The Implementation of Motorcycle Security System Using Voice Commands and Fingerprint Sensors

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***Abstract*—Motorcycle theft cases often occur in Indonesian every year and will continue to exist as long as motorbike users are not vigilant. Public attention to the safety and security of motorbikes is less aware of the public and weak security system in parking lots are some of the things that become obstacles in preventive efforts. This motorcycle security system using voice commands and an IoT-based fingerprint sensor is a solution for taking preventive actions and building awareness to secure the user's motorbike. This motorcycle security system uses a smartphone for monitoring and control, voice commands via a smartphone application and fingerprints as input so as to prevent motorcycle theft cases optimally. In this motorcycle security system, the Blynk platform is used as an Internet of Things (IoT) device that allows users to monitor and control remotely. The control system used is a closed loop control system using Arduino Mega 2560 as a microcontroller, HC-05 as a Bluetooth module for voice input and AS608 as a fingerprint sensor. The output of this security system is remote monitoring and control of the motorcycle and the motorbike cannot be turned on if the voice and fingerprint inputs are not initialized.**

Keywords—voice command, fingerprint, blink, Arduino mega 2560

I. INTRODUCTION

Two-wheeled motorized vehicles in Indonesia have increased, referring to data from the Indonesian Motorcycle Industry Association (AISI), an increase in the number of motorcycles in 2020 reached 292,205 units, growing 74 percent compared to the previous month which was 167,992 units[1]. In addition to the level of development of transportation technology above, the development of information and communication technology also has a high development in Indonesia. One of the information technology and technology that is developing in Indonesia is a smartphone. With the existence of a smartphone, it will greatly facilitate each user in meeting their daily needs and technology needs. As many as 45% of mobile phone users in Indonesia use smartphones and 21.11% of them use Android smartphones[2].

According to data presented by the Central Statistics Agency (BPS) cases of motorcycle theft from 2017-2020 have decreased, but there are still cases of motorcycle theft motor[3]. Attention to the security and safety of motorcycles owned by the public is not realized and the security system in the parking lot is weak are some of the things that become obstacles in preventive efforts[3]. One solution to secure motorcycles from theft is to apply intelligent security system technology. Vehicle safety system technology by combining IoT (Internet of Things) technology is classified as a security technology in the future [2].

Voice command technology is one technology that does not require large costs and special equipment[3]. Voice is one of the unique parts of the human body and can be easily recognized. In addition, the voice biometric system has characteristics such as, cannot be forgotten, not easily lost and not easy to fake because its existence is inherent in humans so that its uniqueness is more guaranteed[3]. Biometrics as a technology that analyzes biological data plays an important role in its use in security systems. . The advantage of biometrics is its uniqueness and stability as an identifier. One example of biometrics is fingerprint[4]. According to a survey conducted by Ping Identity, the concept of biometrics as a security system is considered effective. Using fingerprints is easier than using ID tags. There are many useful applications that can be developed and maximized on smart phones. One of the applications that can be accessed on android smart phones is Blynk. Blynk is an IoT platform that can be obtained for free on Playstore[7][8].

Blynk is a server service used to support Internet of Things projects. There are three main components of Blynk, namely the Blynk application (Blynk apps), Blynk server and Blynk libraries (Blynk libraries)[9][10]. The Blynk application makes it possible to create project interfaces with various input and output components that support sending and receiving data and representing data according to the selected components[11][12]. Data representation can be in the form of visual numbers or graphs. Blynk server is a cloud-based Backend Service facility that is responsible for managing communication between smartphone applications and the hardware environment. Meanwhile, Blynk Library can be used to assist source code development[13][14].

Based on the above problems, a research proposal was carried out with the topic of design and implementation of a motorcycle security system using voice commands and a fingerprint sensor with an IoT platform in the form of Blynk. Voice commands use the HC-05 module while the type of microcontroller used is Arduino Mega 2560.

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II. Design and Implementation

In this study, a design or design for an IoT-based motorcycle security system with IoT devices uses the Blynk application and a control system using a closed loop control system. The design in this study includes the design of hardware and software which is presented in a design flow diagram with the system output according to the expected set point.

A. Control System

The control system is a tool to control, command, and regulate the state of a system[15]. The control system can be seen in Figure 1.

