IOT BASED SMART HELMET SYSTEM FOR MOTORCYCLES

A PROJECT REPORT

Submitted by

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MEPCO SCHLENK ENGINEERING COLLEGE, SIVAKASI

(An Autonomous Institution affiliated to Anna University Chennai)

MAY 2022

BONAFIDE CERTIFICATE

Certified that this project report titled **"IOT BASED SMART HELMET SYSTEM FOR MOTORCYCLES"** is the bonafide work of **Mr. PRASANNA A (Reg.No.201902073), Mr. SANTHRA PRAKASH S (Reg.No.201902089) and Mr. SARAVANA KUMAR M (Reg.No.201902090)** who carried out the research under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

ABSTRACT

The smart helmet system is an IOT-based concept that makes the riding of a bike much safer than before. The objective of the project is to stop the rider from riding the vehicle if he is not wearing a helmet or consuming alcohol. In addition to stopping the rider to start the vehicle, it also notifies specific people via SMS about the passenger's alcohol consumption through the IFTTT applet service.

This smart helmet system is divided into two sections, the transmitter section on the helmet part and the receiver section on the bike part. The alcohol sensor and helmet sensor (i.e. limit switch) are attached to the helmet module and the Node MCU ESP8266 processor module is connected to the bike. RF transmitter in the transmitter section is used to transfer the sensor signals to the receiver section. Rf receiver collects the transmitted signal and gives the signals to the processor. The processor decides the ignition of the engine depending on the signals received.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

India is one of the most populated countries. Due to this exponential population growth and the recent pandemic, many people have not chosen to use public transport to work and travel. According to the 2019 report, the number of traffic accidents increased and 42% of accidents occur in India because of motorcycles several causes of traffic accidents, the main causes are drunken driving and not wearing helmet. When alcohol is mixed with driving, this turns pleasure into pain. Alcohol can decrease our concentration on riding. Reduces the reaction time of the rider's body, making the hands and legs take more time to react. All these factors are responsible for an accident. In India most of the motorcycle riders do not wear helmet while riding a motorcycle. Although many studies have shown that helmets and other protective gear significantly reduce the impact of crashes, many people do not wear helmets. Even though it is a law to be followed.

The proposed project works introduces a smart helmet that prevents the rider from starting the bike without wearing it. We need both a helmet and key to start the bike. And also, when the rider consumes alcohol and tries to start the bike, the alcohol is detected by the alcohol sensor and the proposed system won't allow us to start the bike for the next 20 minutes. It also notifies to a specific people via SMS about passenger alcohol consumption.

1.2 PROBLEM IDENTIFICATION

Over 1.3 million people lost their life and 2050 million people are injured in the world every year. The global status report on road safety, Fig 1.1 says that over 1.24 million lost their lives every year due to road accidents. Road traffic accidents are caused due to drunken driving, riding over speed, and not wearing helmets, seatbelts, and child restraints. To reduce the number of accidents occurring every year we can introduce a smart helmet system that will not allow the rider to start the bike if he is not wearing the helmet and consumed alcohol. In countries like India, bike accidents are due to not wearing a helmet. And also we can reduce the impact of crashes by wearing helmets and safety gear. The government is instructing the citizen to wear a helmet while riding. But most people are not following even though it is a law to be followed. We need both a helmet and a key to start the bike. And also when the rider consumes alcohol and tries to start the bike, the alcohol is detected by the alcohol sensor and the proposed system won't allow us to start the bike for the next 20 minutes.

Fig. 1.1 Deaths due to road accident

1.3 OBJECTIVES

Following are the aims and objectives of this project:

- To build a smart helmet stops starting the vehicles without wearing helmet or even if the driver consumed alcohol.
- To send a SMS to a register mobile number when the rider consumed alcohol.

CHAPTER 2

HARDWARE DESCRIPTION

2.1 NODE MCU ESP8266

Nodemcu is an esp8266 wifi chip module included used as an iot module nodemcu uses the lua as a scripting language and is an open source internet resources platform. This module has a CH340g USB to TTL converter chip on board.ESP8266 NodeMCU CP2102 Board features the ESP8266, a highly integrated chip designed for the requirements of the new world of IoT. It make use of our wifi network to host an application the esp8266 has inbuild processing and storage capabilities, allowing integration with sensors and other device-specific devices via gpios. The size of the chip is small that it ensures minimal external rotation and the entire solution, including the front module.This board is based on the esp8266 wifi module chip considering esp12 smd footprint. The WiFi upgrade board already has all the ESP8266 (ESP12E) code installed on the board to configure and uploading the code. A built-in USB serial chip download code, 3.3V voltage regulator and logic level converter circuit allows you to quickly download the code and connect the circuit. The Fig.2.1 is the Node MCU ESP8266 used in our project.

