

Development and Evaluation of An Android-Based Student Attendance System Using Qr-Code and Waterfall Method at the Global Institute

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ABSTRACT

Student presence plays a crucial role in the learning process at the Bina Sarana Global Institute of Technology and Business. However, lecturers face challenges in manually processing paper-based attendance, which is time-consuming (taking 15–20 minutes per class session) and prone to data scattering. This study aims to develop and evaluate an Android-based Student Attendance System, named Global Academic Information System (GAIS), integrated with QR-Code technology. The system was developed using the Waterfall model and designed with Unified Modeling Language (UML). To evaluate the software's functionality and performance, Black-box testing and User Acceptance Testing (UAT) were conducted. The Black-box testing yielded a 100% success rate across all core modules, including login, QR scanning, and attendance data management. Furthermore, the UAT result reached an acceptance score of 87.5% from students and lecturers, confirming that the GAIS application significantly eliminates manual processing time and improves data logging efficiency.

Keywords—student presence, QR-code attendance, waterfall method, black-box testing, user acceptance testing.

1. INTRODUCTION

Science and technology are increasingly developing from year to year which brings changes in almost all aspects of life [1]. The advancement of knowledge and technology brings people into an age of intense global competition. In facing the era of globalization, a high-quality workforce is needed that meets the necessary standards and is able to adapt to various changes that have emerged [2]. So an information system is needed to make it easier to complete a work process so that it is faster and more efficient. Recording student absences carried out by lecturers also requires appropriate media, because the results of recording absences carried out by lecturers will be information that can influence the assessment of students [3] One activity that is considered significant is the process of recording student attendance, which currently still relies on manual methods through signing on the attendance form that has been prepared. This is considered less efficient, as it takes a relatively long time and also requires concentration of extracts to analyze the data with the aim of producing easily understandable information [4]. With new innovations, existing student attendance data or information will be carried out through an attendance system, with a compact, dense and attractive appearance, making this attendance system more widely used and also easier to understand. So that lecturers can easily recap the student absences they handle. As for the research already carried out on the constraints involved in the manual attendance system. The following are 3 (three) literature reviews of previous

research to be used as references in this research, namely: Research on the Implementation of Business Intelligence Using Highcharts in the YII Framework-based Attendance Assessment System. In this research, it is explained about the recording of student attendance for tutoring carried out by lecturers manually. Where you have to enter data consisting of the student's name, Student Identification Number (NIM), and supervisor one by one into the tutoring attendance table, after that the supervisor must also recap the attendance manually by checking the table sections one by one to get an assessment of the student's attendance. guidance. This manual method takes quite a long time, and also requires concentration to analyze the data so that it becomes information that is easy to digest [5]. Further research regarding the Design of a Lecturer Attendance Information System with Web-Based Student Validation. This research explains the absentee process for lecturers who still use a manual system, namely signatures on attendance paper sheets.

This is considered less effective, especially if there are lecturers who are absent but are not present in class during lecture hours. So that interested parties, in this case Kaprodi, find it difficult to monitor lecturers [6]. The next study will review the development of a Web-based Attendance Information System for Attendance Monitoring at Conference Activities. In the context of organizing academic conferences, one of the main challenges that has arisen is the difficulty in documenting the attendance of the participants attending the various presentation sessions. The process of recording participants' attendance at the presentation session is carried out manually, involving recording the full names of participants, the participant's home university, as well as requests for signatures from each participant. This manual method takes approximately 15 - 20 minutes for each session. After the conference was over, the preparation of attendance reports was also done manually, and this process also took quite significant time. Conference organizers need to re-input attendance data into computers using data processing software such as Microsoft Office Excel before they can create the required reports. This process can take quite significant time [7]. From the problems that have been explained in the references we have obtained, it is concluded that to simplify the attendance recording process at the Institute of Technology and Business Development of Global Facilities, a solution is needed to overcome this problem. One solution is to utilize internet technology, namely creating an attendance application that can make it easier for lecturers to record the value of student attendance they handle. With this, a Global Academic Information System (GAIS) application was created using barcodes which can be used for every teaching and learning activity.

1.1. Understanding Systems

A system is a collection of components that are interconnected in a relationship between these components and the surrounding environment. The system can also be described as a unity of several parts that are bound and connected to each other, aiming to achieve a desired goal [8].

