A Boarding School Santri Supervision System Design Based on Android Application to Replace the Rule of Dormitory Supervisor

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***Abstract*— An Islamic educational facility called a pesantren houses students, or santri, in dormitories. One of the biggest Islamic boarding schools in Jombang is called Darul 'Ulum. Students are expected to participate in early recitation activities, are forbidden from smoking, are forbidden from visiting the student rooms without the coach's permission, and are forbidden from entering the guest rooms. This research used a case study of a high school dormitory as an example. For proper monitoring of student breaches, a high number of students demand more efficient supervision. Based on these issues, a monitoring system is required that may alert the hostel supervisor to infractions in real-time, allowing them to take fast action against violators and impose sanctions in line with the seriousness of the offenses. This study uses an android application monitoring of students. According to the results of testing violations of students who smoke in the room using the MQ-2 sensor with 10 test trials, a 100% success rate is obtained in detecting cigarette smoke, and testing violations of students who are still in the room at the time of the early Koran reading with using a PIR sensor with 10 test trials, the success rate was 100% in detecting the presence of students. Both the RFID sensor test and the fingerprint sensor test resulted in delays of 1.59 seconds and 3.01 seconds, respectively, with 100% success rates.**

***Keywords*— Islamic Boarding School, Supervision, Application, Android, Microcontroller ESP32.**

I. INTRODUCTION

Boarding school is an institution that has existed in Indonesia for hundreds of years since the arrival of Islam in Indonesia. Pondok Pesantren is an Islamic educational institution that is institutionalized in Indonesia which is still in great demand. An Islamic boarding school is basically a traditional Islamic education dormitory where students (santri) live together and study under the guidance of a teacher who is better known as a "kiai" [1]. Pesantren has a set of rules set out in the regulations of the pesantren. Inside the dormitory there are rules and regulations, including students who are required to take part in the early morning reading activities and early morning prayers, smoking is prohibited, students are prohibited from entering the students' rooms without the permission of the supervisor, and students are prohibited from entering the guest rooms, and so on. But the reality on the ground, not all students obey all the rules that apply in the pesantren, there are several cases that occurred in the Darul Ulum Islamic Boarding School Dormitory, including students smoking in their rooms, students not taking part in the recitation of ba'da isya and dawn, and students enter the guest room.

Previous research related to the discipline of students against the rules of the cottage, namely the research of Mochammad Baihaqi, M. Turhan Yan with the title Santri's Motives in Committing Violations at the Modern Darul Ulum Islamic Boarding School, Peterongan Jombang. This study discusses the motives of students who commit violations at the Darul Ulum Islamic boarding school. There are 3 motives of violations committed by students. First, the biogenetic motive, in this case the santri commits violations in the form of smoking, carrying mobile phone s, and interacting with the opposite sex. Second, this sociogenetic motive can be seen from the students' violations, namely addiction, leaving without permission, and skipping the Koran. Third, this theogenetic motive can be seen from the students' violators, namely they do not yet have awareness in divinity, the violation committed is not participating in congregational prayers [2].

Based on the data on cases of violations that occurred in the Darul Ulum boarding school dormitory, such as: students are required to take part in the early isya and dawn prayer activities, smoking is prohibited, entering the students' rooms without the permission of the supervisor, and students are prohibited from entering the guest rooms. The large number of students and the limited number of dormitory supervisors causes supervision of students to be less effective, related to the supervision of the Darul Ulum boarding school, which has implemented a CCTV system, there are 30 cameras as an effort to prevent student violations, but CCTV cameras have several shortcomings including being monitored for 24 hours. and does not provide real-time information when violations occur, such as: unable to detect smoke when there are students who commit smoking violations in the room and cannot detect students who do not participate in diniah activities. The number of students in the Darul Ulum Boarding School Jombang Dormitory is not proportional to the number of existing coaches, so a device is needed that can monitor student violations directly or in real time [3].