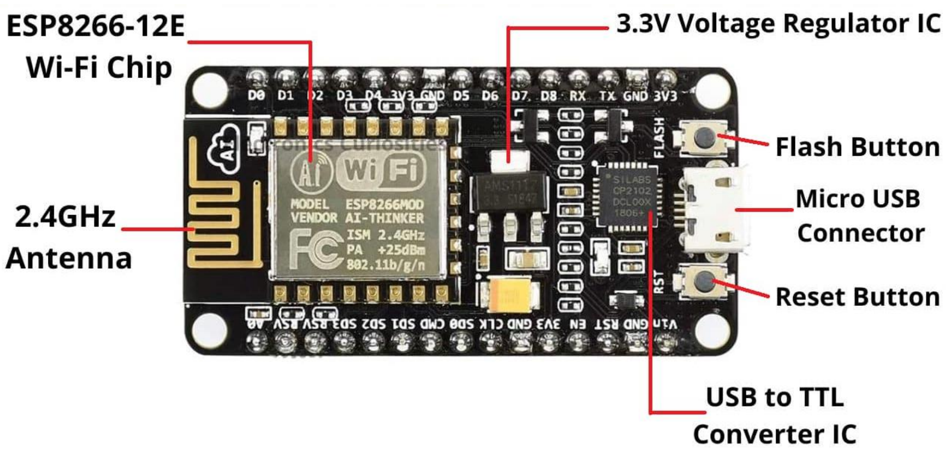

Fig.2.1 Node MCU ESP8266

Nodemcu ESP8266 Specifications:

Operating DC Voltage : 3.3V

Input DC Voltage : 7-12V

Digital INPUT/OUTPUT Pins (DIO) : 16

Analog Input Pins (ADC) : 1

UART : 1

Flash Memory : 4 MB

SRAM : 64 KB

Clock Speed : 80 MHz

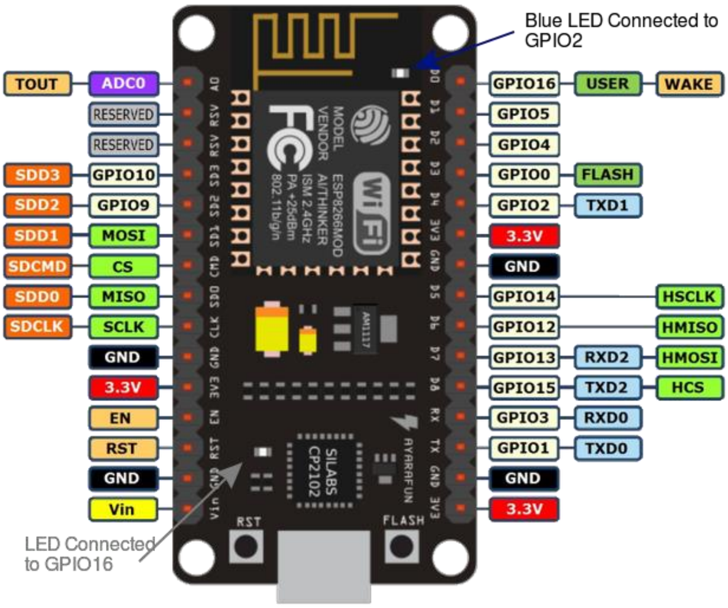

FIG.2.2 Pin diagram of Node MCU ESP8266

2.2 ALCOHOL SENSOR (MQ-3 SENSOR)

MQ3 is one of the sensors of MQ sensor series which is made up of Metal oxide Semiconductor. Metal oxide sensors are also called chemical resistance sensors because their sensitivity is based on the change in the resistance of the sensing material when exposed to alcohol. Therefore, it is possible to determine the alcohol concentration by placing it in a simple voltage divider network. The MQ3 alcohol sensor operates at 5VDC and consumes about 800mW. The sensor can able to detect alcohol concentrations from 25 to 500 ppm. The Fig.2.3 is the alcohol used in our project.

Fig.2.3 Alcohol sensor

2.2.1 INTERNAL STRUCTURE OF MQ-3 SENSOR:

The sensor is surrounded by two layers of fine stainless-steel mesh called a breakwater as shown in Fig.2.4. It can smell flammable gas (alcohol), so the heating element inside the sensor does not cause an explosion. It also provides sensor protection and filters particulate matter so that only gaseous elements can pass inside the chamber.