Fig. 1. Diagram control system

Based on Figure 1 the general diagram of a control system has three components, namely input, process and output. The control system used in the design and implementation of the motorcycle security system uses an Arduino Mega 2560 microcontroller with system inputs in the form of voice commands and fingerprints using the HC-05 bluetooth module and the AS608 fingerprint sensor. The overall control system design can be seen in Figure 2.

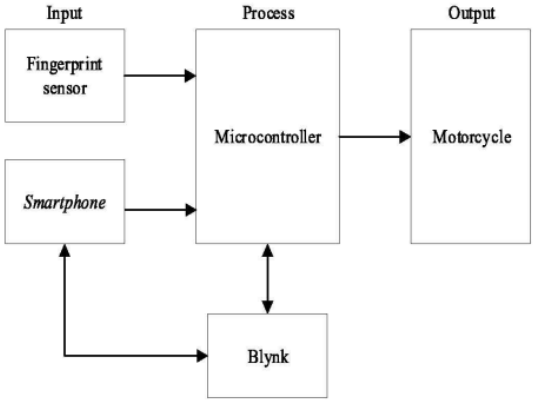

Fig. 2. Block diagram control system design

Figure 2 shows a block diagram of a motorcycle security system design using voice commands and an IoT-based fingerprint sensor, where the input from the system is in the form of voice commands and fingerprints, the system process is carried out by a microcontroller and the IoT system uses the Blynk application with the output on the system in the form of on off bicycles. motor. As for the overall hardware and software design, it can be seen in Figure 3.

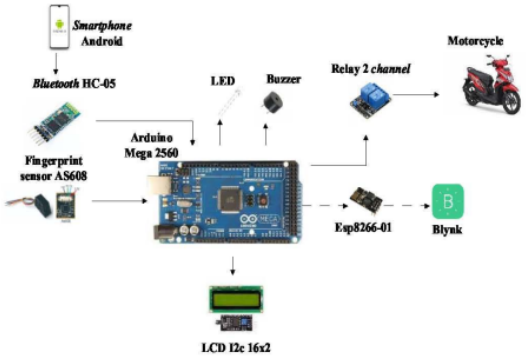

Fig. 3. Design Hardware and Software

Based on Figure 3, the motorcycle security system has two inputs, namely voice commands and fingerprints. The system controller is an Arduino Mega 2560 microcontroller and the system output is a motorcycle on and off. With additional outputs in the form of LEDs and buzzers.

B. Voice Command Design

The design of voice commands is carried out using the HC-05 bluetooth module which is connected to the Arduino Mega 2560. Voice commands can be accessed through the AMR voice application interface installed on the smartphone, the AMR voice application can be downloaded on the Playstore and IOS for free. For the design of voice commands on the system can be seen in Figure 4.

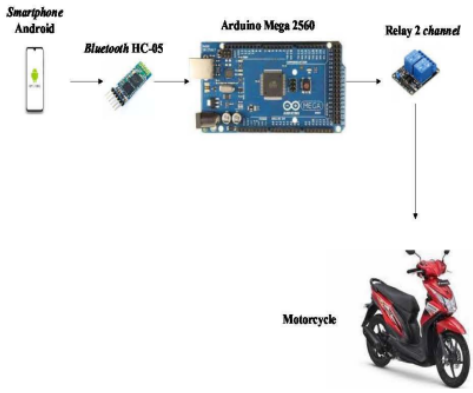

Fig. 4. Voice command design

The voice command designed in Figure 4 is in the form of the word "input input" where this word is set in the programming process using the Arduino IDE software.

C. Fingerprint Pattern Recognition

Fingerprint pattern recognition is carried out using the AS608 fingerprint sensor which is connected to the Arduino Mega 2560 microcontroller. The capacity of the AS608 fingerprint sensor is to store 1000 fingerprints. The design of the fingerprint sensor can be seen in Figure 5.

