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Design of an Intelligent Motorcycle System Using Microcontrol-Based Fingerprinting

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Abstract*—Fingerprint scanners are one of those technological developments that can only be used by persons who have fingerprints embedded in their fingerprints. A gadget that captures a digital image of a person's fingerprints. The fingerprint sensor has two stages. The image acquisition process and the image matching process are the two procedures. Fingerprint recognition devices can use a variety of technologies, the most prevalent of which being optical scanning. Fingerprints are now exclusively used in institutions to authenticate the existence and suitability of a person's fingerprints, as well as as a smartphone security mechanism. However, its application in the field of automotive technology, such as in two-wheeled vehicles, is still not widely used, particularly for security in the most recent model cars. It turns out that fingerprints can be used as a substitute for ignition, open a car door and turn on and off to turn it off. In the event that the driver loses the ignition, he can still start and stop the car, providing more protection for two-wheeled vehicles that lack a sophisticated security system. The method employed is to install a fingerprint sensor in two-wheeled vehicles in place of a switch to turn on and off the engine. The benefit of this research is that the vehicle is safer and can still be started using the fingerprint sensor even if the motorcycle key is lost. Meanwhile, its shortcomings include the inability to be managed remotely, Because fingerprint sensors installed directly on motorcycles cannot be utilised on smartphones, although software can be developed to control them remotely, and fingerprint sensors are expensive. As a result, the authors conducted research titled Designing an Intelligent Two-Wheel Motorised Vehicle System with a Microcontroller-Based Fingerprint Application so that vehicle users can remotely turn on and off the vehicle using fingerprints via a smartphone and do not need to buy. Because it uses the fingerprint that is already on the smartphone with the application, it is a fingerprint sensor. The distance of using wifi with a frequency of 2.4 Gz with the farthest distance of 20 metres works normally, but this system does not yet have extra features like as GPS and alarms, so for car safety and tracking system cannot be utilised and is the next stage of study*

Keywords*— Motorcycle;fingerprint; microcontroller.*

I. INTRODUCTION

The development of science and technology is currently growing rapidly, especially in the automotive and electronics industries. This progress can be seen from the many sophisticated electronic-based tools used in the automotive industry today. This development has many advantages, including easier to identify problems or do something so that time, effort and costs can be used optimally, but also more efficiently. Operations that still use manual movements are now being replaced with automatic artificial devices that can reduce human labor. A fingerprint scanner or fingerprint scanner is a technological advance that can only be used by people whose fingerprints have been embedded in fingerprints [1]. At the moment, fingerprints are only employed in agencies to determine the location and correspondence of a person's fingerprints, as well as as a cell phone security technology. However, its applicability in the field of automotive technology is currently limited; however, fingerprints can be used as a substitute for the ignition switch to start the vehicle, allowing vehicle drivers to start their vehicle even if the ignition switch is lost. A fingerprint scanner is a technological advancement that can only be utilised by persons who have had their fingerprints entered. A digital image of a human fingerprint captured by an electronic equipment. On the fingerprint sensor, two steps occur. The picture capture process and the image matching process are the two procedures. Fingerprint recognition devices can use a variety of technologies, the most prevalent of which being optical scanning. Its applicability, for example, in automotive engineering. The sector of two-wheeled motorised vehicles is currently underutilised, with the majority of it still being employed for safety in today's newest model cars. Turn off the engine. If the ignition key is misplaced, the driver can still start and stop the vehicle, adding security to two-wheeled motorised vehicles that lack a sophisticated security system.

As a result, the author picked the title Design of an intelligent motorcycle system with microcontroller-based fingerprinting so that vehicle owners can turn on and stop the vehicle using their fingerprints if they lose the ignition key. This research activity can also help to develop the national innovation system, which is one of the goals in the field of sensor materials.

II. WRITING METHOD

A. Microcontroller ESP 8266

Because NodeMCU is ESP8266 (particularly the ESP-12 series, including ESP-12E), the features held by NodeMCU will be similar to ESP-12 (including ESP-12E for NodeMCU v.2 and v.3), except that NodeMCU has been wrapped by API written by himself. eLua is a programming language that is very similar to javascript. Among these features are:

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1. 10 GPIO ports numbered D0 through D10.
2. PWM capability
3.SPI and I2C
4. 1 Wire Interface 4
5.ADC