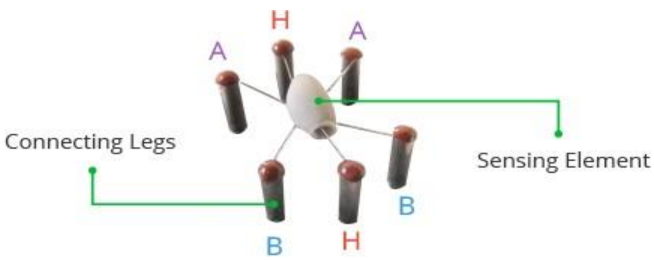

Fig.2.4 Internal structure of MQ-3 sensor

Here's what the sensor looks like with the outer mesh removed. The star-shaped structure is formed by the sensing element and six connecting legs projecting beyond the Bakelite base. Two of the six leads (H) serve to heat the sensing element and are connected via a nickel-chromium coil (a well-known conductive alloy). The remaining four wires (A and B) responsible for the output signal are connected using platinum wires. This wire is connected

to the body of the sensing element and carries a small change in current through the sensing element. The Fig.2.5 is the sensing element of the MQ-3 sensor

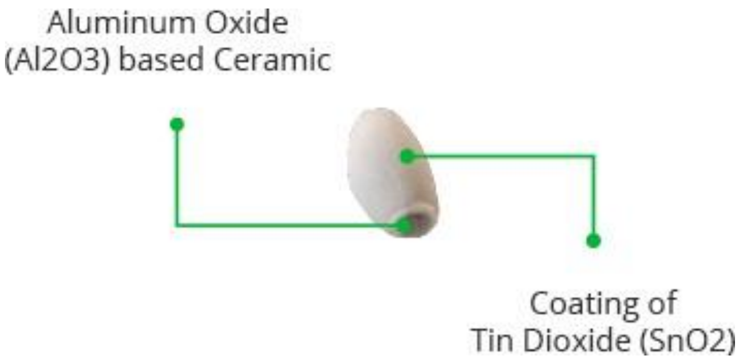

Fig.2.5 Sensing element of MQ-3 sensor

The tubular sensing element is made of alumina ceramic (AL2O3) and coated with tin dioxide (SnO2). Tin dioxide is the most important substance sensitive to alcohol. However, the ceramic substrate only increases the heating efficiency and allows the sensor area to be continuously heated to its operating temperature. In summary, a nickel-chromium coil and an alumina-based ceramic form a heating system. A platinum wire and a coating of tin dioxide form the sensor system.

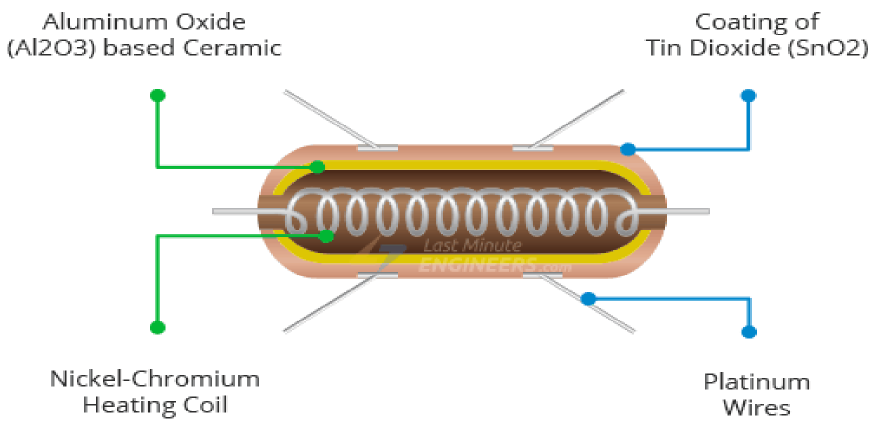

Fig.2.6 Internal structure of sensing element

2.2.2 WORKING OF MQ-3 SENSOR:

When the SnO2 semiconductor layer is heated to a high temperature, oxygen is adsorbed on the surface. In pure air, electrons in the conduction band of tin dioxide are attracted to oxygen molecules. This forms an electron-deficient layer just below the surface of the SnO2 particles and forms a potential barrier. As a result, the resistance of the SnO2 film increases, preventing the flow of current. However, in the presence of alcohol, the surface density of adsorbed oxygen decreases as it reacts with the alcohol. lowering potential barriers. The electrons are then emitted into the tin dioxide, allowing current to flow freely through the sensor.

2.3 BUMP SWITCH

A Bump switch is an electromechanical device which is works by a physical force applied to it. It is used to detect a presence of an object. this is a single pole single throw snap action micro switch with a lever for actuating the snap action and the switch to work. It consists of three legs namely common leg (c), normally closed leg (NC) and normally open leg (NO). This SPST switch can be used as both normally opened or normally closed switch. It can be operated on mode depending on the application requirement. When the lever is pressed at a instant it will establish a connection between the common leg(C) and with the normally opened or normally closed leg(C). This switch can also be used to check whether a device is present or not. The Fig.2.7 is the bump switch used in our project.

