

Utilization of Internet of Things (IoT) for Biometrics Attendance and Web-Based Student Monitoring

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ABSTRACT

SMPN 31 Tangerang aims to enhance the accuracy and efficiency of its student attendance system. The current problem is that the existing attendance system is easy to manipulate and lacks accuracy. This research aims to develop a biometric attendance system based on fingerprint technology to address these issues, with output presented in a web page format and without using paper. The methods used in this study include literature review, interviews, and observations for data collection. Development methods involve system design and the waterfall model. The developed attendance system utilizes IoT (Internet of Things) technology and electronic circuits to facilitate implementation and use. The research results show that the biometric fingerprint attendance system can improve student discipline. The system allows for attendance monitoring through a web interface, with data that can be backed up to Microsoft Excel. This device offers high accuracy, good attendance speed, and ease of use for students. In conclusion, the implementation of the biometric attendance system and web-based monitoring meets the school's needs for efficient and effective attendance management and monitoring.

1. Introduction

The government pays full attention to education that is greater than other sectors, because in this way, sectors in other fields will automatically also develop along with the development of education [1]. The national education system must be able to guarantee equal opportunities for education, improve the quality, relevance, and efficiency of education management to face obstacles in accordance with the demands of changes in life, both locally, nationally, and globally, so that it is necessary to carry out directed and planned education reforms [2]. One thing that can support learning activities, administrative activities, and school data management is the school information system. However, there are still many schools that have not used the school information system as a facility to help the learning process and various important information in the school [3]. The school information system can improve the effectiveness and performance of the school. With this school information system, it can help someone who needs information about a school by saving energy, time, and costs to come to the school location [4]. The benefits of discipline include training an individual to be more orderly and regular in living their life and discipline can foster a sense of sensitivity, concern, order, calm, self-confidence, independence and also obedience in a person [5]. Attendance is an activity carried out by a teacher to pay attention to student attendance every day. Usually the teacher calls

the name written in an attendance book and gives a mark of attendance or absence of a student. However, the attendance process does not always run smoothly, several problems are often experienced by teachers, such as books being left behind, lost, and damaged [6]. By instilling discipline in students, male and female students can adapt to their family and community environments [7].

Biometrics relates to an automatic identification of humans based on physiological or behavioral karate. In addition to having a relatively stable physiological basis, it is also influenced by the changing psychological conditions of humans, while physiological characters tend to be more stable. Physiological characters that tend to be stable will be useful for the future in determining a better future direction [8]. Moving towards a digital direction, biometric technology is increasingly popular. Fingerprints are based on a biometric system that automatically records attendance. Biometric authentication is used to eliminate proxies so that each student cannot provide attendance for other friends [9]. Fingerprint is a biometric authentication system to identify someone using one of the person's body parts, namely fingerprints. By using fingerprints, as an authentication medium, it will increase system security. Fingerprints are often used in authentication systems because they have quite high security because each individual has different fingerprints so that they

can easily reduce forgery [10]. The monitoring website is created using the PHP programming language and the MySQL database. The attendance monitoring interface is made with HTML, CSS, and JavaScript [11].