1.2. Unified Modeling Language (UML)

Unified Modeling Language (UML) is a form of standard language that is widely used in the global industrial sector to describe needs, carry out analysis and design, and illustrate structures in a programming context that focuses on object [9]. Unified Modeling Language (UML) has a scope of more than just a visual programming language, but can also be directly integrated into various programming languages such as JAVA, C++, Visual Basic, or even connected directly to object-oriented databases. The cardinal parts of the Unified Modeling Language (UML) include views, drawing schemes, model elements, and general mechanisms [10]. Examples of Unified Modeling Language (UML) are as follows: use case diagram, activity diagram, sequence diagram and class diagram.

1.3. Web Applications

Web applications are a type of application that uses a three-layer structure, running through the browser as a front interface (front end), while power builder components act as a middle layer (middle tier) running on the IIS server [11]. Web form applications have several advantages when compared to client or server applications and traditional Windows forms. Web form applications do not need to be installed on the client side, their development is easy to improve, no distribution costs are required, and can be accessed by a variety of users [12].

1.4. XAMPP

XAMPP is software used to run websites that use the PHP programming language and utilize the MySQL database management system on local computers [13]. XAMPP's main function is as a web server on your device. In addition, XAMPP can also be considered a virtual server similar to Cpanel, which makes it possible to preview websites, allowing modifications without requiring an internet connection or online access.

1.5. MySQL

A database or database is a collection of information organized and stored on a computer, which can be checked using certain computer software to obtain information from it [14]. Its function is to store data integrated into a computer system. To set up a database, special software called a Database Management System (DBMS) is needed. Database Management System (DBMS) is a software system that allows users to easily create, maintain, control and access databases efficiently. By using a Database Management System (DBMS), users can more easily control and manipulate existing data.

The current manual attendance system at the Global Institute requires students to pass around a paper sheet to sign, which disrupts the lecture focus and consumes roughly 15 to 20 minutes of class time per session. For a class of 40 students, a lecturer spends an additional 10 minutes at the end of the semester to re-input and calculate the attendance percentage into spreadsheets. This manual method creates an average administrative overhead of 30 minutes per course block and risks higher data modification errors. By implementing the proposed GAIS application, the QR-code scanning action takes less than 3 seconds per student, reducing the total class attendance time to under 2 minutes, thereby optimizing teaching time by up to 90%.

2. LITERATURE REVIEW

2.1. Research Object

Research was carried out on the campus of the Institute of Technology and Business for Global Facilities Development. This research was conducted to find out what methods would be used in the student attendance system for the Bina Sarana Global Institute of Technology and Business campus. In the system where attendance is running, manual methods are still used, namely that each student must fill out the attendance list on the paper sheet provided. This method certainly takes quite a long time and is also an obstacle for lecturers when recording student attendance scores. A system that runs on manual attendance, which begins with the student's manual absence from the lecturer until the attendance information can be seen and understood by the student. Where the flow that runs has 2 (two) actors who have different roles, starting with students filling out absences to lecturers via the absent paper provided, after which the lecturer takes notes again. In one semester period, lecturers will recap absences by sorting existing data one by one. After this process, the lecturer will present attendance information in the form of grades to be given for information to students, this method is certainly less efficient because it requires concentration and quite a long time.

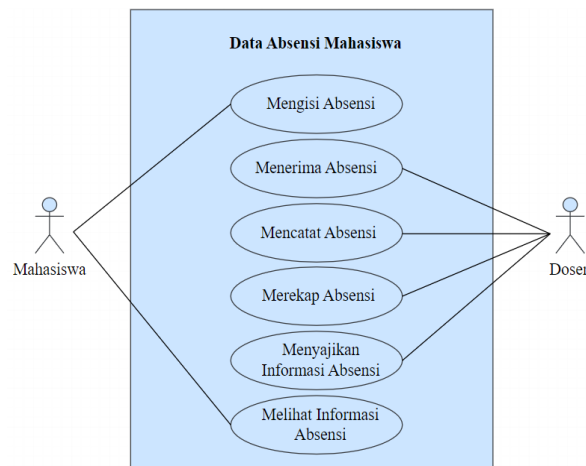


Figure 1. Use Case Diagram the Running System

2.2. Problem Faced

In research conducted by the author on the current system, the author found several problems that occurred with the manual attendance system at the Institute of Technology and Business Development of Global Facilities:

- Student absenteeism carried out manually takes quite a long time, which is a waste of course time.
- Difficulty in searching for data and slow time in processing attendance data manually by lecturers.