SPECIFICATIONS:

Microswitch Actuator: Lever

Contact Configuration: SPDT

Contact Voltage AC: 250VAC

Contact Current Max: 10.1A

Operating Force: Max 1.47N

Fig.2.7 Bump switch

2.4 RF TRANSMITTER

This hybrid RF transceiver module is a complete RF transmitter and receiver module solution that can be used to transmit data up to 3kHz from any standard cmos/ttl source. The transmitter is a very small module. The main part of the transmitter module is a sawtooth resonator used to operate at a frequency of 433 MHz. There are switching transistors and some passive components. When the DATA input is logic HIGH, the oscillator operates to generate a constant RF output carrier at 433 MHz and stops the generator when the DATA input is logic LOW. This method is called amplitude shift keying. In amplitude shift keying, the amplitude of the carrier is changed in response to an incoming data signal. Which is analogous to analog AM radio technology in amplitude modulation. Also known as binary amplitude shift keying because it consists of only two levels and is similar to a switch. The Fig.2.8 is the RF transmitter used in our project.

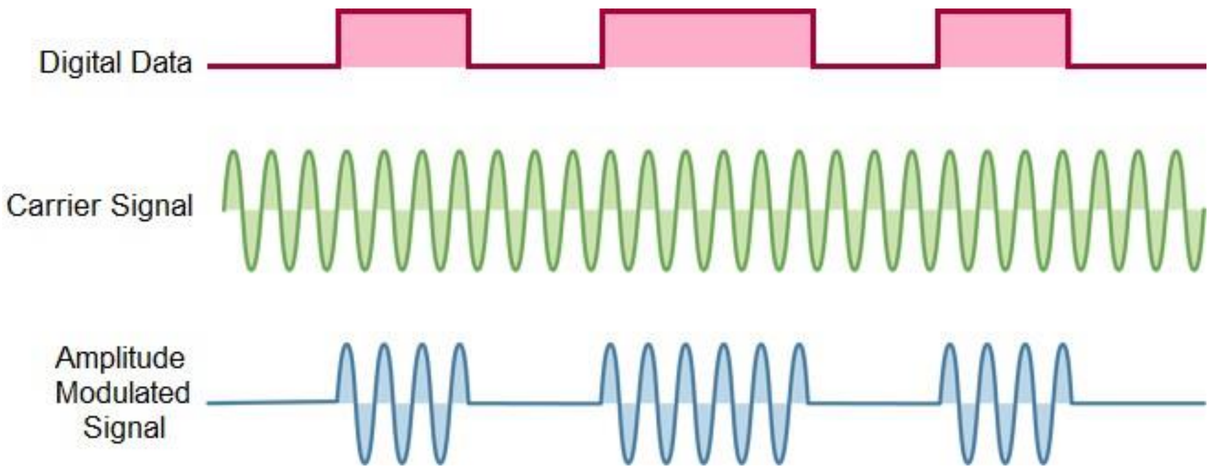

Fig.2.8 Amplitude shift keying

SPECIFICATIONS:

- Range in open space (Standard Conditions) : 100 Meters
- Transmitter frequency range : 433.92MHz
- Transmitter supply voltage : 3v~6v
- Transmitter output power : 4v~12v

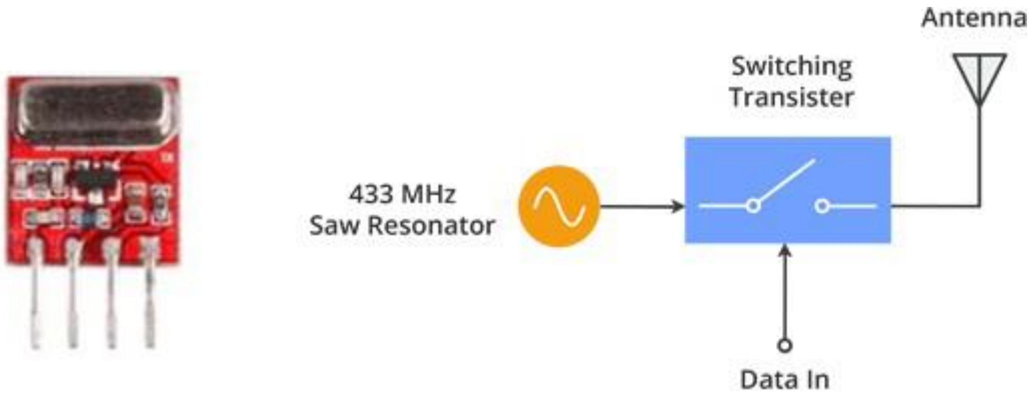

Fig.2.9 RF transmitter

2.5 RF RECEIVER

The receiver module consists of an RF circuit and a pair of op amps to amplify the carrier wave received by the transmitter. The amplified signal is fed into a phase-locked loop (PLL) which causes the decoder to "lock" to the digital data stream. It provides better decoded output and noise immunity. The Fig.2.10 is the RF receiver used in our project.