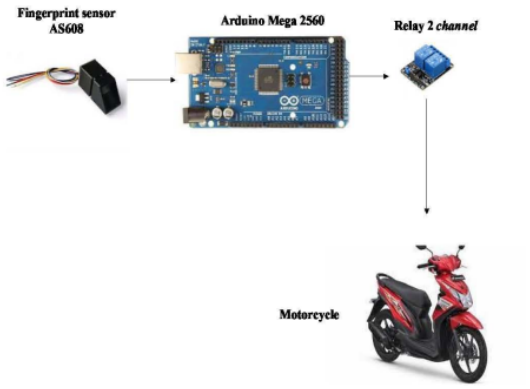

Fig. 5. Fingerprint design

D. Voice Command Interface Design

In designing voice commands, the method used is to use the AMR voice application which is downloaded through the playstore for free. This application uses the google voice feature in the process of entering voice commands. Google voice reads the type of word spoken then the spoken word is forwarded to the Arduino Mega 2560 microcontroller via bluetooth communication. The results of the design of voice commands can be seen in Figure 6.

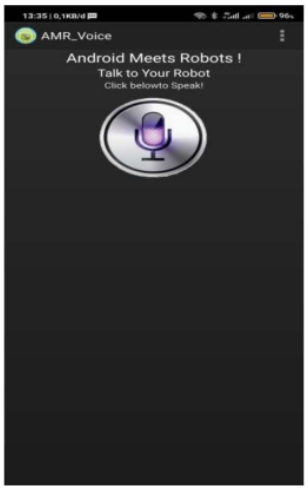

Fig. 6. AMR voice design

Based on Figure 6, the type of voice command that is set is the word "input input" to turn on the motorcycle contacts that are connected through a relay.

E. Blynk Design

Blynk is a widely used and easy to set up IoT tool. The Blynk application is available for free on Playstore and IOS. Blynk is an Internet of Things (IoT) interface application for many uses including for monitoring and controlling processes. The design of the Blynk application in this study can be seen in Figure 7.

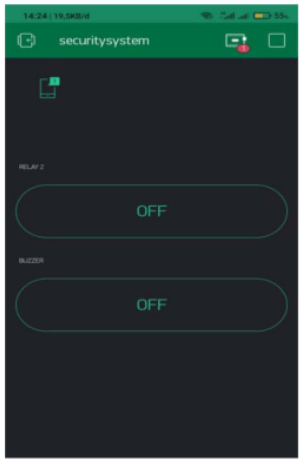

Fig. 7. Blink design

Based on Figure 7 there are 2 buttons or widgets added to the Blynk application, namely notification and on off button. The working principle of the whole system is described in the flow chart and can be seen in Figure 8.

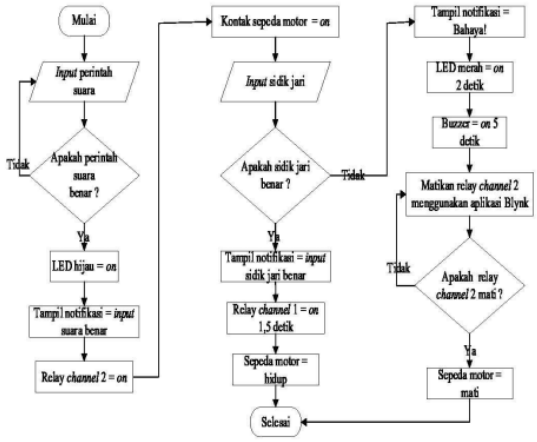

Fig. 8. Flowchart security motorcycle system principles

Based on Figure 8 the working principle of the security system as a whole system works according to the set point that has been set. Where there are two desired outputs, namely when the system input is correct, the motorcycle will turn on and be monitored via the Blynk notification on the smartphone, and if the system input is incorrect, the motorcycle can be turned off from the Blynk application.

III. Testing And Analisys

A. Bluetooth HC-05 Testing

The HC-05 bluetooth test aims to find out how far the maximum distance and response time needed to connect to the application on a smartphone are in seconds in order to turn on the relay connected to the motorcycle contact using voice commands. The method of measuring distance and response time for connectivity and voice command control on the

bluetooth HC-05 uses a measuring meter and stopwatch without any access barriers such as walls. The results of the HC-05 bluetooth test can be seen in Table 1.