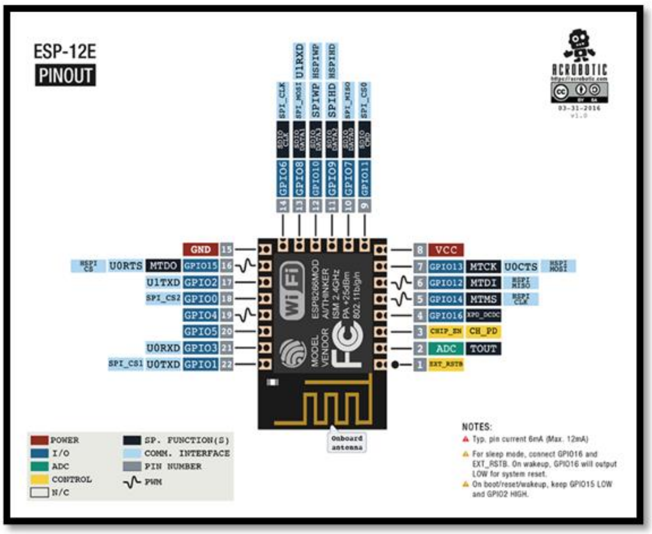

Figure 1. Modul ESP8266 tipe ESP-12 E

1. RST: Module reset functions
2.ADC stands for Analogue to Digital Converter. The input voltage range is 0-1v, while the digital value range is 0-1024.
3. EN: Enable Chip, Active High
4. IO16:GPIO16, which can be utilised to wake up the chipset from deep sleep.
5. GPIO14; HSPI_CLK; IO14
6. IO12:GPIO12: HSPI_MISO
7.IO13:GPIO13, HSPI_MOSI, and UART0_CTS
8. VCC stands for 3.3V power supply (VDD).
9. CS0: Chip choice
10. MISO stands for Slave output and Main Input.
11. IO9 (GPIO9)
12th. IO10GBIO10.
13. MOTION: Primary output, secondary input
14. SCLK: Stopwatch
15. GND stands for Ground.
16.IO15:GPIO15, MTDO, HSPICS, and UART0_RTS
17. IO2: GPIO2; UART1_TXD
18. GPIO0: IO0
19. IO4 (GPIO4):
20. IO5 (GPIO5):
21. UART0_RXD; GPIO3 RXD

Voltage.

The JEDEC standard voltage (3.3V) is what the ESP8266 uses to run. Unlike the majority of Arduino boards and the AVR microprocessor, which both have a TTL voltage of 5 volts. The mcu node can still be linked to 5V, but it must do so using the board's Vin pin or a micro USB port. However, not every ESP8266 pin can accept 5V input. The voltage can then be changed to 3.3V, a safe value, using the Level Logic Converter.

Microcontroller

The schematic and PCB construction of the open source Arduino microcontroller board are available for usage and modification. The Arduino NG or earlier with Atmega8 (Severino), Arduino Duemilanove or Nano with Atmega328, Arduino Uno, and Arduino Mega2560, for instance, require an Atmel AVR microcontroller chip/charger IC. The Arduino Bootloader programme, which is present on the bootloader chip/IC, enables us to load programme code without the need for additional hardware. The ATmega328 microprocessor is used by the Arduino Uno board. The Arduino Uno features 6 analogue input pins and 14 digital pins that can be used as input/output devices. Santoso (2015).

FingerPrint

A piece of technology that stores digital pictures of fingerprint prints. We refer to the image as an optical scanner. A fingerprint that has already been stored in a database can be matched using an optical scanner, a computer processor that generates a biometric pattern. The charge-coupled device (CCD) is the brains of an optical scanner. The scanning process begins when a finger is placed on the glass plate and a picture is taken by the CCD camera. The fingerprint trail is illuminated by the scanner's own light source, which is often a light emitting diode (LED). The CCD technology provides an image of the finger that is inverted, with darker parts (the rear of the fingerprint ridge) denoting more reflected light and lighter portions denoting less reflected light.

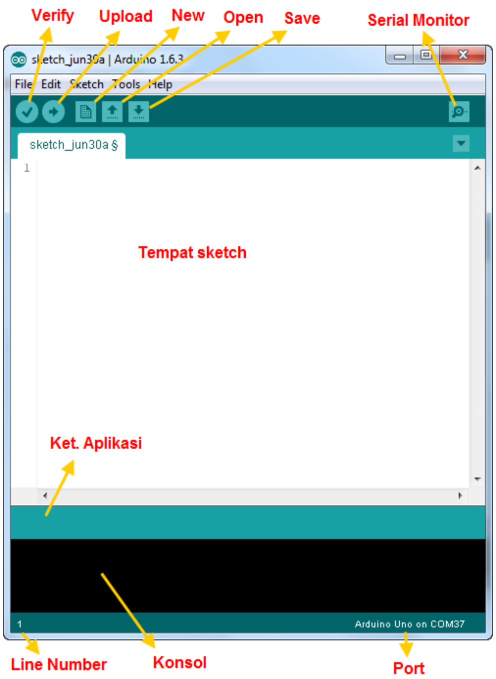

Figure 2. Arduino interface

Arduino application

Writing programmes, compiling them, and uploading them to the microcontroller are all done in the Arduino IDE (Integrated Development Environment). The Arduino IDE's Sketch programming language is used to create programmes.

The creators of this application refer to Arduino source code as "sketch," and it is handy for creating, opening, and modifying Arduino source code. The blueprint is the original code that the microcontroller IC uses to load its logic and algorithm. (Baza & Kurnia, 2018:2, undated)

Kodular application

MIT App Inventor-like tools for creating Android apps using block programming are available on the website Kodular. In other words, writing manual programming code is not required to create Android apps. The Kodular Store and the Kodular Extension IDE, two additional capabilities offered by this Kodular, make it simpler for developers to post Android applications to the Kodular Store and construct IDE extensions as desired. 2019:1 Lestari

Because of this, Kodular can quickly and simply develop unique themes (themes) for Android applications using websites. The presence extension is (.aix), whereas the Kodular presence file is (.aia). Extended Presence The extension part of content is a Java programming language script (.java) that transforms presence into an extension file (.aix). (Lestari).

Aim and objectives

To perform the testing How to create and implement a fingerprint sensor device for a two-wheeled vehicle control system.

Research purposes

To conduct testing How to plan and construct a fingerprint sensor for a control system for two-wheeled vehicles.

TABLE 1 supplies needed to make electrical circuits

NO	Component Name	Unit	Total
1	Mikrokontroler Nodemcu ESP-12	piece	2
2	*Smartphone* fingerprint	piece	1
3	Tin	roll	2
4	Jumper cables	set	2
5	Breadboard	piece	2
6	4 channel relay	piece	2
7	PCB	set	2
8	10v Battery	piece	2
9	Battery Connector	piece	2
10	Cable Insulation	roll	2
11	Step Down Module	set	2

III. RESEARCH METHODOLOGY

Tools and Materials

For the manufacturing process to function properly, tools and materials are necessary, and they must be made available to facilitate the application of this study. The following list illustrates the equipment and supplies required for this study:

The flowchart for research

The foundation of the research process in this study is separated into four steps, which are as follows:

1. literature review

The principles from earlier studies are furthered and scientifically investigated by literary studies. The exploration of sensor and control programming difficulties is the main goal of this literature study.