SPECIFICATIONS:

- Receiver frequency :433MHz
- Receiver typical frequency :105Dbm
- Receiver supply current :3.5mA
- Receiver operating voltage :5v

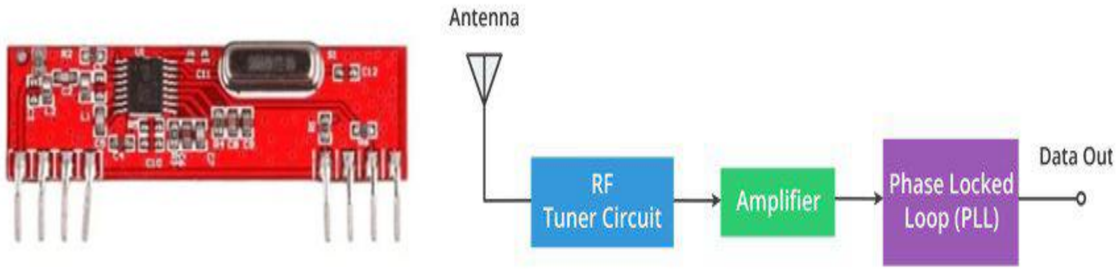

Fig.2.10 RF receiver

5.6 HT12E ENCODER IC

The HT12E is a 212 series encoder integrated circuit. Paired with a 212 series decoder for use in remote control systems. It is mainly used to interface RF and infrared circuits. The selected encoder/decoder pair must have the same number of addresses and data types. The HT12E converts a parallel input to a serial output. Encodes 12-bit parallel data into serial data for transmission via an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits.HT12E has a transmit enable contact that is active low. When a trigger signal is received on the TE pin, the programmed address/data is transmitted along with the header bits over an RF or IR transmission medium. The HT12E starts a 4-word transmission cycle after receiving permission to transmit. This cycle repeats as long as the TE remains low. When TE goes high, the encoder output completes its last cycle and then stops. The Fig.2.11 is the encoder IC used in our project.

SPECIFICATIONS:

12 Bit encoder IC

supply voltage range	:2.4V to 12V
Low stand by current	:0.1uA at Vcc=5V

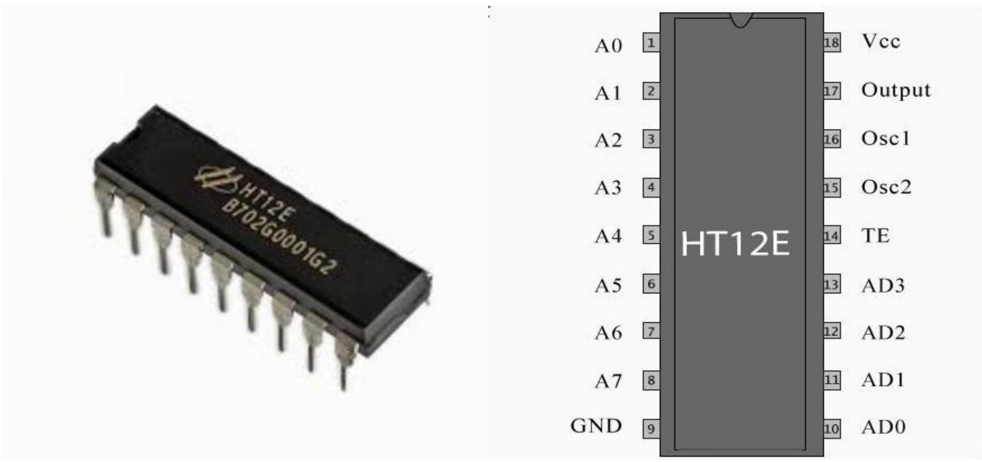

Fig.2.11 HT12E IC

5.7 HT12D DECODER IC

HT12D is a decoder integrated circuit belonging to the 212 series decoder. This decoder series is mainly used in remote control system applications such as burglar alarms, car door controllers, security systems, etc. It is primarily designed to connect RF and infrared circuits. They are paired with 212 series encoders. The selected encoder/decoder pair must have the same number of addresses and data types. The HT12D converts a serial input to a parallel output. It decodes the serial address and data received by the RF receiver into parallel data and sends it to the data pin. Serial input data is compared to the local address three times in a row. If no error or mismatch code is found, the input data code is decoded. A valid transmission is indicated by a high signal on the VT pin. HT12D can decode 12 bits, of which 8 bits are address and 4 bits are data. The data on the 4-bit latch output pin remains unchanged until new data is received. The Fig.2.12 is the decoder IC used in our project.

