Digital Attendance Using Student Identification Cards with Fuzzy Method at Khoirul Huda Islamic Boarding School 3

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Keywords: Digital Attendance, Student Identification Cards, Web Based Programming, Fuzzy Method.

Abstract: The Khoirul Huda 3 Islamic Boarding School also conducts attendance recording every month as a student discipline report, with manual recording it takes quite a long time. From this problem, the author offers a final project in the form of "Digital Attendance Using Santri Identification Cards with the Fuzzy Method at the Khoirul Huda Islamic Boarding School 3". The result of this research is an attendance system using a student identification card equipped with a barcode, attendance can be done lightly and recorded in real time on the website. To determine the punishment for students who violate the recitation, the fuzzy method is used to determine the punishment in accordance with the criteria for student violations. To avoid cheating or leaving an absence, before being absent using a student identification card, the student must identify the owner of the card by attaching a fingerprint to the Finger Print first. From the tests carried out, it was found that the percentage of successful barcode reading from a distance of 1 cm to 10 cm was 66.11% and the accuracy level of the fuzzy method implemented in the system was 99%.

1 INTRODUCTION

The growing number of Muslims on this earth has encouraged the growth of facilities and infrastructure that are also needed for Muslims. Khoirul Huda Student Islamic Boarding School is one of the Islamic boarding schools intended for students who are pursuing higher education in the city of Surabaya, which is located in the Medokan Semampir village, Sukolilo. This Islamic boarding school has a recitation schedule in which three hours a day are allocated for recitation activities. This three-hour time is then divided into two times, namely at night and at dawn where one hour is used to recite the Koran after dawn (05.00 to 06.00) and two hours after the Isha prayer (19.30 to 21.30) is used to recite the Koran at night. This lodge focuses on the activities of studying the interpretation of the Qur'an and Al-Hadith, where the book of hadith studied is the book of Hadith. This study includes interpretation and practice in everyday life (Warsito, 2022).

Attendance is a list of attendance of employees/students/teachers that contains the hours of arrival and departure times as well as the reasons or information for their attendance. Attendance data retrieval is currently still done manually so it has many shortcomings, such as invalid data due to errors in the attendance data input process by the admin manager and missing or damaged attendance forms because the form must be brought and then stored back (Maulani, Julian, Hakim, 2018). The Khoirul Huda 3 Islamic Boarding School has an attendance system as a parameter for monitoring student discipline in attending recitations. However, the attendance system at the Khoirul Huda 3 Islamic Boarding School is still manual so it is still experiencing problems as mentioned above.

From these problems, this project aims to create a digital attendance system. In which the attendance system can be done lightly by simply sticking the student's identity card on the reader or barcode scanner so that the results can be known quickly because the output will be displayed directly on the website. In addition, data will not be lost or scattered because all data will be inputted into the database and periodically upgraded as needed. To avoid cheating or leaving an absence, before being absent using a student identification card, the student must identify the card owner by attaching a fingerprint to the *Finger*

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Print first and then bringing the student identification card closer to the *Barcode Scanner*.

2 RELATED WORK

Attendance using a barcode is one solution to the problem of manual attendance. In the study, the researcher made a presence presence where the output of the system design was an automatic attendance program based on an information system with a barcode scanner for tutors at the Pesma KH Mas Mansyur International Islamic Boarding School. This attendance was developed with a waterfall model as well as a MySQL Database in the PHP programming language. The purpose of this digital presence is to report to his superiors which will influence decision making to improve pesma's academic section (Fahmi, 2018).

So that there is no mistake in filling in attendance data, it is necessary to monitor attendance in real time through the website. In the study, the researcher created a Web-based attendance system using a Barcode that can be used for every conference activity. The development of attendance systems uses the Spiral method which allows systematic and iterative development of the system for each of its features. The result of this study is an attendance system that can be used to take absences in each presentation session in a conference activity. The system can also display attendance reports for each presentation session and also the presentation sessions that are most in demand (Rotikan, 2016).

3 PROPOSED SYSTEM

An initial design of the system as a whole is required, which will later be processed as an individual system before finally being integrated after all processes have been successfully carried out. In general, several steps to achieve the desired results. These steps will be applied starting from data retrieval to activity classification. The following is a flow chart for the system to be designed.

