

Locker Security System Design Based On Internet of Things (IoT) Android Interface

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Abstract—Technological sophistication is growing in various ways, for example in the security system of an object. Basically, the security system of an object is done manually which is less practical than today's technological systems. One application of the security system is for locker safety. Therefore, to overcome the security system in the locker, the solution is to create a security system that uses ESP32-CAM as an Internet of Things (IoT) android-based microcontroller for the android interface for the security system in the locker and when someone forcibly opens the ESP32-CAM module it will take a photo. the person to notify the user about the current state of the locker via the telegram application on android.

Keywords— Locker security, Modular, IoT, ESP32-CAM, Telegram

I. INTRODUCTION

Technological sophistication is growing in various ways, for example in the security system of an object. Basically, the security system of an object is done manually which is less practical than today's technological systems. The security of the lockers depends on the lock on the door. So far, the locker security system uses conventional metal locks. The use of locks like this is no longer effective to ensure the safety of the items in the lockers.

Therefore, this study uses an Internet of Things (IoT)-based security system to open lockers with the android application and uses ESP32-CAM to take photos of people who open locker doors forcibly and will send the photos to the user's

telegram, the author makes a security system lockers to prevent unwanted things from happening.

The aims of this research are as follows:

1. Know how to apply the Internet of Things (IoT) in a locker security system.
2. Know how to apply ESP32-CAM in a locker security system.

The benefits of this research are as follows:

1. Train students' abilities to solve existing problems, by applying the Internet of Things (IoT) and ESP32-CAM as locker security systems.
2. With this design, it is expected to minimize the loss of valuables when placing items in the locker lo

II. METHODS

A. Product Design

2.1. Product Design

In this study, the product system design is described according to the following design scheme:

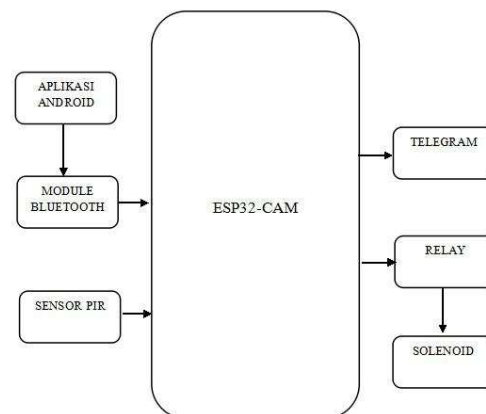


Figure 1. Block of diagram

Diagram How the system works:

1. Connect the application that has been provided by the user with the specified password.
2. When the password is entered incorrectly, the application will not go to the 2nd slide in the application.
3. When the correct password is entered, it will be directed to the 2nd slide in the application, and locker users can connect the application with the HC-05 bluetooth module.
4. When the application is connected to the HC-05 bluetooth module, locker users can open the locker door using the application.
5. When the locker user does not open the locker with the application that has been provided by the user and tries to open it forcibly (the door opens), the PIR sensor will detect the movement in front of it to give an order to the ESP32-CAM to take a photo of the object in front of it. sent to the user's telegram app.

2.2. Product Design

In the locker design, the dimensions are 35 cm long, 35 cm wide and 45 cm high. On the front of the locker there is a solenoid as a locker lock and on the inside of the locker there is an empty space as a place for the circuit with the size of the space with a length of 35 cm, a width of 35 cm and a height of 9 cm. While the design on the back of the locker, the security system still uses a conventional key as an emergency door if a problem occurs in the locker.



Figure 2. *Product Design*

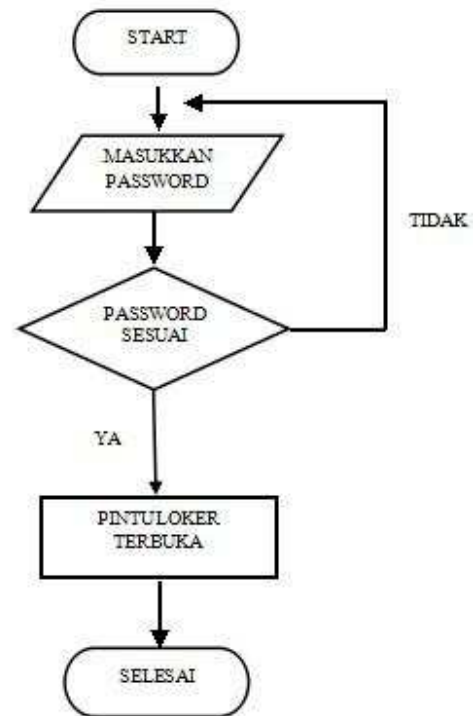


Figure 3. *Product Design*

Flowchart Description:

1. It starts by entering the user-defined password. If the password is entered incorrectly, you cannot proceed to the second slide to open the locker.
2. If the password is correct, the user is directed to the slide to the two applications that have been provided by the user. On the second slide there are two options, namely, opening the locker and locking the locker.