SPECIFICATIONS:

Decoded data has 4 Data bits and 8 Address bits (8+4=12-bits)

Operating Voltage : 5V

Low stand by current :0.1uA at Vcc=5V

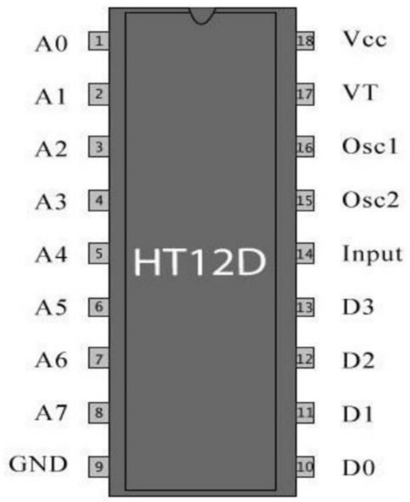

Fig.2.12 HT12D IC

5.8 RELAY MODULE

A relay is a simple electromechanical switch. A relay is a switch that connects two circuits or disconnects them. A relay, on the other hand, operates by sending an electrical signal to an electromagnet, which connects or disconnects another circuit. We are using a single channel 5v relay module. It can switch circuits of DC 5V/10A and AC250V/10A. The Fig.2.13 is the relay used in our project.

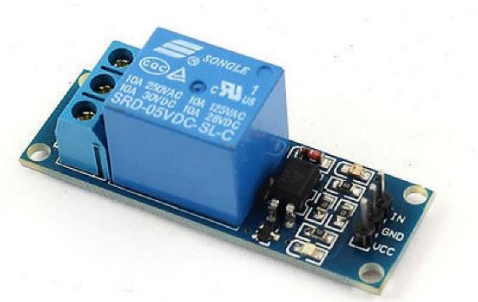

Fig.2.13 Relay element

5.9 LED

It is just a Light Emitting Diode, which glows when supply is given to it. Fig:2.14 shows LED which is used for indication of the status of the system in our project.

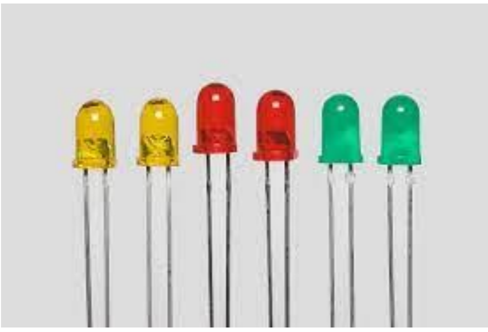

Fig2.14 LED

CHAPTER-3

BLOCK DIAGRAM

3.1 TRANSMITTER SECTION:

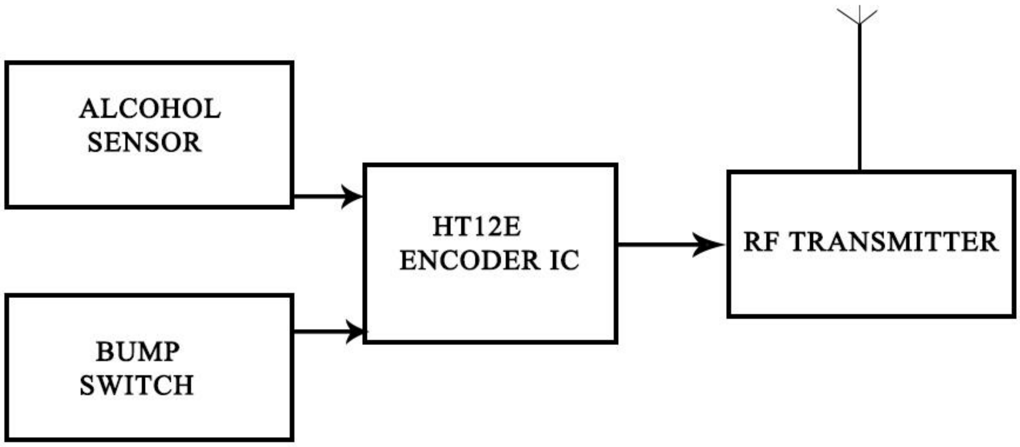

Fig.3.1 Block diagram of transmitter section

The above Fig.3.1 is the block diagram representation of the transmitter section. The transmitter section is fitted to the helmet of the rider. The values of the alcohol sensor and the bump switch and the bump switch are sent to the HT12E encoder IC. The encoder IC will encode the two signals and send them to the RF transmitter. The encoded signals will be transmitted wireless through radio frequency signals. The frequency of the RF transmission is 433 MHz. The whole transmitter section is compact so that it can be fitted on the helmet easily.