3.1 Hardware Design

First step in making a digital attendance system is hardware design. In this hardware design, all the components needed are designed in such a way that the system can run properly. The components used are Esp32, Fingerprint R307, GM65 Barcode Scanner, Buzzer and Lcd. Everything is designed in advance on the Kicad application before assembly is carried out.

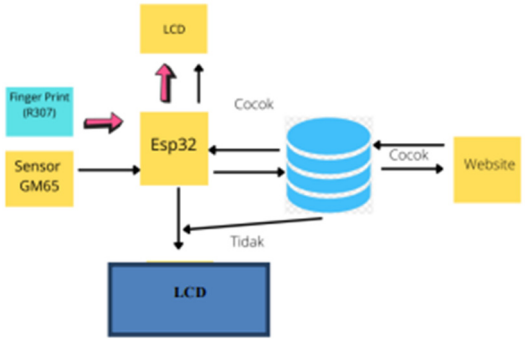

Figure 1: Design hardware.

3.2 Hardware Programming on Arduino IDE

After designing the hardware, the next step is to program the Arduino IDE. The program is made according to the components used and the ports and pins used. It is in programming that determines whether these components can run according to the desired system or not.

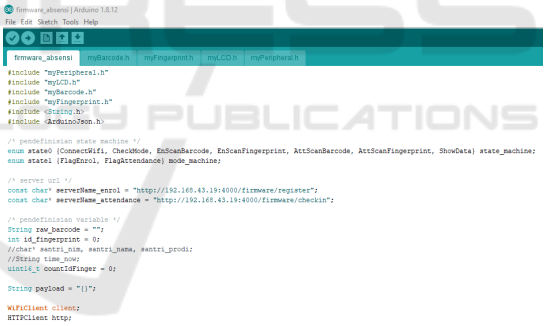

Figure 2: Programming on Arduino IDE.

3.3 Sensor Data Retrieval

Fingerprint Data Retrieval Fingerprints. Fingerprints are the result of reproduction of fingerprints, whether intentionally taken, stamped with ink, or marks left on objects because they have been touched by the skin of the palms of the hands or feet. Fingerprint is biomedical authentication that differs from one person to another, because one is different from another, fingerprints are usually used as data security. In this fingerprint data collection process, each student attaches or leaves his/her fingerprint to the Fingerprint sensor R307 in enrol mode which will then be stored in the database.

Figure 3: Fingerprint data retrieval.

3.4 Barcode Data Retrieval

Barcode (Bar Code / Cross Code / Bar Code) is an optical data techzeroogy that has a line or strip machine readable. These different codes serve to distinguish one product type from other products. Included in the student identification card at the Khoirul Huda Islamic Boarding School 3 also uses barcode to store student ID number data. In the barcode data collection process, each student must: attach the student identification card to the GM65 Barcode Scanner. What later from the data collection will be processed by the microcontroller to perform attendance and also stored into the database.

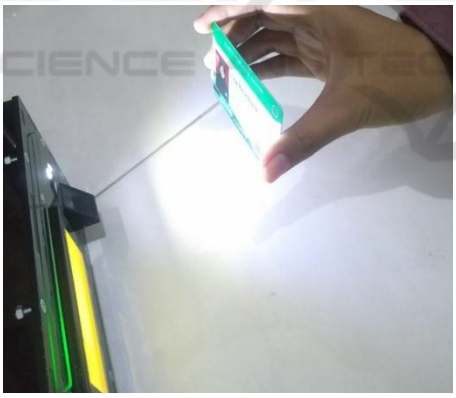

Figure 4: Data retrieval on barcode sensors.

3.5 Database Design

Database or database is a collection of data that is managed in such a way based on certain conditions interconnected so that it is easy to manage. Through this management, users can obtain relief in seeking information, storing information and disposing of information. Including to manage fingerprint and barcode data on this system, a database is used. That is data that has been detected by the sensor is entered into the database, it is useful if the sensor detects the incoming data and matches the database stored, then the process on the system can run and students can do attendance. But if the data detected on the sensor does not match the stored database, the process on the system will not work.