2.3. Alternative Problem Solving

After observing and researching several problems that occur in the running system, the author proposes several alternative solutions to the problems faced, including:

- Design a student attendance system by displaying several menu options, especially the attendance menu. So students no longer need to fill in attendance on attendance paper which takes quite a long time.
- Designing a attendance system that can make it easier and faster for lecturers to record student attendance scores and minimize data scattering.

The method used in developing this attendance system is the Waterfall method. Several stages in this method are:

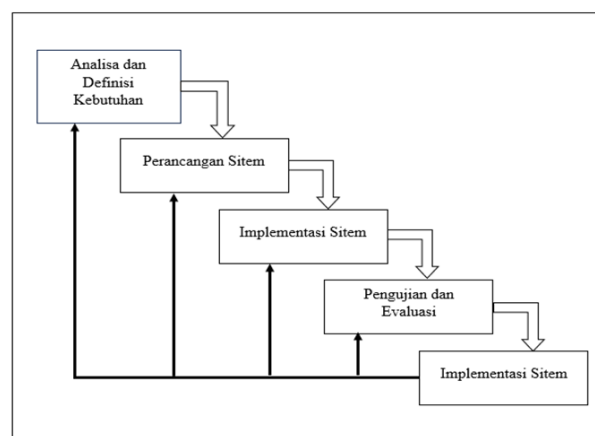


Figure 2. Stages in the Waterfall Method

The waterfall method has the following stages:

- a. Analysis and Definition of Needs
This stage is the initial stage in conducting research where there is a data collection process by means of literature study, observation and collecting student data needed for the attendance process, problem identification and analysis of system needs starting from software to the hardware used. This stage also aims to be an illustration for system design and system design to be created.
- b. System Design
Based on the results of system analysis and obtaining the required data, at this stage application display design, database design and user interface design are carried out [15].
- c. System Implementation
In this stage, the system is created in accordance with the design that was created in the previous stage [16].
- d. Testing and Evaluation
After going through several stages, testing and evaluation of the system that has been created is carried out. The aim of this test is to find out the errors contained in the application, then they can be corrected and ensure that the system is created successfully so that attendance management becomes more effective and efficient.
- e. Maintenance
At this stage, the system created can experience changes that arise due to user needs or are caused by adjustments to developments in hardware, software and operating systems.

3. METHODOLOGY

3.1. New Proposed Procedures

Based on the problems explained in the previous chapter, in this chapter we will discuss the system proposed by the author, using the waterfall method to create an Android-based application which will later be used to fill out the student attendance list. This system will certainly make it easier for lecturers to recap student attendance scores for one semester and minimize data scattering which was originally done manually. This system will be named the Global Academic Information System (GAIS). The Global Academic Information System (GAIS) is the media used by students to carry out the attendance process. In creating the software, the author created the design of the Global Academic Information System (GAIS) using the PHP programming language and the MySQL database. The system description is that students can take attendance using the Global Academic Information System (GAIS) if they have entered the class at the scheduled time. This system will start with students having to install the Global Academic Information System (GAIS) application which is available on the Play Store. Then students are required to enter a nim and password. After that, select the attendance menu, then select scan QR. Then select the school year and click the filter and the system will display the courses in that school year. Then students can choose ongoing courses to fill out their attendance by scanning the available QR.

3.2. System Design Diagram

This system design is the stage of designing the system to be formed which can be in the form of a process depiction of the elements of a component, this design process is the initial stage of designing the website of the proposed system

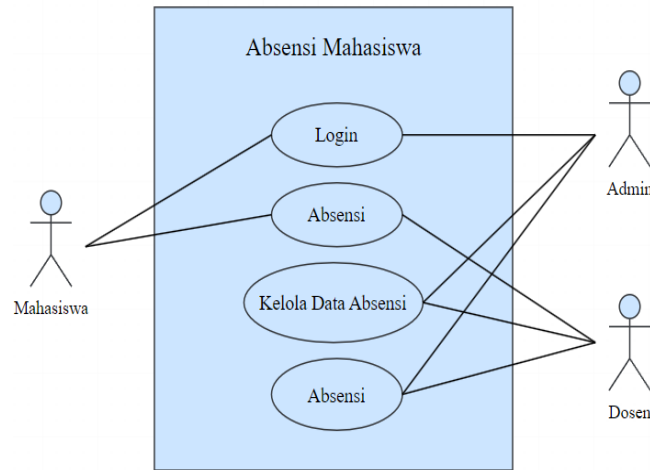


Figure 3. Proposed Use Case Diagram

In figure 3 *Use Case Diagram*, there are several actors involved in the system. Among them are students, lecturers and admins.