Based on the problems described above, new ideas and innovations were created. As a result, a study titled "Designing a Supervisory System for Pondok Tinggi Santri Dormitory to Replace the Role of Android Application-Based Dormitory Trustees" was conducted. To develop a technology that can alert instructors in real time when students violate the rules so that they may investigate the infractions immediately and impose punishments as necessary.

Several similar studies have been conducted, such as [4] The results of this study are the Android-based Santri Activity Monitoring Application using a qualitative research type, while the data collection method uses observation, interviews, and literature studies. A tool that can assist pesantren managers by leveraging Internet of Things (IoT) technology has been developed as a result of study [5] at the Nurul Jadid Islamic Boarding School (PPNJ). Administrators only get telegram messages from this tool, which is designed to assist them follow up on students who breach it. This tool uses nodeMCU ESP8266 as a microcontroller which is equipped with a wifi module. Other researchers created a monitoring system for cigarette smoke detectors that had been developed from previous research to control violations that occurred. This cigarette smoke monitoring system connects the microcontroller with telegrams on smartphones, laptops and computers so that the monitoring range becomes wider. This tool will automatically turn on when cigarette smoke is detected. Inside the cigarette smoke detector there is a Wemos D1 ESP8266 microcontroller. While the cigarette smoke sensor uses the MQ-135. [6]

Microcontroller is a breakthrough in microcomputer technology that is used to handle a particular application [7]. The microcontroller has limited RAM and ROM than microcomputer [8]. Along with the development of electronics, microcontrollers are made more compact with programming languages that also change [9]. The advantages of ESP32 microcontroller with built-in camera compared to ESP8266 [10]. In terms of Bluetooth and Wi-Fi, ESP32 has been integrated in a System on Chip, including the camera used in this study.

The number of applications based on the Android platform is increasing rapidly now [11]. The Android OS is becoming the mobile platform of choice for an increasing number of users. People rely on Android mobile devices for surfing the web, purchasing products, or to be part of a social network [12].

Android comes with a few different notions of “Version”. android has platform numbers, API levels, codename, and probably some other versioning schemes. The versioning schemes don’t increase in lockstep. An android version may have variations. [13]

In this study using several sensors such as a fingerprint sensor, MQ-2 smoke sensor, PIR sensor, and door lock solenoid. Solenoid is an automatic lock sensor, which can be controlled by Arduino and works. When given a 12V voltage, inside the solenoid there is a wire wrapped around an iron core [14]. The PIR (Passive InfraRed) sensor is a sensor specifically designed to detect signals in the form of thermal radiation at infrared wavelengths, which are produced by every living thing. MQ-2 smoke sensor for sensing gas or smoke [15].

II. METHOD

A. The System Block Diagram

The research method used in making this journal is to carry out several stages ranging from literature studies, hardware planning, software planning to the manufacturing process to implementing the system that has been created. The design of the student and guest room system that will be carried out in this study is shown in the following figure.