TABLE I. BLUETOOTH HC-05 CONNECTIVITY TESTING

Test	Distance (m)	Bluetooth Status	Response Time (s)
1	1	Connected	4,21
2	2	Connected	4,32
3	3	Connected	4,39
4	4	Connected	4,41
5	5	Connected	4,41
6	6	Connected	4,60
7	7	Connected	4,61
8	8	Connected	5,00
9	9	Connected	6,82
10	10	Connected	9,24
11	11	Disconnected	-
12	12	Disconnected	-

Based on Table 1, the maximum distance the HC-05 bluetooth sensor can connect to the application on a smartphone is 1o meter and the response time required to connect to the AMR voice application is getting longer, from 4.21 seconds to 9.24 seconds. The response time required to connect is calculated when the application connection is started. At a distance of 10 meters, voice commands can also be processed.

B. Voice Command Testing

Testing of voice commands is carried out via a smartphone connected to bluetooth HC-05 using the AMR voice application. The test of voice commands aims to turn on the motorcycle contacts that are connected to the channel 2 relay on the motorcycle security system. The results of the test can be seen in Table 2.

TABLE II. VOICE COMMAND TESTING USING THE AMR APP

Condition	Word Type	Green LED	Relay Channel 2	Motorcycle contact
Voice command's correct	Enter input	ON	ON	ON
Voice command's wrong	Enter input	OFF	OFF	OFF

Based on Table 2, the correct type of voice command is the word "input input" and the wrong type of voice command is the word "enter input".

C. AS608 Fingerprint Sensor Testing

The AS608 fingerprint sensor testing was carried out with the aim of testing the sensor response in initializing the fingerprint pattern that had been stored through the program on the Arduino IDE software. The results of fingerprint pattern recognition can be seen in Table 3 and Table 4.

TABLE III. AS608 FINGERPRINT SENSOR RESPONSE TIME TEST FOR TRUE FINGERPRINT

Test	Fingerprint's Correct (Edi)	Response Time (s)
1	1 (ID#1)	2,31
2	2 (ID#2)	2,58
3	3 (ID#3)	2,67
4	4 (ID#4)	2,81
5	5 (ID#5)	2,58
6	6 (ID#6)	2,60
7	7 (ID#7)	2,76
8	8 (ID#8)	2,56
9	9 (ID#9)	2,78
10	10 (ID#10)	2,6
Average		2,62

TABLE IV. AS608 FINGERPRINT SENSOR RESPONSE TIME TEST FOR WRONG FINGERPRINT

Test	Fingerprint's Wrong (Dera)	Response Time (s)
1	1	2,51
2	2	2,10
3	3	2,27
4	4	2,09
5	5	2,01
6	6	2,10
7	7	2,53
8	8	2,66
9	9	2,48
10	10	2,00
Average		2,27

Based on Table 3 and Table 4 the average response time for correct fingerprints is 2.62 seconds. Meanwhile, the average response time for wrong fingerprints is 2.27 seconds. This response time is calculated from the state of the finger affixed until the system responds.

D. Motorcycle Starter Testing Using Fingerprint Sensor

The starter test on the motorcycle was carried out in two conditions, namely the correct fingerprint with the fingerprint object belonging to "Edi" and the wrong fingerprint with the fingerprint object belonging to "Dera". which was attached to the AS608 fingerprint sensor. When the fingerprint input is correct, the motorcycle will automatically start until the motorcycle turns on with a staret duration of 1.5 seconds. The results of the test can be seen in Table 5.

TABLE V. MOTORCYCLE STARTER TESTING USING FINGERPRINT

Condition	Red LED	Buzzer	Relay Channel 1	Motorcycle contact
Fingerprint's correct (Edi)	OFF	OFF	ON	ON
Fingerprint's Wrong (Dera)	ON	ON	OFF	OFF

Based on Table 5, the motorcycle turns on with the correct fingerprint input and does not turn on with the wrong fingerprint input. The LED and buzzer function to indicate the fingerprint input value is true or false.

E. Testing Voice Command Input Notification

Testing the voice command input notification aims to monitor the condition of the motorcycle using the AMR voice application. The purpose of this notification is to monitor the input on the system so that the user can see remotely

The results of the test can be seen in Table 6.

TABLE VI. VOICE COMMAND NOTIFICATION RESPONSE TIME TEST IS CORRECT

Test	Notification	
	Voice command's correct	*Response Time (s)*
1	Enter input	0,49
2	Enter input	0,49
3	Enter input	0,50
4	Enter input	0,48
5	Enter input	0,45
6	Enter input	0,47
7	Enter input	0,49
8	Enter input	0,50
9	Enter input	0,25
10	Enter input	0,42
Average		0,45

Based on Table 6 the results of the notification time response for correct voice commands in the form of the word "input input" on average are 0.45 seconds. This response time is calculated from the position when performing a voice command until a message appears on the LCD that the voice command input is correct. For notification results on Blynk in the form of text sent in real time, the results can be seen in Table 7.