Table 1. Description of Actor in Use Case

No	Actor	Description
1.	Admin	Have the right to log in, manage attendance rates, and <i>logout</i> .
2.	Lecturer	Have the right to log in, accede students, manage attendance data, and <i>logout</i> .
3.	Student	Have the right to log in, fill out attendance, and <i>logout</i> .

Activity Diagram is a diagram that depicts the flow of functionality of the system. At the system modeling stage, *activity diagram* can be used to show the system workflow. Can also be used to describe the flow of events.

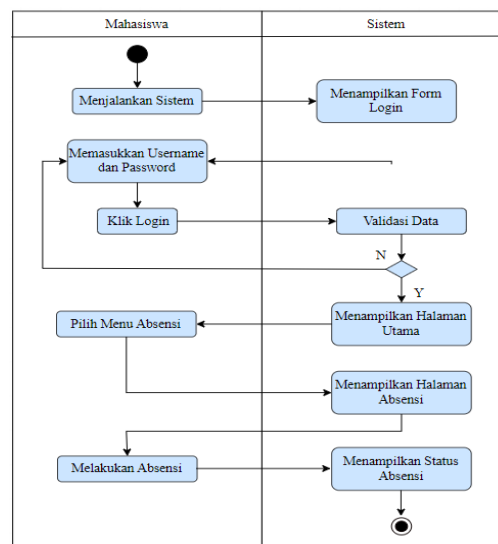


Figure 4. Proposed Activity Diagram

Figure 4 illustrates the workflow where students open the system and the system displays a login form. Then the student enters the username and password, the system will validate the data, namely in the form of checking the correctness of the username and password entered. If

the username and password entered are incorrect, the system will display a message in the form of a login failure and if the username and password entered that's right, then the system will process to the main page. After successfully entering the main page, students can select the attendance menu. Then the system will display an attendance page. Then students can take attendance for ongoing courses. After that, the system will display the status of the attendance that has been carried out.

Each Sequence Diagram has an action step that is started by the first actor, namely towards the interface. Sequence Diagrams are used to illustrate how objects interact sequentially over a time span. Despite its principle, Sequence Diagrams are utilized in the abstract layer of object models. The goal is to describe the series of messages sent between objects, interactions between objects, and events that occur at certain points in the system's execution.

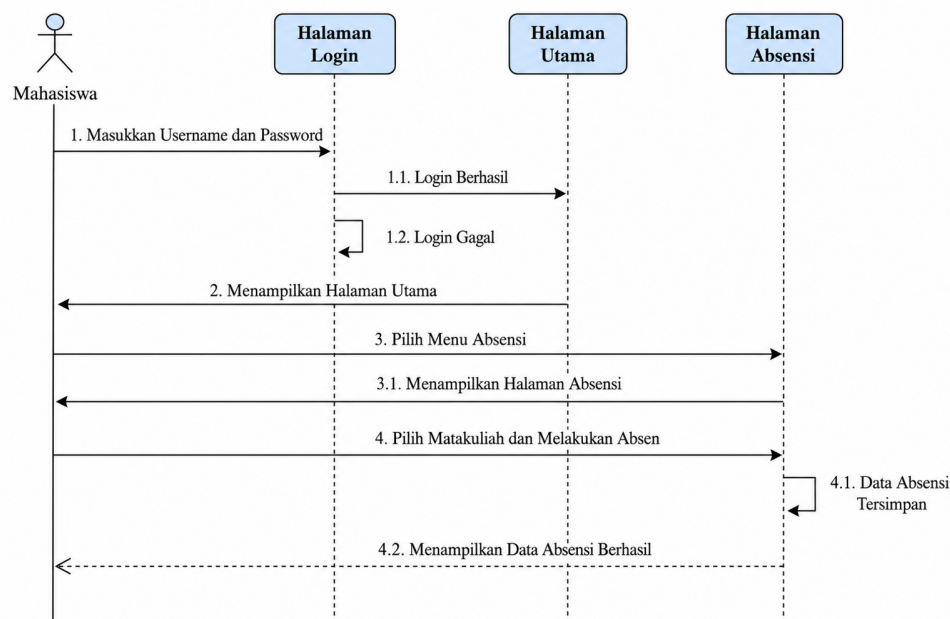


Figure 5. Proposed Diagram Sequence

In figure 5 above you can see that there are 3 classes that interact with each other, namely:

- a. Login Page
- b. Home Page
- c. Attendance Page

Figure 5 above is a Sequence Diagram of students when they want to take attendance on the system, the process starts with the student opening the system and then the system will display a login page. Then the student enters the username and password, the system will validate the data, namely in the form of checking the correctness of the username and password entered. If the username and password entered are correct, the system will process it to the main page. After successfully entering the main page, students can select the attendance menu. Then the system will display an attendance page. Then students can take attendance for ongoing courses. After that, the system will store student attendance data and display the status of the attendance that has been carried out.

3.3. Display Design

The display design process involves a deep understanding of the target user, the purpose of the product, and the context of use. The design team sought to integrate functional needs with design elements to produce an intuitive and effective experience for users. The following is a view of the Student Attendance System at the Android-based Global Institute:

a. System view

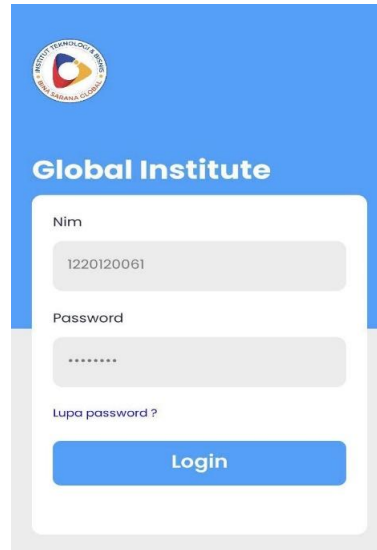


Figure 6. Login View

In figure 6 there is a menu display for logging in, where there are two columns, namely NIM and password, which must be input in order to enter the system.

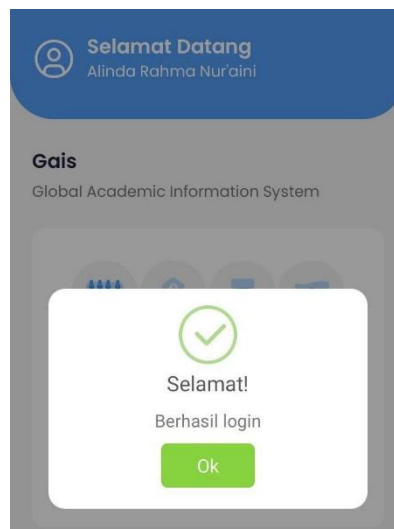


Figure 7. Display Successful Login

In figure 7 there is a view of successfully logging in. After successfully inputting the NIM and password, the system will display a safe and successful login

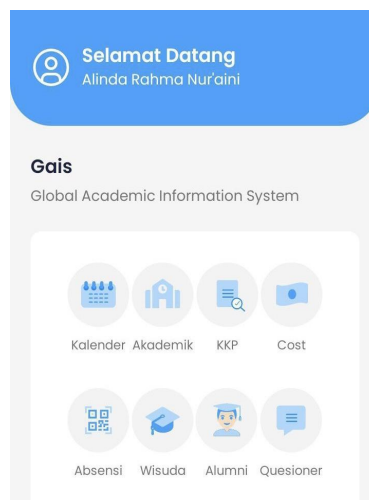


Figure 8. Home Page For Students

In figure 8 there is a main page that has been provided for students to access. Some of these menus include calendar, academic, kkp, cost, attendance, graduation, alumni and questionnaires. Each of these menus provides relevant students with access to different areas of life and experiences in the academic environment they experience.



Figure 9. Absence Page For Students

In figure 9 there is an absent page for students, before absenting students must filter the schedule according to the ongoing academic year. Then courses will automatically appear that have previously been taken by students and contain information about numbers, courses, rooms, QR scans and absenteeism. For a QR scan and a look at the absences is in the next image.