1. Using PCB maker software to create PCB design designs**,** Machining pcb*Tables and figures*
2. Testing

Testing for this fingerprint-based microcontroller application was done without the engine running. The fingerprint application must be able to read or recognise the results of scanning fingerprint patterns based on fingerprint patterns stored in the database (storage) before the optical scanning (reading) of the fingerprint is carried out by the smartphone application to turn on the vehicle's engine power and then the scan is carried out again to start the vehicle's engine (starting system).

Additionally, for the system to work effectively, the fingerprint sensor on the smartphone must be able to read the fingerprint scans kept in the database (storage) if it is not destroyed. Further enhancements need to be made if this system isn't functioning properly for whatever reason.

Draught Concept and Data Gathering

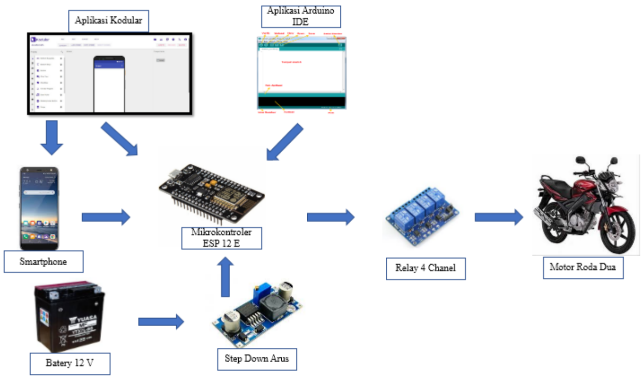

Figure 3. Arduino interface

The electrical circuit for creating fingerprint-based two-wheeled motorised vehicle applications using microcontrollers is designed as follows:

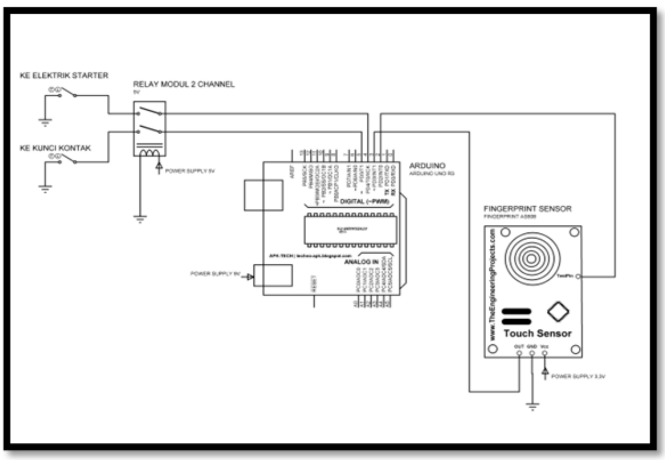

Figure 4. Design of Electrical Circuits

Research Flowchart

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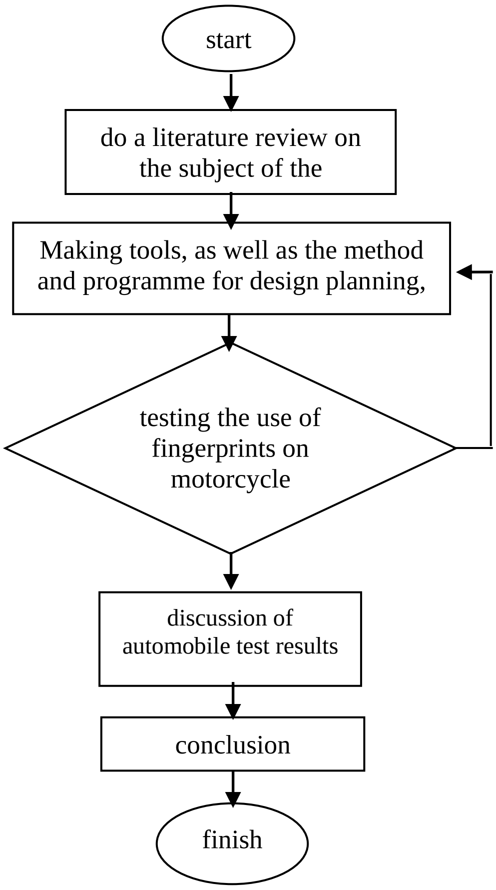

IV. RESULT AND DISCUSSION

A. *Simulation Design in LabView*

The outcomes of the "Intelligent System Design is a microcontroller-based fingerprint application for two-wheeled motorised vehicles" circuit design and fingerprint application are displayed in Electrical Circuit Design.

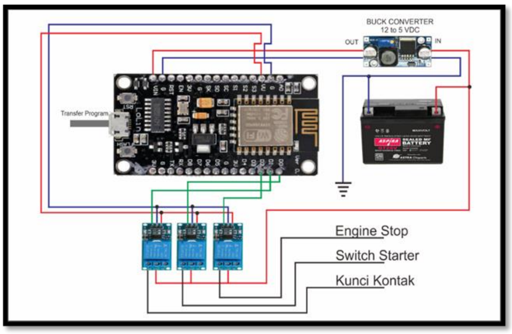

Figure 5. the electrical circuit

This smart system functions by using a 12V battery to power the NodeMCU ESP-12 microcontroller, which then triggers and sends a WiFi signal that is used by the smartphone's fingerprint app and to drive the relay module. When connecting power switches, start and engine stop buttons for two-wheeled motorised vehicles, only 3 of the available 4 channels are actually linked. This ESP-12 NodeMCU microcontroller. then use an application with a capability built into it to get fingerprint scanning data from the smartphone's fingerprint sensor. These are then transformed into instructions that are utilised to connect the relay module's (-) and (+) terminals, which serve to replace the switch, start button, and engine stop for the safety of the vehicle.