Previous research conducted by Syafira & Sidik in 2022, developed a research on an attendance system using web-based GPS. The difference between the author's research and Safira & Sidik, Safira & Sidik's research did not use a biometric system so that it was still possible to manipulate attendance, while the author's research used a biometric system with fingerprints so that the possibility of manipulation was smaller [12]. Previous research conducted by Haryogi et al. in 2022 was web-based daily report recording. The author developed research on the Web-Based Biometric Attendance and Monitoring System while Haryogi et al. research developed a Web-Based Daily Production Report Recording Information System. The difference between the author's research and Haryogi et al. lies in the system developed. The author developed a web-based attendance system while Haryogi et al. developed a web-based daily report recording system [13]. Previous research conducted by Kamal et al. in 2020 namely the effect of fingerprint attendance on improving employee work discipline at the Ministry of Communication and Informatics. The author developed research on the Web-Based Biometric Attendance and Monitoring System while Kamal et al. developed the Effect of Fingerprint Attendance on Improving Employee Work Discipline at the Ministry of Communication and Informatics. The difference between the author and Kamal et al. lies in the monitoring of attendance. The author uses web-based attendance monitoring while Kamal et al. still uses a conventional system for monitoring [14]. Previous research conducted by Napitu et al. in 2020 namely the design of a web-based attendance system at the PT UNIMUDA Sorong study program. The difference between the author and Napitu et al. lies in the technique of taking attendance. The author takes attendance using fingerprints while Napitu et al. still uses conventional methods for taking attendance. Napitu et al.'s research whose attendance taking still uses conventional methods is susceptible to manipulation, while the author's research has used fingerprints so that the attendance results are difficult to manipulate [15]. Previous research conducted by Yang et al. in 2020 namely Highly Sensitive Mutual - Capacitive Fingerprint Sensor With Reference Electrode. The difference between the author and Yang et al. lies in the research topic. The author uses a broader research topic, namely utilizing the fingerprint system as a biometric attendance with web-based monitoring, while Yang et al. more specifically researched fingerprint sensors and the fingerprint was not developed into an attendance but only explored. [16]

2. Method

2.1 Data Collection Method

The data collection methods used in this study are divided into 2 types, namely library studies and field studies.

Literature study are the first method. Data information collection is done by understanding, studying, researching and looking for references related to the research. Next is Field Study. Field study activities that aim to obtain data or facts directly on the problems taken. Field studies in this making were carried out directly at SMPN 31 Tangerang. The next method is Interview Method. Interviews are a way of collecting information by asking several questions directly to related stakeholders or sources who are used as sources of information. The last one is observation Method Direct observation or observation is a data collection technique by seeing field conditions directly, coming to the research location, and writing systematically about phenomena, symptoms and research objects.

The type of research used is qualitative research where the data obtained is based on research, interviews, and observations and supported by the use of literature studies. The data obtained will later be used in system development. System development means designing a new system to replace the old system as a whole or improving an existing system in the hope that the system will run well according to needs.

2.2 System Development Method

The data obtained will later be used in system development. System development can mean compiling a new system to replace the old system as a whole or improving an existing system. The method used for system development is the waterfall model.

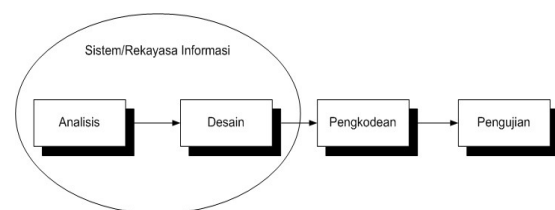


Figure 1. Waterfall model

From figure 1, we can see the first stage is Analysis. The process of gathering requirements is carried out intensively to specify software requirements so that it can be understood what kind of software is needed by the user. Second stage is Design. Software design is a multi-step process that focuses on the design of software program creation including data structures, software architecture, interface representations, and coding procedures. Third stage is Coding. The design must be translated into a software program. The result of this stage is a computer program in accordance with the design that was created in the design stage. The last

one is Testing. Testing focuses on software logically and functionally and ensures that all parts have been tested to minimize errors and the output must be appropriate. The selection of testing methods is carried out by using data that is often used for data processing, starting from operational data, input and output data.

3. Result and Discussion

The following is an explanation of the system that runs on the SMPN 31 Tangerang attendance system: First, students and teachers enter the classroom together. After that, the student who serves as secretary opens the agenda to start the attendance process. The teacher then calls students one by one to take attendance. During the attendance process, the teacher and the student who serves as secretary record the attendance. The student who is the secretary records it in the agenda, while the teacher records it in the attendance book.