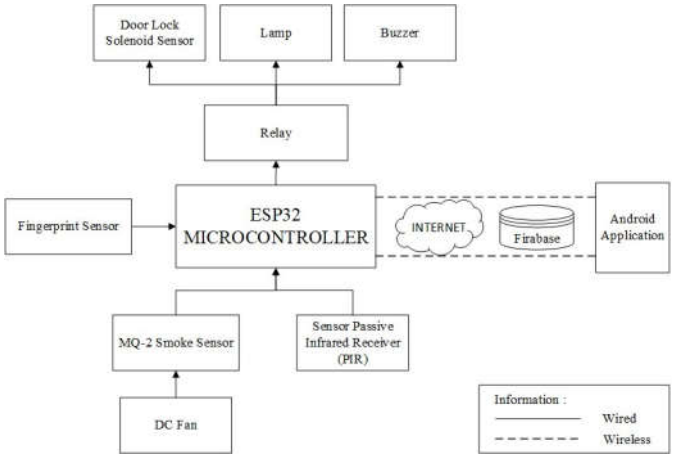

Figure 1. Block Diagram of the santri room system

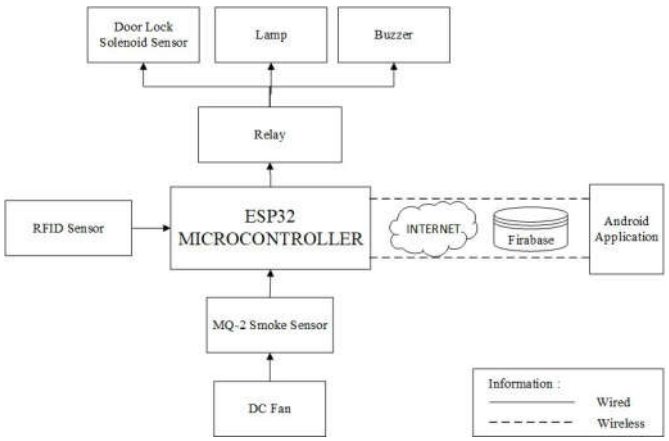

Figure 2. Guest room system block diagram

In figure 1. The block diagram above can be described regarding the process of monitoring students, in each student room consisting of a fingerprint sensor, MQ-2 smoke sensor, PIR sensor, door lock solenoid, 5 Volt DC LED light, buzzer. The fingerprint sensor functions as access to enter the student's room and as a monitoring tool for the presence of students in the room. The MQ-2 smoke sensor functions as a smoke detector. PIR sensor functions as used to detect human presence. The solenoid door lock functions as a lock for the bedroom door.

In figure 2. The block diagram above can be described regarding the process of monitoring guest rooms, in each guest room consisting of a Radio Frequency Identification (RFID) sensor, an MQ-2 smoke sensor, a door lock solenoid, a 5 Volt DC LED light, a buzzer. The Radio Frequency Identification (RFID) sensor functions as access to enter guest rooms. The MQ-2 smoke sensor functions as a smoke detector. The solenoid door lock functions as a room door lock.

B. The System Workflow

The flow diagram for designing a hardware system for student and guest rooms is shown in the following figure:

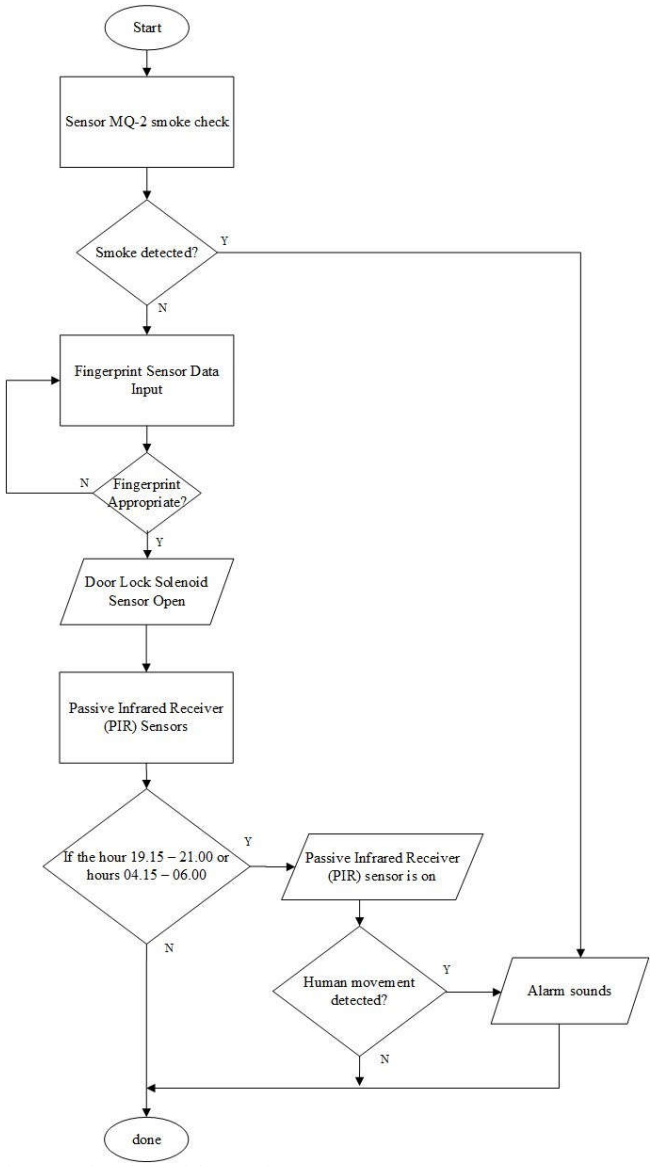

Figure 3. Flowchart of the santri room system

When students enter the room, they will do a fingerprint scan, the data from the scan results will be matched in the database if the data matches the security door Solenoid door lock as the room door lock will open, if someone unknown tries to enter the fingerprint 5 times then the alarm will sound and send a notification to the mobile phone hostel builder. When there are students smoking in the room, the MQ-2 smoke sensor will detect the presence of cigarette smoke so that it will trigger an alarm to sound and send a notification to the hostel supervisor's mobile phone. At the time of the early recitation, there are students who are still in the room, the PIR sensor will detect the presence of the students so that it will trigger an alarm to sound and send a notification to the hostel supervisor's mobile phone. All sensor data received by the microcontroller will be sent via the wifi network and will be stored in the database which will then be displayed on the android application found on the hostel supervisor's mobile phone, so that the supervisor can easily supervise the students.

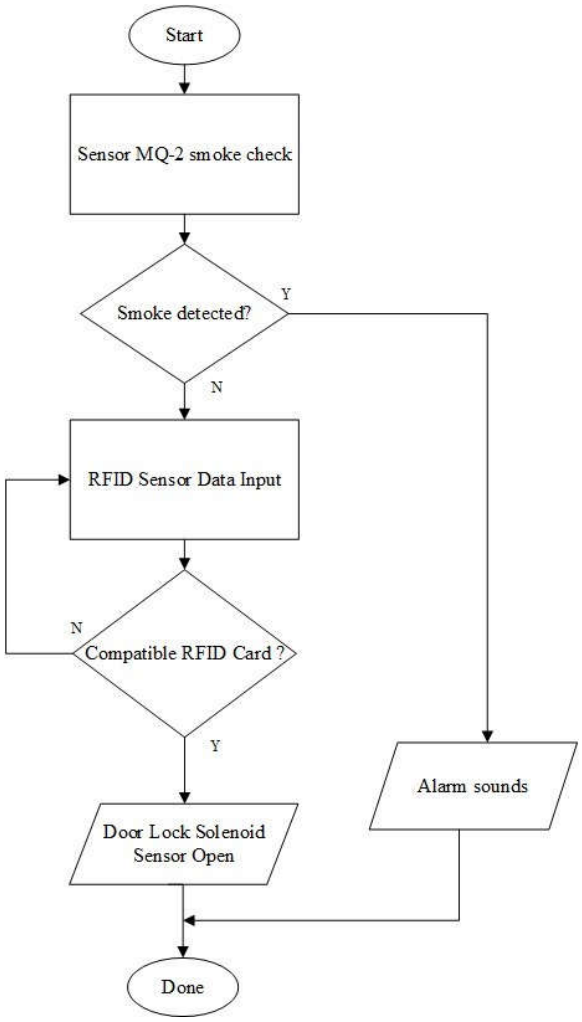

Figure 4. Guest room system flowchart

When there are guardians of students who want to stay in the dormitory, the guardians of students are required to report to the hostel supervisor, after reporting the hostel supervisor will provide a guest room access card. Guardian students who will enter the guest room will TAB the access card to the RFID Reader near the door, the data from the card scan will be matched in the database if the data matches the Solenoid door lock as the room door lock will open, if someone unknown tries

to open the door with the card the wrong thing is that the card you have is access to room 1 but that person does TAB in room 2 then the door of room 2 will not open but there will be a notification on the LCD monitor "sorry, you are in the wrong room". When there are guardians of students / guests who smoke in the room, the MQ-2 smoke sensor will detect the presence of cigarette smoke so that it will trigger an alarm to sound and send a notification to the hostel supervisor's mobile phone. All sensor data received by the microcontroller will be sent via the wifi network and will be stored in the database which will then be displayed on the android application found on the hostel supervisor's mobile phone, so that the supervisor can easily carry out supervision.