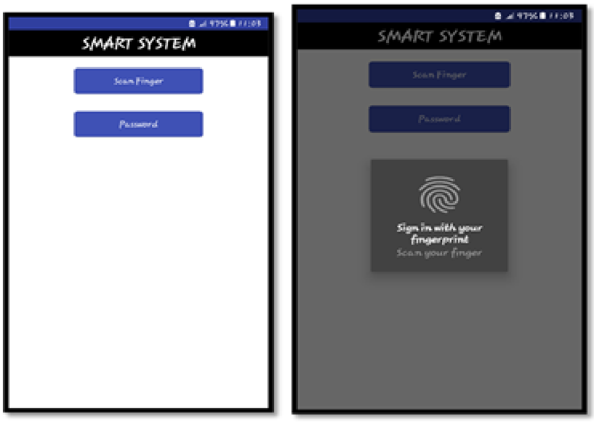

Figure 6. early screenshot of the programme

When you launch the Smart System application, the first menu is shown in Figure 6. So that this application can be used once the NodeMCU ESP-12 microcontroller has sent a WiFi signal to the used smartphone. The user must first pass fingerprint verification that has been saved on the smartphone before entering the command function menu. Alternatively, the user can input a password to gain access to the command function. The programme won't be able to launch the following command menu if the fingerprint is not registered on the smartphone and does not know the password.

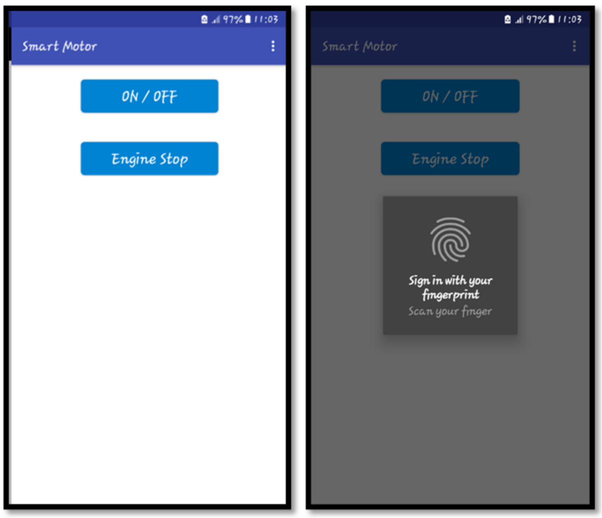

Figure 7. display After a fingerprint scan

The expanded menu for the initial fingerprint control option is shown in Figure 7. Two command options are available on the menu:

1. On/Off: When selected, the on/off function is active. The first relay is instantly given the order to activate the machine/IG switch (switch) by the on/off menu. The gadget displays a fingerprint prompt when the ignition is turned on. The second relay is commanded, i.e. H. Turns ST(Starter)/Engine ON
with a half-second delay, if the fingerprint matches the prior one.
2.Engine stop: This menu immediately informs the first relay to stop the motor current or the IG (bay) starting switch to stop the engine when the engine stop feature is enabled. It also instructs the third relay. Specifically, turning on the ignition of the engine to ensure that it is secure when the regular key is turned on or making an effort to take the vehicle's ST (starter motor). To convert it into a ST (starter), the engine stop must first be turned off.

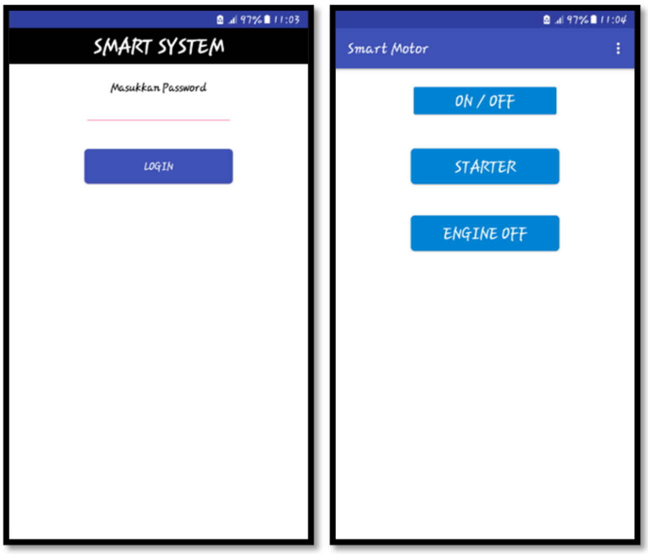

Figure 8. Display after entering the password

Figure 8 shows an enlarged home menu that can be accessed by providing the right password. Therefore, the goal of this password option is to allow customers to continue access the command function on their smartphone even if they run into fingerprint-related issues. There are options in the menu that are comparable to fingerprint-based options. The instruction that the ST (starter) uses to turn on differs in that it is manually chosen rather than using a fingerprint.

1. Manufacturing Process

There are three steps involved in creating "Smart System Design on Two-Wheeled Motorised Vehicles Using a Microcontroller-Based Fingerprint application," including circuit assembly, programming, and vehicle assembly.

