or fail to make a presence then display it on the android application.

2.5 Designing the android application user interface

In the android application, there are 3 menus, namely the presence menu, registration, and the presence menu, that can be seen in the following figure 7.

3. Result

In carrying out testing in advance, determine the location/place of system testing. The following are figures and some test location points. There are several test location points inside or outside the coverage area of the presence. It can be seen in Figure 8, and the test results can be seen in Table 1.
Where there are several provisions in the test results, namely:

- True positives: presence in an area is considered inside
- True negatives: presence outside the area is considered inside
- False positives: presence in an area is considered outside
- False negatives: presence outside the area is considered outside

![Figure 8. Test location point.](image)

**Table 1.** Presence test results at several different points.

| No. point | Latitude    | Longitude | Reach of Presence (Outside / Inside) | Provisions |
|-----------|-------------|-----------|--------------------------------------|------------|
| 1         | 3.561681    | 98.654854 | Inside                               | TP         |
| 2         | 3.561853    | 98.655035 | Inside                               | TP         |
| 3         | 3.561914    | 98.654830 | Inside                               | TP         |
| 4         | 3.562131    | 98.654733 | Outside                              | FN         |
| 5         | 3.561772    | 98.655185 | Outside                              | FN         |
| 6         | 3.561533    | 98.655125 | Outside                              | FN         |
| 7         | 3.561778    | 98.655805 | Inside                               | TP         |
| 8         | 3.561840    | 98.655682 | Inside                               | TP         |
| 9         | 3.561705    | 98.655497 | Inside                               | TP         |
| 10        | 3.561725    | 98.656044 | Outside                              | FN         |
| 11        | 3.561578    | 98.653692 | Inside                               | TP         |
| 12        | 3.561422    | 98.653823 | Inside                               | TP         |
| 13        | 3.561576    | 98.654095 | Outside                              | FN         |
| 14        | 3.561558    | 98.653487 | Outside                              | FN         |
| 15        | 3.561276    | 98.653556 | Outside                              | FN         |
| 16        | 3.561637    | 98.653903 | Inside                               | TN         |
| 17        | 3.561833    | 98.654574 | Inside                               | TN         |
| 18        | 3.561908    | 98.654831 | Outside                              | FP         |
| 19        | 3.561716    | 98.655363 | Inside                               | TN         |
| 20        | 3.561840    | 98.655612 | Outside                              | FP         |
| 21        | 3.561658    | 98.654729 | Inside                               | TP         |
From the table above it is found that the value of TP = 13, THN = 3, FP = 7, FN = 2, the values of sensitivity, specificity, and accuracy of the system are as follows:

\[
\text{Sensitivity} = \frac{TP}{TP+FN} \times 100\% = 65\%
\]

\[
\text{Specificity} = \frac{FN}{FN+TN} \times 100\% = 70\%
\]

\[
\text{Accuracy} = \frac{TP+TN}{total} \times 100\% = 72\%
\]

4. Conclusions
The web application built for the lecturer and staff attendance system has 11 functions that are running well. REST API attendance and registration REST API designed for lecturer and employee attendance systems can connect with systems that have been built on mobile devices (Android). The system has been built has a sensitivity of 65%, a specificity of 70%, and an accuracy rate of 72%, indicating that the system is running well. Android applications and Web applications that have been designed to be integrated with each other show that the system built can facilitate the process of gathering presence data.

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