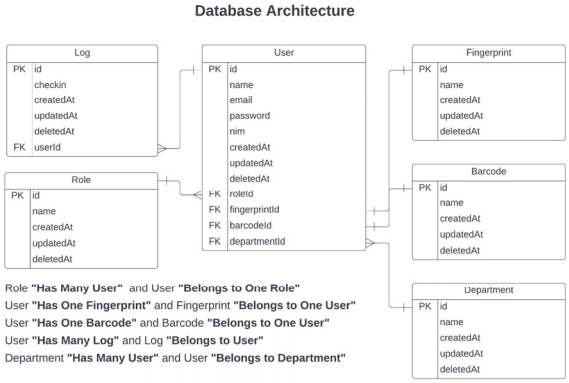

Figure 5: Database design.

3.6 Website Creation

Website is a collection of pages in a domain that contains various information so that it can be accessed read and viewed by internet users through a search engine. Information that can be contained in a Websites generally contain image, illustration, video, and text content for various purposes. The website on this system is used as attendance monitoring that has been carried out by sensors and microcontrollers, then the data obtained is placed in the database and the website can access the database by doing the following: the connection between the database and the API that has been created. In the web there are 2 sides, namely the user side and the admin side. On the user side will only display some information such as student data and attendance. While on the admin side need to log in first, and also admins can add information, edit and enter data required Website will be fully controlled by the Attendance Team as admin.

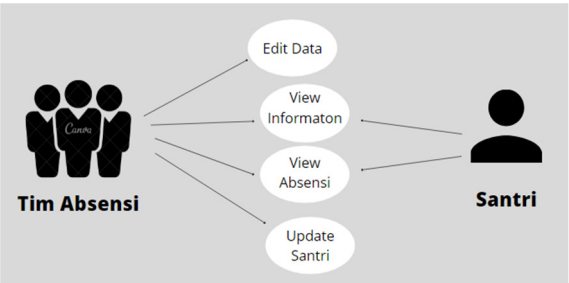

Figure 6: User website design.

3.7 Fuzzy Design

The design of fuzzy logic in research is used to determine the punishment for students who commit crimes violations in the form of neglecting recitation and late recitation. The Fuzzy Inference System (FIS) used is Fuzzy Sugeno. The stages of fuzzy design are:

3.7.1 Fuzzy Variable

In decision making, 2 input variables and 1 output variable are made, namely the missed recitation and late variables. And there is also an output in the form of action_punishment.

3.7.2 Linguistic Values

After determining the 3 variables, in each variable its linguistic value is determined, namely:

a. The alpha variable is divided into 4 inputs: Light, Medium, Heavy, Very Heavy.
b. The late variable is divided into 4 inputs: Small, Medium, Large, Very Large.
c. Action_punishment variable is divided into 4 inputs: Light, Medium, Heavy, Very Heavy.

3.7.3 Fuzzyfication

Fuzzyfication is a mapping of crisp values into fuzzy sets and determines the degree of membership in the fuzzy set. In general, the mapping is as shown below:

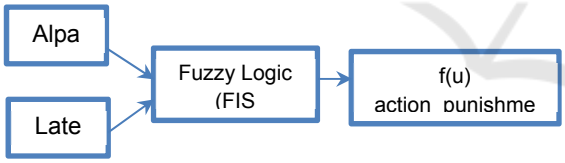

Figure 7: Fuzzy design.

Based on the FIS above, the mapping is as follows:

a. The alpha variable has a range of values between a minimum of 0 and a maximum of n. The alpha variable is divided into five inputs, namely zero, light, medium, heavy and Very Heavy. each with a range of values as follows:

Table 1: Alpa variabel.

Linguistic values	*Range*
Zero	0
Light	0-2
Medium	1-3
Heavy	2-4
Very Heavy	3-*n*

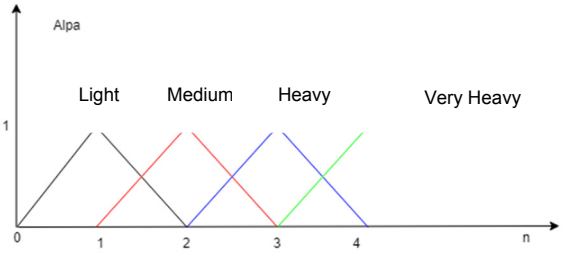

Figure 8: Input graphic variabel alpa.