C. Tool Implementation Results

Figures 5. and 6. are the result of designing the implementation of a tool for monitoring student rooms and rooms. Each sensor component is connected according to the pins that have been designed to the esp32 microcontroller.

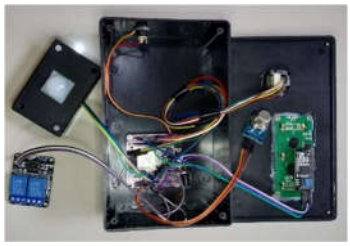

Figure 5. Implementation of student room supervision tools

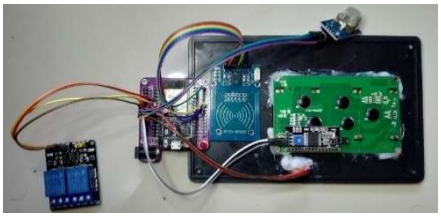

Figure 6. Implementation of guest room monitoring tools

D. Android Application Implementation Results

The software display design uses the React Native application which is designed to monitor student rooms and guest rooms.

Figure 7. Main page display

On the main page there is a menu button/button display, namely: guest room button, student room button, and notification button.

Figure 8. View of the student room

On the page of the students' room there is a list of rooms starting from room 1, room 2, room 3 and so on. In each room there is a status, namely: the status of there are students when there are students in the room and the status of no students when there are no students in the room.

Figure 9. View of the santri room pages in room 1

On the page of the students' room in room 1 there are the names of the students who are in the room, the status of the gas that detects cigarette smoke, and the status of human movement when there are students who do not participate in the diniyah/religious activities.

Figure 10. Guest Room Page View

On the guest room page there is a room availability status, namely: rooms with available status are rooms that are currently empty and rooms with unavailable status are rooms that are currently being filled by guests. As well as the status of the gas that detects cigarette smoke.

Figure 11. Notification page display

On the notification page there is a history of notifications/notifications that occurred in the dormitory such as: cigarette smoke detected in room 1, there were students who did not follow the diniyah in room 1.

III. RESULTS AND DISCUSSION

A. Sensor Accuracy Test

This sensor accuracy test was carried out with the aim of knowing the accuracy of the fingerprint sensor, Radio Frequency Identification (RFID) sensor, Passive InfraRed (PIR) sensor, and the MQ-2 sensor which were compared using the JSM-131SC measuring instrument as a reference.

TABLE I
FINGERPRINT ACCURACY TEST RESULTS

Test to -	Fingerprint Sensor Test Results	
	Information	Delay (s)
1.	Succeed	2.99
2.	Succeed	3.11
3.	Succeed	2.89
4.	Succeed	3.22
5.	Succeed	2.90
6.	Succeed	3.03
7.	Succeed	3.17
8.	Succeed	2.83
9.	Succeed	2.90
10.	Succeed	3.01
Average		**1.59**

Based on Table I, it can be seen that the test results were carried out 10 times using a registered finger that has been registered, an average delay of 3.01 seconds was obtained with an accuracy rate of 100%.

TABLE II
RADIO FREQUENCY IDENTIFICATION (RFID) ACCURACY TEST RESULTS

Test to -	RFID Sensor Accuracy Test Results	
	Information	Delay (s)
1.	Succeed	1.58
2.	Succeed	1.59
3.	Succeed	1.42
4.	Succeed	1.55
5.	Succeed	2.01
6.	Succeed	1.56
7.	Succeed	1.57
8.	Succeed	1.58
9.	Succeed	1.59
10.	Succeed	1.40
Average		**1.59**

Based on Table II. it can be seen that the test results were carried out 10 times testing trials using a registered card, the average delay was 1.59 seconds.