3.2 RECEIVER SECTION:

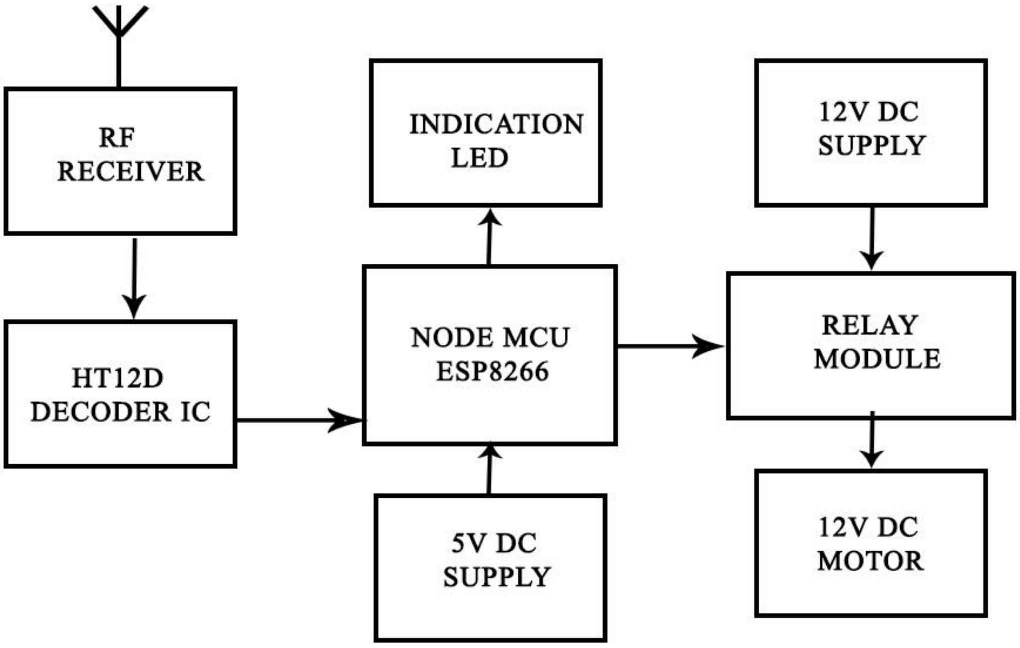

Fig.3.2 Block diagram of receiver section

The above Fig.3.2 is the block diagram representation of the receiver section. The receiver section is fitted to the bike. The RF signals transmitted by the transmitter section are received by the RF receiver. The received signals are decoded by the HT12D decoder IC. These decoded signals are sent to the node MCU ESP8266. The 12v starter motor of the bike is controlled by a relay module. Here the node MCU sends signals to the relay module depending on the input received from the RF transmitter. There is a LED indication for the acknowledgment for the Rider. The receiver section is compact and it can be operated by the bike's battery supply.