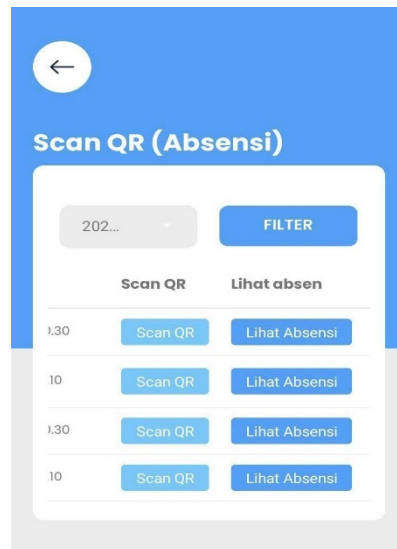


Figure 10. Home Page For Students

In figure 10 there is a continuation of figure 9 where the page is absent for students when moved to the left, there will be a QR scan and see attendance. When students click scan QR, a camera will immediately appear to scan the barcode. If the attendance has been opened by the lecturer, then the QR scan is successful. But if the attendance has not been opened by the lecturer, then a QR scan is not available. After that, if students want to see the attendance status of the course, students can see the attendance status by clicking view attendance. Then the attendance status will appear, whether the attendance status is successful or not.

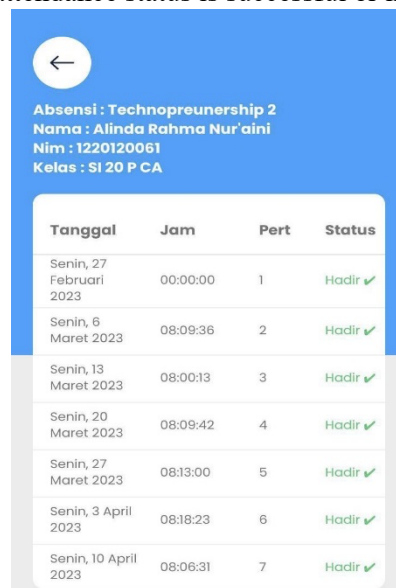


Figure 11. Attendance Status View

3.4 System Evaluation and Testing Results

A. Black-Box Testing

To ensure the functionality of the developed Global Academic Information System (GAIS), comprehensive Black-box testing was executed on key software requirements. The verification focuses on the system response toward various inputs.

Table 2. Black-Box Testing Matrix for GAIS Application

Test Case ID	Feature Tested	Input Scenario	Expected Result	Actual Result	Status
BB-01	User Login	Enter valid NIM and Password	System authenticates and redirects to Home Page	As expected	PASSED
BB-02	User Login	Enter invalid NIM / blank fields	System shows "Login failed" error alert	As expected	PASSED
BB-03	QR Filtering	Select academic year and click filter	Displays ongoing course schedule matching criteria	As expected	PASSED
BB-04	QR Scan	Scanning valid barcode opened by lecturer	Attendance successfully logged, status updates	As expected	PASSED
BB-05	QR Scan	Scanning barcode before opened by lecturer	System rejects scan, displays "QR not available"	As expected	PASSED

B. User Acceptance Testing (UAT)

A questionnaire-based usability evaluation was administered to 5 lecturers and 30 active students at the Global Institute to analyze the perception of system novelty, efficiency, and interface friendliness. The calculation uses a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

$$\text{FINAL SCORE (\%)} = \left(\frac{\text{Total score Obtained}}{\text{Maximum Possible Score}} \right) \times 100\%$$

Table 3. UAT Assessment Evaluation Metrics

No	Evaluation Variables	Category	Score Percentage
1	System Efficiency & Time Reduction	Lecturers / Students	89.2%
2	QR-Scanner Responsiveness & Reliability	Students	85.0%
3	User Interface (UI) Clarity and Navigation	Students / Lecturers	86.5%
4	Data Integrity & Auto-Recap Report Precision	Lecturers / Admin	89.3%
Average Acceptance Score			87.5% (Highly Acceptable)

4. RESULT AND DICUSSION

Unlike generic attendance tools, the GAIS application provides a closed-loop authentication protocol by binding the hardware IMEI or student identity token (NIM) during the active session. This structural addition eliminates proxy attendance ("titip absen"). Synthesizing the quantitative evaluation metrics, the transition from paper sheets to an automated server-side database model achieves structural efficiency, guaranteeing 100% clean logs that match the higher education reporting standards (PDDIKTI).

5. CONCLUSION

Based on activities during the analysis of the Android-based Student Attendance System process at the Global Institute, several conclusions can be drawn as follows:

- Attendance carried out by Global Institute students is still done manually, namely by filling in the attendance list on the paper sheet provided. This method takes quite a long time, so it is a waste of course time.
- An integrated student attendance system is needed that can make it easier for students to fill out absences. By using the PHP programming method as well as the MySQL database system.
- To create an Android-based student attendance system that can help Global Institute students fill out attendance lists and make it easier for lecturers to record grades.

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