TABLE III
MQ-2 SENSOR ACCURACY TEST RESULTS

Test to -	Mq-2 Sensor Accuracy Test Results		
	CO2 gas detection tool (ppm)	Sensor MQ-2 (ppm)	Error (%)
1	551	550	0.18
2	569	562	1.23
3	571	569	0.35
4	568	559	1.58
5	575	571	0.70
6	582	578	0.69
7	590	587	0.51
8	603	598	0.83
9	597	592	0.84
10	588	580	1.36
Average			0.83

Based on Table III. seen the results of the comparison test of the value of methane gas which was carried out by taking 10 data measured using the Mq-2 sensor compared to the JSM-131SC Co2 gas measuring instrument, the percentage error was 0.83% where the percentage of error was small so the MQ-2 sensor could be used for research. The percentage of measurement error is obtained by dividing the value of the difference between the readings and the value of the methane detector then multiplied by 100%.

TABLE IV
PASSIVE INFRA RED (PIR) SENSOR ACCURACY TEST RESULTS

Test to -	PIR Sensor Accuracy Test Results	
	Distance (m)	Information
1.	0,5	Succeed
2.	1	Succeed
3.	1,5	Succeed
4.	2	Succeed
5.	2,5	Succeed
6.	3	Succeed
7.	3,5	Succeed
8.	4	Succeed
9.	4,5	Succeed
10.	5	Succeed

Based on Table IV. it can be seen that the test results were carried out 10 times testing experiments using human movement obtained a 100% sensor success rate.

B. Tool Testing When There is a Student Violation

1. Smoking Violation Test Results

Figure 12. Display of smoking violation notifications

The smoking violation test uses the MQ-2 smoke sensor as a cigarette smoke detector, this sensor is placed in every student's room when there are students smoking in the room. The following is a picture of the notification display on the student monitoring application when there are students smoking in the room.

TABLE V
RESULTS OF TESTING CIGARETTE SMOKE

Cigarette Smoke Test Results	
Test to -	**Information**
1.	Succeed
2.	Succeed
3.	Succeed
4.	Succeed
5.	Succeed
6.	Succeed
7.	Succeed
8.	Succeed
9.	Succeed
10.	Succeed

2. Result of Violation Testing of Students Not Following the Koran Diniah

Testing of students' violations of not taking the diniah isya and dawn readings uses the PIR sensor which is swallowed in the students' rooms to detect students who are still in the room when the schedule of the early hours of reciting is scheduled. Here's a picture of the notification display on the student monitoring application when there are students who don't take the early readings.

Figure 12. Notification display when there are students who don't follow diniah

TABLE VI
VIOLATION TEST RESULTS DO NOT FOLLOW DINIAH

Violation Test Results Not Following Diniah	
Test to -	**Information**
1.	Succeed
2.	Succeed
3.	Succeed
4.	Succeed
5.	Succeed
6.	Succeed
7.	Succeed
8.	Succeed
9.	Succeed
10.	Succeed

IV. CONCLUSION

The student supervision system uses an esp32 microcontroller with input sensors used by fingerprint sensors, RFID sensors, MQ-2 smoke sensors, and passive infrared receiver sensors. Where every student's room has an mq-2 sensor, PIR sensor, and 2 boxes placed in front and behind the student's room door, each box has a fingerprint sensor as an access key to the students' entrance and exit. While the guest room has an mq-2 sensor and 2 boxes which are placed in front and behind the guest room door, each box has a sensor as an access key to the guest room entrance and exit.

The results of testing violations of students who smoke and students who do not take part in the early Koran using the MQ-2 sensor and PIR sensor produce a 100% success rate with this result the system can be utilized in every Islamic boarding school.

This system uses a fingerprint sensor as a key access to the entrance and exit of the santri room, an RFID sensor as an access key to the entrance and exit of the santri room, the MQ-2 smoke sensor as a detector of cigarette smoke, and the Passive Infrared Receiver Sensor as a detector of human presence when there are students who are still there. in the room at the time of the prayer schedule, early dawn and isya.

Making a student monitoring application using react native sensor measurement results are stored in the firebase real time database, after the data is stored the data is displayed in the student monitoring application.

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