Calculation of the five variables obtained four different functions, namely the three functions and the trapezoid function. After this is the calculation of the four functions, namely:

$$\mu|Zero| = 1; x = 0 \quad (1)$$

First Triangle Curve: Light $\mu|Light| = \{0;\ x \le 1 or\ x \ge 1\ \frac{x-0}{1-0}; 0 \le x \le 1\ \frac{-(x-2)}{2-1}; 1 \le x \le 2\}$ (2)

Second Triangle Curve: Medium

$$\mu|Medium| = \{0;\ x \le 1\ or\ x \ge 3\ \frac{x-1}{2-1}; 1 \le x \le 2\ \frac{-(x-3)}{3-2}; 2 \le x \le 3\} \quad (3)$$

Third Triangle Curve: Heavy

$$\mu|Heavy| = \{0;\ x \le 2\ or\ x \ge 4\ \frac{x-2}{3-2}; 2 \le x \le 3\ \frac{-(x-4)}{4-3}; 3 \le x \le 4\} \quad (4)$$

First Trapezoidal Curve: Very heavy

$$\mu|Very\ Heavy| = \{0;\ x \le 3\ \frac{x-3}{4-3}; 3 \le x \le 4\ 1; x \ge 4\} \quad (5)$$

The late variable has a range of values between a minimum of 0 and a maximum of n. The alpha variable is divided into five inputs, namely zero, small, medium, large and very large. each with a range of values as follows:

Table 2: Alpa Variable.

Nilai Linguistic	*Range*
Zero	0
Little	0-6
Medium	3-9
Big	6-12
Very big	9-n

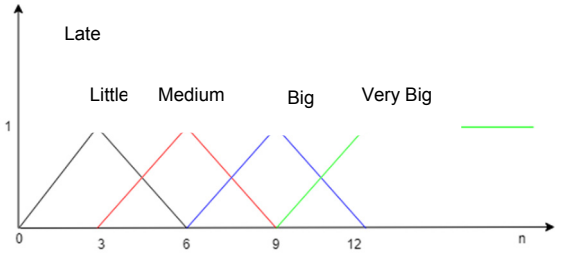

Figure 9: Input graphic variabel late.

Calculation of five variables obtained four different functions, namely 3 triangular functions and one trapezoidal function. After this is the calculation of the four functions, namely:

$$\mu|Nol| = 1; x = 0 \quad (6)$$

First Triangle Curve : Little $\mu|Kecil| = \{0;\ x \leq 0\ or\ x \geq 3\ \frac{x-0}{3-0}; 0 \leq x \leq 3\ \frac{-(x-6)}{6-3}; 3 \leq x \leq 6\}$ (7)

Second Triangle Curve: Medium

$$\mu|Medium| = \{0;\ x \leq 3\ or\ x \geq 9\ \frac{x-3}{6-3}; 3 \leq x \leq 6\ \frac{-(x-9)}{9-6}; 6 \leq x \leq 9\} \quad (8)$$

Third Triangle Curve : Big

$$\mu|Big| = \{0;\ x \leq 6\ or\ x \geq 12\ \frac{x-6}{9-6}; 6 \leq x \leq 9\ \frac{-(x-12)}{12-9}; 9 \leq x \leq 12\} \quad (9)$$

First trapezoidal curve: Very big $\mu|Very\ Big| = \{0;\ x \leq 9\ \frac{x-9}{12-9}; 9 \leq x \leq 12\ 1; x \geq 12\}$ (10)

b. Action_punishment variable is divided into 4 outputs, namely Light Punishment, Moderate Punishment, Hard Punishment and Very Hard Punishment. Fuzzy Rules or fuzzy rules set amounted to 25 rules. The rule determines how heavy the penalty is.

Table 3: Fuzzy rules.