As the build stage begins, Figure 9 illustrates how to create a circuit path on a circuit board and print it out on photo paper.

PCB creation utilising PCB maker software, followed by post-processing to produce printed materials. The paper on the copper board is printed out next so that it may be used for PCB cutting and machining. the use of an iron or a laminating machine to connect a series model to a circuit. Then, as depicted in Figure 10, the model is connected to the circuit.

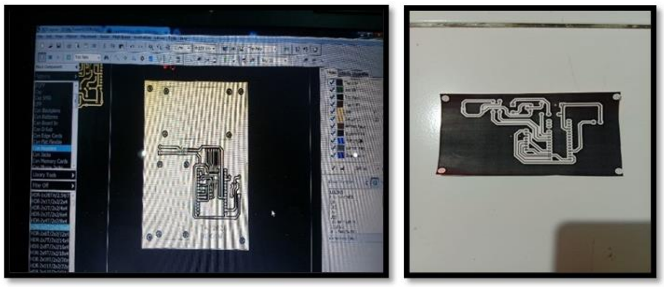

Figure 9. PCB route creation

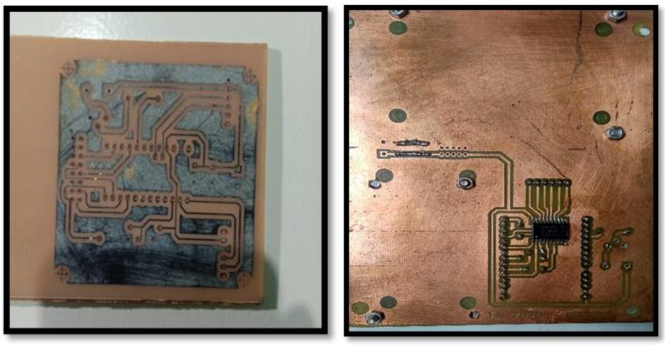

Figure 10. PCB designing

The circuit is etched with liquid chemical while the model is fastened to it, forming a circuit on circuit. As seen in Figure 10, let the model run for approximately 10 minutes. After 10 minutes of immersion, the circuit is withdrawn from the chemical solution so that the electrical channel can be seen, and component soldering is then done.

Figure 11. Results of network assembly

2. Programming Process

The Smart System Design system on two-wheeled motorised vehicles with a fingerprint application is operated by two programming or coding procedures produced with the Kodular and Arduino IDE software.

1. To programme commands to control the relay and deliver WiFi signals, the Arduino IDE software is used:

Using void setup

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Initialising pin status as an input or output and initialising sequences delivered to NodeMCU ESP-12 are done using this menu.

```
#define ENA   14        // Enable/speed motors Right        GPIO14(D5)
#define ENB   12        // Enable/speed motors Left         GPIO12(D6)
#define IN_1  15        // L298N in1 motors Right           GPIO15(D8)
#define IN_2  13        // L298N in2 motors Right           GPIO13(D7)
#define IN_3  2         // L298N in3 motors Left            GPIO2(D4)
#define IN_4  0         // L298N in4 motors Left            GPIO0(D3)

#include <ESP8266WiFi.h>
#include <WiFiClient.h>
#include <ESP8266WebServer.h>

#define  RLY1 15
#define  RLY2 12
#define  RLY3 16
#define  RLY4 14
#define  RLY5 0
#define  RLY6 13
#define  buzz 10

String command,curcommand;          //String to store app command state.
int speedCar = 800;         // 400 - 1023.
int speed_Coeff = 3;

const char* ssid = "Smart Motor";
const char *password = "abcd1234";
ESP8266WebServer server(80);
void setup() {
 curcommand=" ";
 pinMode(ENA, OUTPUT);
 pinMode(ENB, OUTPUT);
 pinMode(IN_1, OUTPUT);
 pinMode(IN_2, OUTPUT);
 pinMode(IN_3, OUTPUT);
 pinMode(IN_4, OUTPUT);

 Serial.begin(115200);
 pinMode(13,OUTPUT);
   pinMode(14,OUTPUT);
   pinMode(16, OUTPUT);
   pinMode(0, OUTPUT);
   pinMode(12, OUTPUT);
   pinMode(15, OUTPUT);
   pinMode(10, OUTPUT);
   digitalWrite(13, HIGH);
   digitalWrite(14, HIGH);
   digitalWrite(16, HIGH);
   digitalWrite( 0, HIGH);
   digitalWrite(12, HIGH);
   digitalWrite(15, HIGH);
   digitalWrite(10, LOW);

 // Connecting WiFi

  WiFi.mode(WIFI_AP); WiFi.softAP(ssid, password);

  IPAddress myIP = WiFi.softAPIP();
  Serial.print("AP IP address: ");
  Serial.println(myIP);

 // Starting WEB-server
    server.on ( "/", HTTP_handleRoot );
    server.onNotFound ( HTTP_handleRoot );
    server.on ( "/", HTTP_handleRoot );
    server.begin();
}
void onkunci(){ digitalWrite(RLY1,LOW);}
void stater()
 { digitalWrite(RLY2,LOW);
  delay(3000);
  digitalWrite(RLY2,HIGH);
 }
void engine(){
 digitalWrite(RLY3,HIGH);
 }
```