TABLE VII. TEXT NOTIFICATION TEST ON BLINK APP

Condition	Word Type	Notification	Description
Voice command's correct	Enter input	Real time	Text notification "voice input is correct"
Voice command's wrong	Enter input	Nothing	System not responding

Based on Table 7, notifications in the Blynk application for voice commands are real time where notification delivery is less than 2 seconds.

F. Fingerprint Input Notification Test

Testing the fingerprint input notification on the Blynk application is carried out in two circumstances, namely when the fingerprint input is correct and the fingerprint input is incorrect. This test aims to determine whether notifications on the Blynk application are real time or not. The test results can be seen in Table 8.

TABLE VIII. NOTIFICATION TIME RESPONSE TESTING ON THE BLYNK APP

Notification			
Finngerprint's correct (Edi)	*Response Time (s)*	*Fingerprint's wrong (Dera)*	*Response Time (s)*
1 (ID#1)	0,29	1	0,50
2 (ID#2)	0,45	2	0,49
3 (ID#3)	0,47	3	0,25
4 (ID#4)	0,42	4	0,38
5 (ID#5)	0,43	5	0,48
6 (ID#6)	0,32	6	0,36
7 (ID#7)	0,33	7	0,50
8 (ID#8)	0,43	8	0,42
9 (ID#9)	0,40	9	0,49
10 (ID#10)	0,35	10	0,40
Average	0,32	Average	0,42

Based on Table 8, the average value of the notification time response for the correct fingerprint is 0.38 and the incorrect fingerprint notification is 0.42. Based on Table 5.8 notifications are in the form of real time notifications, because the notification response is fast, which is less than 2 seconds. The results of the text notification test on Blynk can be seen in Table 9.

TABLE IX. TEXT NOTIFICATION TEST ON BLYNK APP

Condition	Notification	Description
Fingerprint's correct (Edi)	Real time	Text notification "Fingerprint input is correct"
Fingerprint's wrong (dera)	Real time	Text notification "danger"

Based on Table 9, the types of notifications are in the form of real time notifications and notification texts according to the text on the Arduino IDE set.

G. On/Off Control Test on Motorcycle

In this test there are two conditions, namely when the motorcycle is on and when the motorcycle is off. in this test the user can turn on and off the motorcycle remotely through the Blynk application. The test results can be seen in Table 10 and Table 11.

TABLE X. ON/OFF CONTROL TEST ON BLYNK APP IN STATE MOTORCYCLE IS ON

Button Blynk	Condition	Description
ON	Relay channel 2 OFF	Motorcycle contact's OFF
OFF	Relay channel 2 ON	Motorcycle contact's ON

TABLE XI. ON/OFF CONTROL TEST ON BLYNK APP IN STATE MOTORCYCLE IS OFF

Button Blynk	Condition	Description
ON	Relay channel 2 ON	Motorcycle contact's ON
OFF	Relay channel 2 OFF	Motorcycle contact's OFF

Based on Table 10 and Table 11, the on/oof control through the Blynk application, the switch button is used in reverse when the motorcycle is on and the switch button is used normally when the motorcycle is off.

IV. CONCLUSION

The design of voice commands on a motorcycle security system with a bluetooth sensor HC-05 can be made by inputting voice in the AMR voice application using a smartphone according to the command text on the Arduino IDE software with a maximum distance of 10 meters which is the maximum limit of connectivity that can be reached by the HC bluetooth sensor. -05 to turn on motorcycle contacts via voice commands. The longer the distance between the HC-05 bluetooth sensor and smartphone users, the slower the time it takes to reach the connected state and be able to perform voice commands. The response time required by the AS608 fingerprint sensor to start Turning on the motorcycle from 10 trials of correct fingerprints is an average of 2.62 seconds and the response time for incorrect fingerprints is 2.27 seconds on average. Notifications from the Blynk application are displayed in real time in the form of text that can be seen by the user where the type of notification corresponds to the program that has been set in the Arduino IDE software. when the motorcycle is off.

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