No	Input		Output
	Alpa	Late	Action_Punishment
1	Zero	Zero	No Punishment
2	Zero	Little	Light Punishment
3	Zero	Medium	Light punishment
4	Zero	Big	Medium punishment
5	Zero	Very big	Heavy punishment
6	Light	Zero	Light punishment
7	Light	Little	Light punishment
8	Light	Medium	Light punishment
9	Light	Big	Medium punishment
10	Light	Very big	Punishment Medium
11	Medium	Zero	Light punishment
12	Medium	Little	Light punishment
13	Medium	Medium	Medium punishment
14	Medium	Big	Medium punishment
15	Medium	Very big	Medium punishment
16	Heavy	Zero	Medium punishment
17	Heavy	Little	Heavy punishment
18	Heavy	Medium	Heavy punishment
19	Heavy	Big	Heavy punishment
20	Heavy	Very big	Heavy punishment
21	Very heavy	Zero	Heavy punishment
22	Very heavy	Little	Heavy punishment
23	Very heavy	Medium	Very heavy punishment
24	Very heavy	Big	Very heavy punishment
25	Very heavy	Very big	Very heavy punishment

c. Implications and Defuzzification. The Fuzzy Sugeno method uses the minimum implication function (MIN). For defuzzification using the weight average method.

$$z* = \frac{\sum ai\ zi}{\sum ai} \quad (11)$$

To make it easier to read the value of the punishment according to the weight of the violations committed by the students, it can be seen in the table below.

Table 4: Range violation.

Linguistic Value	*Range*
No Punishment	$0 < x \leq 1$
Light Punishment	$1 < x \leq 2$
Medium Punishment	$2 < x \leq 3$
Heavy Punishment	$3 < x \leq 4$
Very Heavy Punishment	$4 < x \leq n$

4 RESULT AND ANALYSIS

After the digital attendance system is realized, it is necessary to carry out various tests to find out how the device works and analyze the level of reliability,

weaknesses and limitations of the functional specifications of the system that has been created. In addition, this test is also carried out to find out about how to condition the system so that it can be used optimally.

4.1 Reader Testing on Digital Attendance Systems

4.1.1 Testing the Time Lag Required in Reading Barcode Scanner Tags

Table 5: Testing the time lag required in reading barcode scanner tags.

Sample card	1 second	2 second	3 second	4 second	5 second
Card 1	√	√			
Card 2		√	√		
Card 3		√	√		
Card 4	√	√			
Card 5	√	√			
Card 6		√	√		
Card 7	√	√			
Card 8	√	√			
Card 9	√√				
Card 10	√√	√			
Card 11	√	√			
Card 12		√	√		
Card 13	√	√			
Card 14	√	√			
Card 15		√	√		
Card 16		√√			
Card 17	√	√			
Card 18		√√			
Card 19	×	×	×	×	×
Card 20	×	×	×	×	×
Card 21	×	×	×	×	×
Card 22	×	×	×	×	×

From the tests that have been carried out, it is found that, the lag time required for reading Barcode Scanner tag is a time range of 1 second to 3 seconds. As for cards 19 to 22 can't be read because the barcode on the card doesn't have a good print or can be said to be damaged, so Barcode Scanner cannot read.

4.1.2 Testing the Distance Required by the Barcode Scanner Sensor in Reading the Barcode on the Card Student Sign

Table 6: Barcode scanner sensor distance test in barcode reading.

Sample Card	1 cm	2 cm	3 cm	4 cm	5 cm	6 cm	7 cm	8 cm	9 cm	10 cm
card 1	?	?	?	✔	✔	✔	✔	✔	✔	✔
card 2	?	?	?	✔	✔	✔	✔	✔	✔	✔
card 3	?	?	?	✔	✔	✔	✔	✔	✔	✔
card 4	?	?	?	?	✔	✔	✔	✔	✔	✔
card 5	?	?	?	✔	✔	✔	✔	✔	✔	✔
card 6	?	?	?	✔	✔	✔	✔	✔	✔	✔
card 7	?	?	?	✔	✔	✔	✔	✔	✔	✔
card 8	?	?	?	✔	✔	✔	✔	✔	✔	✔
card 9	?	?	?	?	✔	✔	✔	✔	✔	✔
card 10	?	?	?	✔	✔	✔	✔	✔	✔	✔
card 11	?	?	?	✔	✔	✔	✔	✔	✔	✔
card 12	?	?	?	?	✔	✔	✔	✔	✔	✔
card 13	?	?	?	✔	✔	✔	✔	✔	✔	✔
card 14	?	?	?	✔	✔	✔	✔	✔	✔	✔
card 15	?	?	?	?	✔	✔	✔	✔	✔	✔
card 16	?	?	?	?	✔	✔	✔	✔	✔	✔
card 17	?	?	?	?	✔	✔	✔	✔	✔	✔
card 18	?	?	?	?	✔	✔	✔	✔	✔	✔
card 19	?	?	?	?	?	?	?	?	?	?
card 20	?	?	?	?	?	?	?	?	?	?
card 21	?	?	?	?	?	?	?	?	?	?
card 22	?	?	?	?	?	?	?	?	?	?