Using void loop

This menu is used for applications that the NodeMCU ESP-12 continually runs, such as H. This menu is used to configure a device or smart system to execute the system.

```
void loop() {
   server.handleClient();
      command = server.arg("State");
    if (command == "A") {
      if (command!=curcommand)
{digitalWrite(RLY2,HIGH);
digitalWrite(RLY3,LOW);
curcommand=command; delay(100);}
     }
    else if (command == "B")
    {
     if (command!=curcommand)
{digitalWrite(RLY1,LOW);
delay(1000);digitalWrite(RLY1,HIGH);
curcommand=command; delay(100);}
    }
    else if (command == "C") {
     if (command!=curcommand)
{digitalWrite(RLY2,LOW);
digitalWrite(RLY3,HIGH);
curcommand=command; delay(100);}
    }

}

void HTTP_handleRoot(void) {
```


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```
//if( server.hasArg("State") ){
//       Serial.println(server.arg("State"));
// }
  server.send ( 200, "text/html", "" );
  delay(1);
}
```

2. The second programming involves entering commands into the Kodular software using a smartphone and the Smart System fingerprint app. such that the system can be instructed to perform similarly to Arduino coding via the command function from the application.

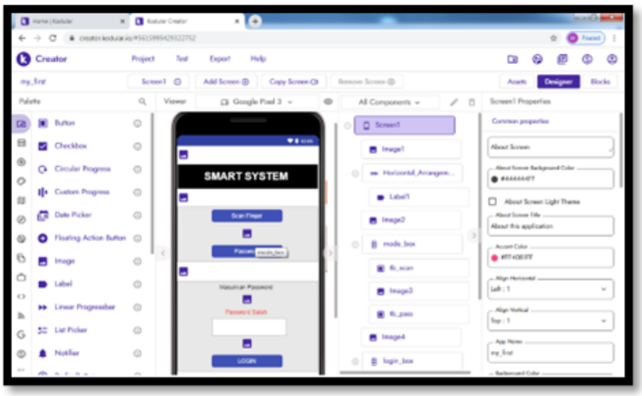


Figure 12. Display screen 1

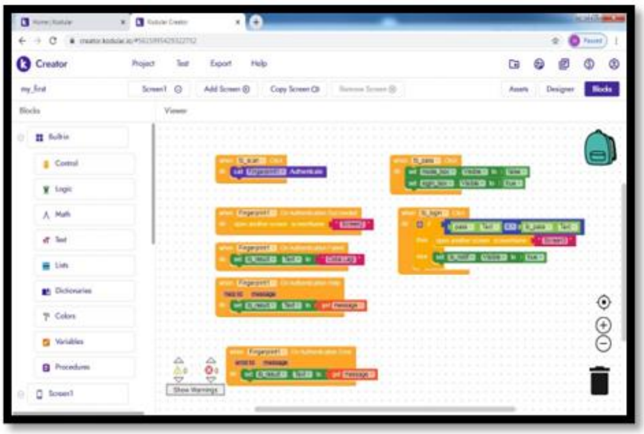


Figure 13. Display coding screen 1

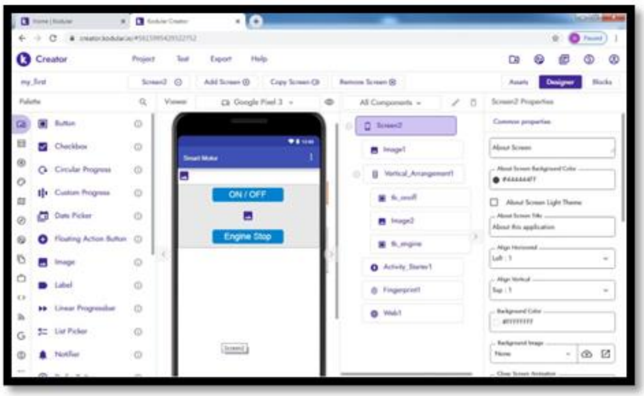


Figure 14. Display screen 2

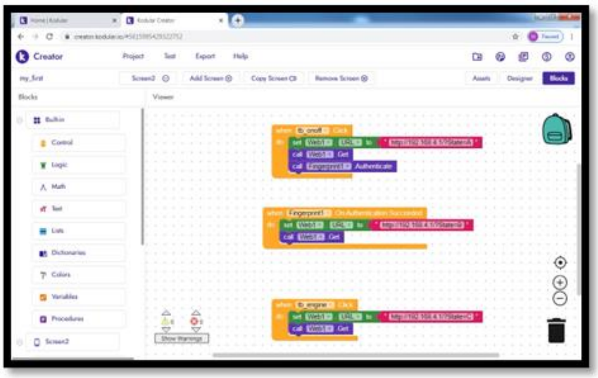


Figure 15. Display coding screen 2

3. Process of circuit assembly for two-wheeled vehicles

a. the procedure for removing the turn signal and headlight from the Yamaha Vixion 150R car.
b. Remove the cable cover and inspect the main cable that runs from the ignition IG to the engine start and stop buttons.
c. Install a new cable line, isolate it using specialised cable insulation, and connect the smart system circuit to the vehicle's main line.
d. Circuits for intelligent systems have new channel layout in the trunk, and new channels have been separated.
e. The procedure of mounting it on the motorised trunk, installing a number of intelligent systems, and installing new cable lines with isolation.

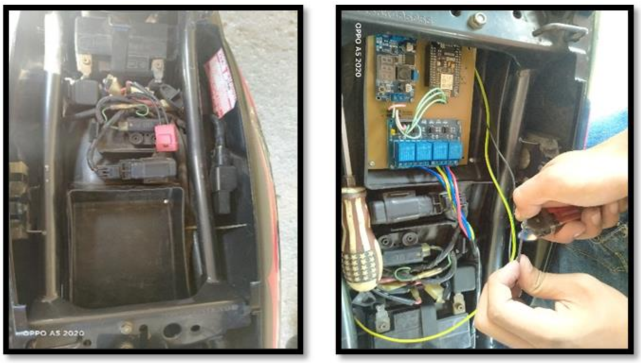
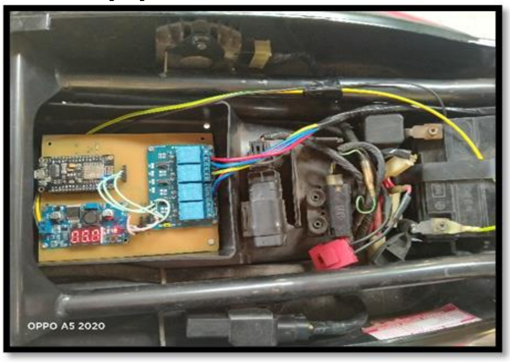


Figure 16. the smart system circuit on the vehicle and its safety system

f. The smart system circuit setup and assembly results for the vehicle's safety system



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4. Instrument Inspection

This microcontroller-based fingerprint application is used to test the intelligent system design on two-wheeled motorised vehicles after tool production is finished and it is prepared for testing.