The alternative solutions to the problem that the author provides are as follows: First, develop a system that can automatically record student attendance using fingerprint technology. Second, change the attendance recap mechanism that was previously done manually using paper into an automatic system. Third, create a website-based attendance monitoring system to increase effectiveness and efficiency in controlling the entry and exit times of students at SMPN 31 Tangerang.

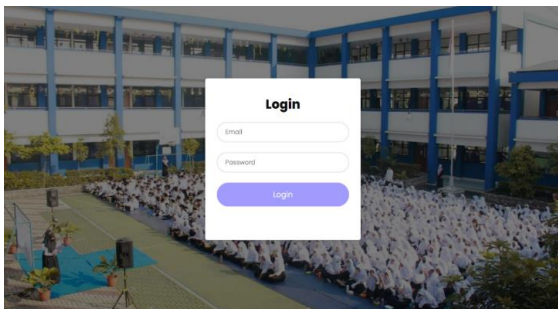


Figure 2. Login page

Figure 2 is a view of the login page. If the admin/teacher wants to log in, the display will look like figure 2.

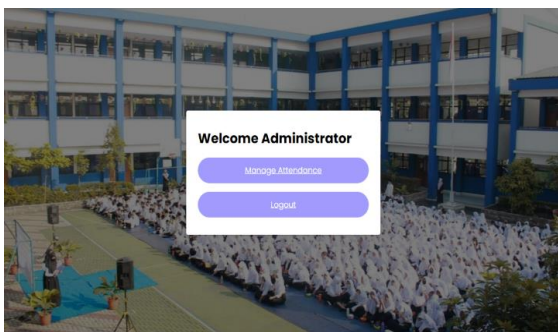


Figure 3. Home page

Figure 3 above is the home page display. If the admin or teacher successfully logs in, the display will

be like figure 3 above. There are 2 menus that can be accessed, namely the manage attendance menu to manage attendance and the logout menu to return to the login page.



Figure 4. Users Page

Figure 4 above is a display of the users page. The user page can be accessed after successfully logging in. This page is used to view registered user data.

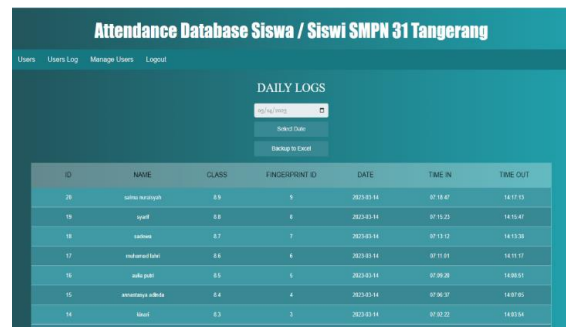


Figure 5. Users log page

Figure 5 above is a display of the users log page. Where the page can be accessed if the admin/teacher successfully logs in, then the main menu appears, click manage attendance, and click users log.



Figure 6. Manage user page

Figure 6 above is a display of the manage users page. Where the page can be accessed if you have successfully logged in, on the main page click manage attendance, and click manage users. The manage users page functions to manage users such as adding new users, deleting users, changing user data if there is an input error when registering attendance.



Figure 7. Initial view of the device series

The following is a description of the initial display of the circuit based on figure 7.

Table 1. Description of the initial display of the circuit

Name	Description
1 Fingerprint Sensor	Used for fingerprint registration and fingerprint attendance
2 Nodemcu ESP8266	Provides wireless features and accommodates scripts
3 LCD 128x32	Show notifications
4 Base plate nodemcu	Increase the volt and gnd pins nodemcu
5 Cooling fan	Stabilizing the ESP8266 temperature
6 Clock, temperature, volt sensor	Displays time, temperature and incoming volts