$$Percentage\ Of\ Success = \frac{Lots\ Of\ Success}{Lots\ Of\ Trials} \quad (12)$$

Table 7: Success percentage.

Sample Card	Many Successes	Number Of Trials	Success Percentage
card 1	7	10	70%
card 2	7	10	70%
card 3	7	10	70%
card 4	6	10	60%
card 5	7	10	70%
card 6	7	10	70%
card 7	7	10	70%
card 8	7	10	70%
card 9	6	10	60%
card 10	7	10	70%
card 11	7	10	70%
card 12	6	10	60%
card 13	7	10	70%
card 14	7	10	70%
card 15	6	10	60%
card 16	6	10	60%
card 17	6	10	60%
card 18	6	10	60%
card 19	0	10	0%
card 20	0	10	0%
card 21	0	10	0%
card 22	0	10	0%

$$Average\ Success\ Percentage = \frac{Total\ of\ success\ percentage}{total\ sample} = \frac{1190\%}{18} = 66{,}11\% \quad (13)$$

From the tests carried out, it was found that the distance between the student identification card and the Barcode Scanner that could be detected was from a distance of 3cm to 10 cm. And the average success of all trials is 66.11%.

4.1.3 Fingerprint Best Condition Test for Fingerprint Sensor Reading

Table 8: Condition fingerprint dry.

Sample Fingerprint	Condition Fingerprint	Time Required
Id 1	Dry	Detected
Id 2	Dry	Detected
Id 3	Dry	Detected
Id 4	Dry	Detected
Id 5	Dry	Detected
Id 6	Dry	Detected
Id 7	Dry	Detected
Id 8	Dry	Detected
Id 9	Dry	Detected
Id 10	Dry	Detected
Id 11	Dry	Detected
Id 12	Dry	Detected
Id 13	Dry	Detected
Id 14	Dry	Detected
Id 15	Dry	Detected
Id 16	Dry	Detected
Id 17	Dry	Detected
Id 18	Dry	Detected

Table 9: Condition fingerprint wet.

Sample Fingerprint	Condition Fingerprint	Time Required
Id 1	Wet	Not detected
Id 2	Wet	Not detected
Id 3	Wet	Not detected
Id 4	Wet	Not detected
Id 5	Wet	Not detected
Id 6	Wet	Not detected
Id 7	Wet	Not detected
Id 8	Wet	Not detected
Id 9	Wet	Not detected
Id 10	Wet	Not detected
Id 11	Wet	Not detected
Id 12	Wet	Not detected
Id 13	Wet	Not detected
Id 14	Wet	Not detected
Id 15	Wet	Not detected
Id 16	Wet	Not detected
Id 17	Wet	Not detected
Id 18	Wet	Not detected

From the fingerprint condition testing carried out, it can be seen that the Fingerprint Sensor only can only detect fingers or perform fingerprint readings, when the finger is dry. Whereas when the finger is

wet the Fingerprint Sensor can't read the fingerprint either registered or unregistered.

4.1.4 Testing the Time Required in Reading the Fingerprint Sensor Tag

Table 10: Testing the time required in reading the fingerprint sensor tag.