When the Yamaha VIXION 150R's smart system circuit is turned on and off, it checks to see if it is transmitting WiFi or not. If it is, the connection to the smartphone will remain, and the smart system application will open. Open the smart system application on the smartphone and authenticate with a fingerprint or password to access the control menu, which contains the following: Turn the engine on and off while turning the ignition on and off. Using the ignition key and start button to start the Yamaha VIXION 150R engine and checking to see if the intelligent system is affected if starting the vehicle manually. Using the installed and ready-to-use Fingerprint Smart System application, turn on the power and start the Yamaha VIXION 150R instead of using a manual key. Then, monitor the instrument by understanding the benefits and drawbacks of this smart system application when used on a regular basis.

The information obtained by using the Fingerprint application on the microcontroller platform to assess the state of the Intelligent System equipment on two-wheeled motorised vehicles is displayed in the image below:

Connecting the WiFi network that the smart system circuit emits to the smartphone in order to access the smart system application is the test. Smart system application entrance authentication using fingerprint scanning in order to access the control menu, which includes the ignition ON/OFF and engine ON/OFF options. Comparative testing of the motorcycle starter using the electric key and manual start button against starting the engine with the electric Yamaha VIXION 150R.

5. Fingerprints installation on Honda CBR 150 R

Figure 17 below displays the outcomes of the circuit diagram for designing and constructing an intelligent system for the Honda CB 150 R motorcycle utilising an Arduino-based fingerprint sensor.

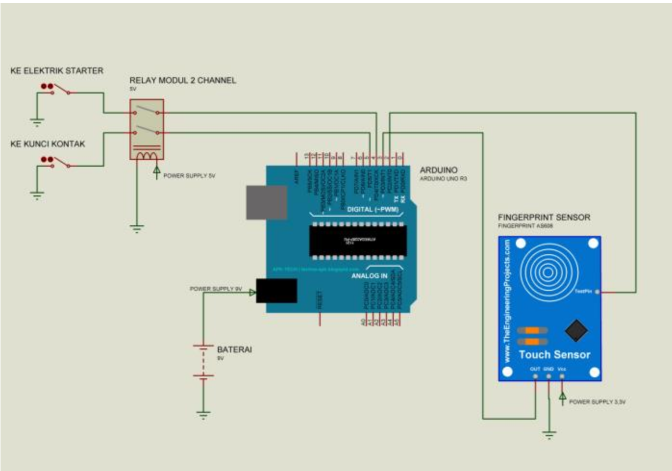

Figure 17. Series of Fingerprint Sensor Smart Systems

The process of smart system works is that the Arduino microcontroller is powered by a 9 volt battery, which will then provide power to the fingerprint sensor and act as a power supply for the 2-channel relay module connected to the electric lock and start button. The Arduino will then receive fingerprint scan data input from the fingerprint sensor, which will then be converted into commands used to connect the terminal to the relay module, which will later replace the ignition lock and start button modules.

Using the Arduino IDE software, the intelligent system design system for the Honda CB 150 R that uses a fingerprint sensor is programmed or coded. Libraries are required when coding in order to ensure that each component performs as intended. The Arduino IDE software has two crucial components when programming: void setup and void loop.

1. void setup

Initialising the pin mode as input or output and initialising the serial that will be uploaded to the Arduino are both done using this menu.