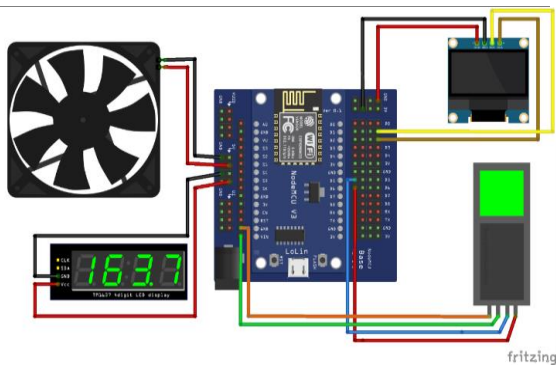


Figure 8. Design of fingerprint attendance device

The following Table 2 is a description of the electronic device circuit along with the main pins and target pins.

Table 2. Description of the main pins and target pins

Devices	Main Pins	Target Pins
1 Fingerprint sensor	GND sensor	GND nodemcu

		3v3 sensor	3v nodemcu
2	LCD OLED 126x32	GND LCD	GND nodemcu
		VCC LCD	3v nodemcu
		SCL LCD	D1 nodemcu
		SDA LCD	D2 nodemcu
3	Cooling fan	(-) Negative	GND nodemcu
		(+) Positive	3v nodemcu
4	Clock, Temperature, volt sensor	(-) Negative	GND nodemcu
		(+) Positive	5v nodemcu



Figure 9. Final view of fingerprint attendance device

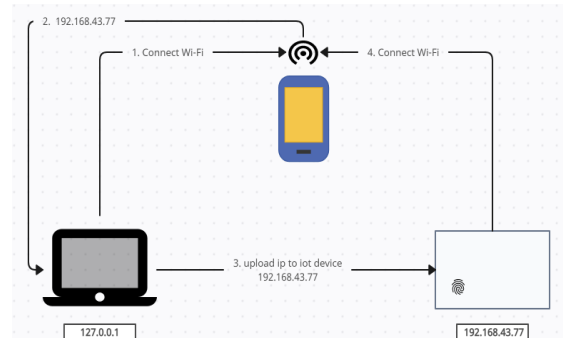


Figure 10. Design of fingerprint attendance network






Based on Figure 10, the sequence that will be carried out is as follows: First, Android turns on the hotspot connected to the internet, then sets the Wi-Fi name and password. Next, the laptop connects to Wi-Fi until it gets an IP address. After the laptop gets an IP address, enter the Wi-Fi name, Wi-Fi password, and IP address into the Node MCU ESP8266 script. Then, upload the script to the fingerprint attendance device. After that, the fingerprint attendance device will connect to Wi-Fi. Finally, run XAMPP on the laptop as a localhost server with the IP address 127.0.0.1.



Figure 11. Testing of fingerprint attendance network

Figure 11 above is a display of the fingerprint attendance network design that was tested. Where the laptop is a local server and the fingerprint attendance device is a client in a network.

Table 3. The result of fingerprint attendance device testing

Testing Scenario	Testing Result
1 Enter the wrong Wi-Fi SSID and password for fingerprint attendance then click "upload sketch"	
2 Enter the correct Wi-Fi SSID and password for fingerprint attendance, then click "upload sketch"	
3 Current position is not doing attendance, attendance list	
4 Register a fingerprint ID that has never been registered before, then click "add fingerprint ID"	
5 Attendance at the time of entry then "tap fingerprint"	

- Attendance at the time of going home then "tap fingerprint"



4. Conclusion

From the implementation of biometric attendance and web-based monitoring at SMPN 31 Tangerang, the following conclusions can be drawn: First, the research results indicate that using a biometric attendance system with fingerprint technology helps instill discipline as attendance is managed by the system and is difficult to manipulate. Second, the research shows that this system makes the attendance record-keeping process more efficient for administrators and teachers, as the system prevents issues such as paper records being lost, wet, or damaged. Third, the study concludes that the biometric attendance system with web-based monitoring reduces student indiscipline since arrival and departure times can be effectively monitored via the web.

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