Sample Fingerprint	1 second	2 second	3 second	4 second	5 second
Id 1	√√	√			
Id 2	√√	√			
Id 3	√√√				
Id 4	√√√				
Id 5	√√	√			
Id 6	√√	√			
Id 7	√	√√			
Id 8	√√√				
Id 9	√√	√			
Id 10	√√	√			
Id 11	√√	√			
Id 12	√√	√			
Id 13	√√	√			
Id 14	√	√√			
Id 15	√√	√			
Id 16	√√	√			
Id 17	√√	√			
Id 18	√	√√			

From testing the time lag for reading the Fingerprint Sensor tag, it was found that the length of time Fingerprint Sensor to be able to detect fingerprints is for 1 second to 2 seconds. At that time The Fingerprint Sensor can read new fingerprints as well as registered fingerprints previously.

5 CONCLUSION

To be able to connect between the hardware and the server must use the same network. which is the time required for barcode reading ranges from 1 second to 3 seconds. The percentage of successful barcode reading from a distance of 1cm to 10 cm is 66.11%. and the distance that can be detected by the barcode reader in reading the barcode on the student sign card is at a distance of 5 cm to a distance of 10 cm. Furthermore, the Fingerprint reader can read on all registered fingers, be it the thumb, index, medium, ring, and little fingers. Fingerprint reader can only read fingerprints in a dry state. and Fingerprint reader cannot print in wet condition. The time lag required in reading the Fingerprint Sensor is in the range of 1 second to 2 seconds. The level of accuracy of the fuzzy method implemented in the system is 99%.

REFERENCES

Warsito, E. (2022). "Studi Kasus Di Pondok Pesantren Mahasiswa Khoirul Huda Surabaya,". Universitas Islam Negeri Sunan Ampel, Surabaya.

Maulani, M. R., Julian, A., Hakim, L. L. (2018). "Rancang Bangun Aplikasi Absensi Perkuliahan Berbasis Clien-Server Menggunakan Tekzeroogi Rfid (Radio Frequency Identification),". *Jurnal Teknik Informatika.* Vol., X. No., 3. Pp., 12-16.

Fahmi, R. B. (2018). "Information System-Based Automated Tutor Attendance Using Barcode Scanner In International Boarding School Pesma Kh Mas Mansyur,". Universitas Muhammadiyah Surakarta, Surakarta.

Fadlil, A., Firdausy, K., Hermawan, F. (2008). "Pengembangan Sistem Basis Data Presensi Perkuliahan Dengan Card Mahasiswa Ber-Barcode,". *TELKOMNIKA.* Vol., VI. No., 1. Pp., 65-72.

Rotikan, R. (2016). "Sistem Informasi Absensi Berbasis Web Untuk Kegiatan Konferensi,". *Jurnal Ilmiah SISFOTENIKA.* Vol., VI. No., 1. Pp., 46-55.

Fahreza, A. T. (2019). "Rancang Bangun Sistem Autentikasi Penyewa Kamar Kos Menggunakan QR Code Bebasis Iot,". Politeknik Negeri Medan, Medan.

Amin, F. N. (2016). "Timbangan Berbasis Arduino Dengan Output Lcd Dan Suara,". Universitas Nergeri Semarang, Semarang.

Fani, H. A., Sumarno, Jalaluddin, Hartama, D., Gunawan I. (2022). "Perancangan Alat Monitoring Pendeteksi Suara Di Ruangan Bayi RS Vita Insani Berbasis Arduino Menggunakan Buzzer,". *Jurnal Media Informatika BUDIDARMA.* Vol., IV. No., 1. Pp. 144-149.

Nugroho, K. (2016). "Model Analisis Prediksi Menggunakan Metode Fuzzy Time Series,". *Infokam.* Vol., I. No., 12. Pp., 46-50.

Suryono, E. (2019). "Perancangan Sistem Absensi Fingerprint Berbasis Arduino Dengan Notifikasi Telegram,". Universitas Kristen Satya Wacana, Salatiga.

Silvia, A. F., Haritman, E., Muladi, Y. (2014). "Rancang Bangun Akses Kontrol Pintu Gerbang Berbasis Arduino Dan Android,". *Electrans.* Vol., XIII. No., 1. Pp., 1-10. Yuliansyah, H. (2016). "Uji Kinerja Pengiriman Data Secara Wireless Menggunakan Modul ESP32 Berbasis Rest Architecture,". *Electrician-Jurnal Rekayasa Dan Teknik Elektro.* Vol., X. No., 2. Pp., 68-77.