```
#include <Adafruit_Fingerprint.h>
// pin #2 is IN from sensor (GREEN wire)
// pin #3 is OUT from arduino  (WHITE wire)
// comment these two lines if using hardware serial
#include <SoftwareSerial.h>
SoftwareSerial mySerial(2, 3); //rx, tx

Adafruit_Fingerprint finger =
Adafruit_Fingerprint(&mySerial);

const byte R_KONTAKTOR = 4;
const byte R_STARTER = 5;

int count_salah = 0;
int count_benar = 0;

byte status_jari;
byte hold_starter = 0;

#define READY 0
#define BENAR 1
#define SALAH 2
#define TUNGGU 3
 #define AKTIF_FINGER 0
#define NON_AKTIF_FINGER 1
 const int LIMIT_WAKTU = 5;
 byte state = 0;
int i;
 void setup()
{
  pinMode(R_KONTAKTOR, OUTPUT);
  pinMode(R_STARTER, OUTPUT);
  digitalWrite(R_KONTAKTOR, HIGH); // matikan
relay
  digitalWrite(R_STARTER, HIGH); // matikan
relay

  Serial.begin(9600);
  while (!Serial);  // For Yun/Leo/Micro/Zero/...
```


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```
delay(100);
Serial.println("\n\nAdafruit finger detect test");

// set the data rate for the sensor serial port
finger.begin(57600);
  if (finger.verifyPassword()) {
 Serial.println("Found fingerprint sensor!");
} else {
 Serial.println("Did not find fingerprint sensor
:(");
 while (1) { delay(1); }
}
 finger.getTemplateCount();
Serial.print("Sensor contains ");
Serial.print(finger.templateCount); Serial.println("
templates");
Serial.println("Waiting for valid finger...");
}
```

2. Void Loops

This menu is used to design a system that will operate on the device or, in other words, for programmes that the Arduino will run continuously.

```
void loop()                // jalankan lagi dan lagi
{
 //getFingerprintIDez();
 switch(state){
  case AKTIF_FINGER:
   getFingerprintID();
   //getFingerprintIDez();
   control();
   delay(500);           // tidak perlu menjalankan ini
dengan kecepatan penuh.
  break;
  case NON_AKTIF_FINGER:
   break;
 }  }

uint8_t getFingerprintID() {
 uint8_t p = finger.getImage();
 switch (p) {
  case FINGERPRINT_OK:
   Serial.println("Image taken");
   break;
  case FINGERPRINT_NOFINGER:
   //Serial.println("No finger detected");
   return p;
  case FINGERPRINT_PACKETRECIEVEERR:
   Serial.println("Communication error");
   return p;
  case FINGERPRINT_IMAGEFAIL:
   Serial.println("Imaging error");
   return p;
  default:
   Serial.println("Unknown error");
   return p;
 }
 // OK success!

 p = finger.image2Tz();
 switch (p) {
  case FINGERPRINT_OK:
   Serial.println("Image converted");
   break;
  case FINGERPRINT_IMAGEMESS:
   Serial.println("Image too messy");
   return p;
  case FINGERPRINT_PACKETRECIEVEERR:
   Serial.println("Communication error");
   return p;
  case FINGERPRINT_FEATUREFAIL:
   Serial.println("Could not find fingerprint
features");
   return p;
  case FINGERPRINT_INVALIDIMAGE:
   Serial.println("Could not find fingerprint
features");
   return p;
  default:
   Serial.println("Unknown error");
   return p;
 }
  // OK converted!
 p = finger.fingerFastSearch();
 if (p == FINGERPRINT_OK) {
  Serial.println("Found a print match!");
  Serial.println("Benar........");
  count_benar ++;
  if ( count_benar == 4) count_benar = 0;
  status_jari = BENAR;

 } else if (p ==
FINGERPRINT_PACKETRECIEVEERR) {
  Serial.println("Communication error");
  return p;
 } else if (p == FINGERPRINT_NOTFOUND) {
  Serial.println("Did not find a match");
  Serial.println("Salah.........");
  count_salah ++;
  if ( count_salah == 4) count_salah = 0;
  status_jari = SALAH;

  return p;
 } else {
  Serial.println("Unknown error");
  return p;
 }

 // found a match!
 Serial.print("Found ID #");
Serial.print(finger.fingerID);
 Serial.print(" with confidence of ");
Serial.println(finger.confidence);

 return finger.fingerID;
}
```


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```
// returns -1 if failed, otherwise returns ID #
int getFingerprintIDez() {
  uint8_t p = finger.getImage();
  if (p != FINGERPRINT_OK) return -1;

  p = finger.image2Tz();
  if (p != FINGERPRINT_OK) return -1;

  p = finger.fingerFastSearch();
  if (p != FINGERPRINT_OK)  return -1;
    // found a match!
  Serial.print("Found ID #");
Serial.print(finger.fingerID);
  Serial.print(" with confidence of ");
Serial.println(finger.confidence);
  return finger.fingerID;
}
 void control(){
  switch(status_jari){
    case READY:
      getFingerprintID();
      control();
      delay(50);
    break;
    case BENAR:
      switch(count_benar){
        case 1:
          state = AKTIF_FINGER;
          hold_starter = 0;
          Serial.println("kontaktor hidup");
          digitalWrite(R_KONTAKTOR, LOW);
//relay kontaktor hidup
        break;
        case 2:
          if ( hold_starter == 0 ){
            Serial.println("Starter motor");
            digitalWrite(R_STARTER, LOW);
            delay(700);
            digitalWrite(R_STARTER, HIGH);
            delay(500);
            hold_starter = 1;
          }
        break;
        case 3:
          hold_starter = 0;
          Serial.println("Kontaktor mati");
          digitalWrite(R_KONTAKTOR, HIGH); //
relay kontakor mati
        break;
      }
    break;
    case SALAH:
      switch(count_salah){
        case 1:
          Serial.println("Finger print Salah 1x");
        break;
        case 2:
         Serial.println("Finger print Salah 2x");
        break;
        case 3:
          Serial.println("Finger print Salah 3x");
          status_jari = TUNGGU;
        break;
      }
    break;
    case TUNGGU:
      state = NON_AKTIF_FINGER;
      for( i = 0; i < LIMIT_WAKTU; i++){
        Serial.print("Tunggu finger aktif: ");
        Serial.println(i);
        delay(1000);
      }
      state = AKTIF_FINGER;
      count_salah = 0; status_jari = 0;
    break;
  }
 }
```

V. CONCLUSION

Based on the findings and discussion of the design of an intelligent system for two-wheeled motorised vehicles using a fingerprint-based microcontroller application, it can be said that: The distance for using WiFi with a frequency of 2.4 Gz with a maximum distance of 20 metres functions normally, but this system does not yet have additional functionality. Because the wifi connection is more secure and economical, vehicles can be remotely operated.

Credit author statement

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