2.5. Method of collecting data

In collecting data, several tests were carried out. Testing is a process in which the tools or components needed to work properly. In this study there are components that must be tested as follows:

a. PIR Sensor Test

In this test, a trial was conducted to determine the sensitivity of the PIR sensor on the system made. This trial is carried out by moving an object that is in the locker without opening the locker security system with an application that has been provided by the user.

b. ESP32-CAM Test

In this test, a trial was conducted to determine the success of the ESP32-CAM to photograph the object in front of it and send the photo to the user's telegram. The test is done by waiting for the PIR sensor to detect the movement in the locker first, after that the ESP32-CAM will take a photo of the object in front of it and will send the photo to the user's telegram.



Figure 4. Overall Tool

2.6. Data Analysis Method

The method used in this research is a comparative method. Through research, the results of the data obtained can be used by humans to understand, solve and anticipate problems. Data collection is carried out in the following stages:

- 1) First stage, by making a locker prototype.
- 2) Second stage, performs movements that can be detected by the PIR sensor without opening the locker security system properly.
- 3) Third stage, takes data on the sensitivity level of the PIR sensor which is obtained when there is a moving object.
- 4) Fourth stage is to compare the data in the five experiments.
- 5) Fifth stage is to move at various angles to find out at what angle the PIR sensor does not work.
- 6) Sixth stage is to check the telegram so that you can find out the photos that can be sent.
- 7) Last stage, conclusions about concluding the sensitivity level of the PIR sensor.

III. RESULTS AND DISCUSSION

3.1. Product Results and Evaluation

In this circuit, a 12v power supply is used to drive the solenoid, while the ESP32-CAM requires an input voltage of 5v. As a voltage drop, the author uses a DC step-down component, because the output of the voltage adapter is still 12v, step-down is used to lower the voltage to 5v for the ESP32-CAM input.

3.2. Data Presentation

Presenting the data this time using the PIR sensor sensitivity test:

1. PIR sensor distance test

This test measures how far the PIR sensor can detect the movement of an object in front of it. 5 experiments were carried out at each specified distance to test the sensitivity of the PIR sensor.

Table 1. PIR Sensor Delay Test Data

Distance	Delay Test Results (Seconds)				
	1	2	3	4	5
5 cm	4,83	9,06	10,19	8,56	9,88
10 cm	8,56	8,3	8,36	9	9,02
15 cm	7,32	8,81	8,69	8,17	8,14
20 cm	8,63	8,13	8,79	8,52	9,17
25 cm	8,40	8,81	8,17	8,41	8,39

2. PIR sensor angle testing

This test is carried out to determine the angle that can be detected by the PIR sensor. In this test, we use a way to partially close the sensor so that it forms a predetermined angle.

Table 2. PIR Sensor Angle Testing Data

Angle	Delay (Seconds)	Information
15°	Not detected	Not detected
30°	24,83	Detected
45°	11,96	Detected
60°	9,78	Detected
75°	5,99	Detected
90°	5,20	Detected

3. ESP32-CAM Testing

This test was conducted to determine the success of the ESP32-CAM in processing photos to be sent to the user's telegram. In this test, the object is moved until the ESP32-CAM takes a photo and sends the photo to the user's telegram 3 times.

- a. The first attempt, when trying to connect the ESP32-CAM to the user's telegram, a problem occurred because the network was unstable. Therefore photos cannot be sent to Telegram users.



Figure 5. Display When ESP32-CAM Fails to Send Photos

- b. While in the second and third experiments, the ESP32-CAM was successfully connected to the user's telegram and the photos were successfully sent smoothly with the delay determined by the network obtained by the ESP32-CAM.



Figure 6. Telegram Display Receiving Photos From ESP32-CAM

3.3. Data Analysis

Based on the data obtained in this study, the data analysis was carried out in stages and carefully and thoroughly. With the analysis of the data obtained, it produces a comparison of 5 experiments carried out when testing the

delay at a distance that has been determined by the user.

Table 3. Delay Testing PIR Sensor

Distance	Delay Test Results (Seconds)				
	1	2	3	4	5
5 cm	4,83	9,06	10,19	8,56	9,88
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25 cm	8,40	8,81	8,17	8,41	8,39

3.4. Discussion

Designing this locker security system, it has the following work system:

- 1) The ESP32-CAM module reads the data that has been generated by the PIR sensor.
- 2) Then the data is processed by the ESP32-CAM to turn on the camera to take pictures of the object in front of it.
- 3) The results of the ESP32-CAM photos are automatically sent to the user's telegram.

The purpose of making this tool is so that the items in the locker can be safe and can be used briefly and easily by following current technological developments. Because the security system still uses conventional keys it is more vulnerable to being forced open and there is no double security system to find out the perpetrator. This technology is suitable for modern times, so users don't have to worry about items that have been placed in lockers.

IV. CONCLUSIONS

From the research, testing and analysis of the Android Internet of Things (IoT) Interface-Based Locker Security System, the following conclusions can be drawn:

1. The PIR sensor module has a detectable angle range.
2. When uploading programs using the FTDI USB to TTL module
3. The distance measurement system was carried out 5 times to obtain delay data.
4. In testing the angle of the PIR sensor, the limit that can be detected is 30° to 90°.

Suggestion

The suggestions that can be made in further research are as follows:

1. Develop a security system to be able to record activities when locker doors are forcibly opened.
2. Added a servo motor on the door so it can open automatically.
3. Tighten the way to open the locker door by adding a finger print.

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