CHAPTER 4

WORKING PROCEDURE

4.1 FLOW CHART

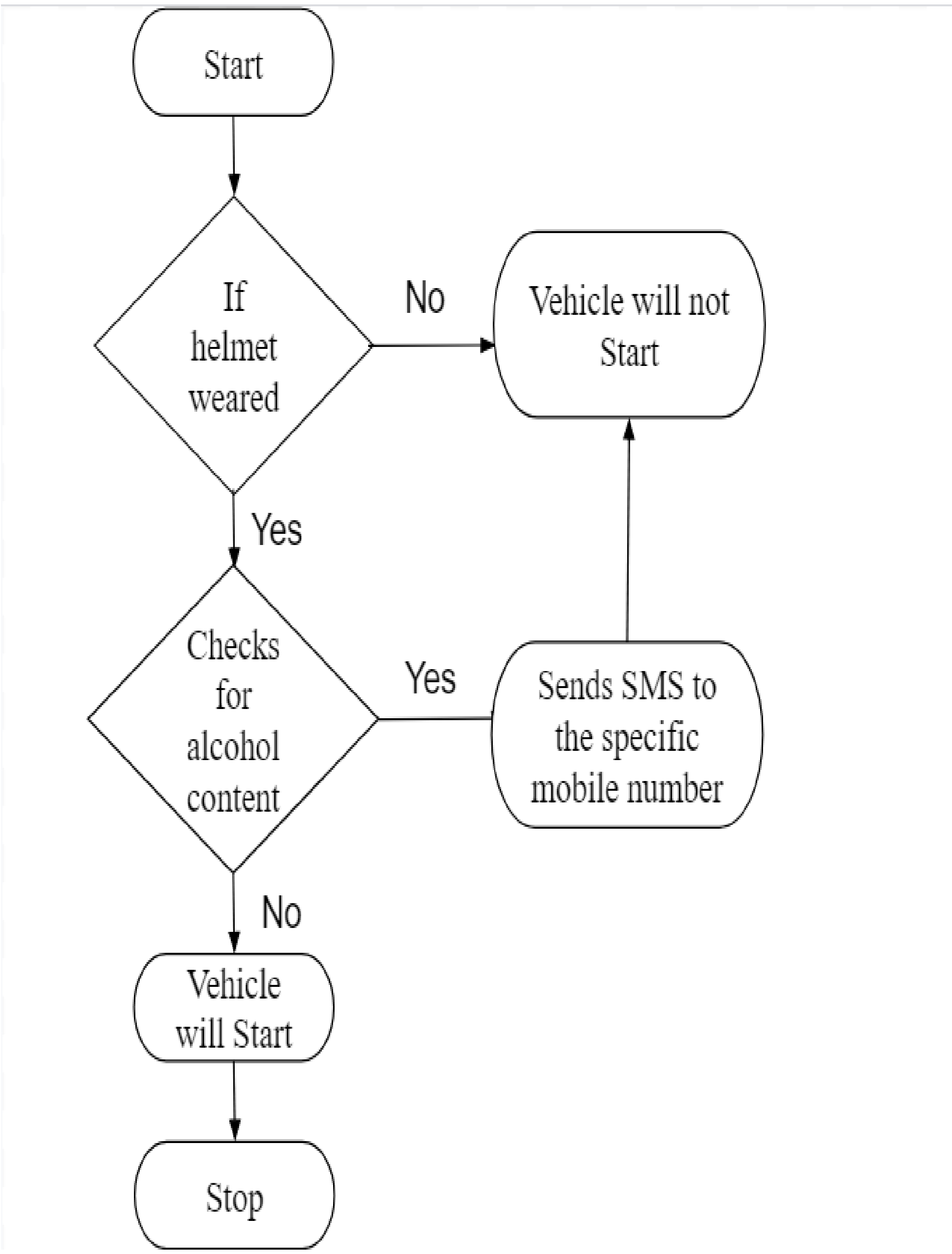

Fig.4.1 Flow chart

4.2WORKING

The working procedure of the IoT Based Smart Helmet System for Two Wheelers is explained below. This smart helmet system is divided into two sections, the transmitter section and the receiver section. In the helmet, we are using an Alcohol sensor and a bump sensor (i.e. limit switch) is attached to the helmet and the receiver section with processing unit is attached to the bike. These two sections sends and receives signal using radio frequency communication, using node MCU as microcontroller unit. MQ3 sensor is used to detect alcohol content from the breath. So, it is placed on the mouth of the helmet. To detect the presence of a helmet a limit switch is used. When the rider wears the helmet, the head of the rider presses the limit switch and it will create a closed contact, if the helmet is wearied by the rider the switch will remain in the open state. To start the bike, the receiver section is to be connected with a mobile hotspot. the transmitter will send the sensor and limit switches values to the receiver. The receiver sends the value to the processing unit. When the helmet is worn and no alcohol is detected the processing unit will give on signal to the relay which switches on the starter motor of the bike. And the bike will be started. When the helmet is not worn, the receiver will wait for the rider to wear the helmet. When alcohol is detected the node MCU will request the IFTTT server to send alert message to the registered number of the raider from the IFTTT configured mobile number. Once the alcohol is detected the raider cannot start the bike for the next 15 minutes. We can alter the timing by changing the programmed code.

CHAPTER 5

IMPLEMENTATION

5.1 TRANSMITTER SECTION

Fig.5.1 Implementation of transmitter section

A **-** 5V voltage regulator

B - HT12E encoder IC

C – RF transmitter

D- Bump switch

E – Alcohol sensor

The above fig.5.1 is the final implementation of the transmitter section. The alcohol sensor is placed below the visor of the helmet and the bump switch is placed inside the center of the helmet. The encoder IC and the transmitter is soldered on a single dot board. The board is operated by a 9V battery. The 9v is reduced to 5V by a 5V voltage regulator. Since the operating voltage of the alcohol sensor is 5V we are using a 5V regulator L7805. We can use a rechargeable battery instead of a non-rechargeable battery in the practical case. The signals from the alcohol sensor and the bump switch are sent to the encoder IC. The encoder IC encodes the signals and sent to the RF transmitter. The RF transmitter transmits the signal wirelessly. The receiver section is compact and sweatproof.

5.2 RECEIVER SECTION:

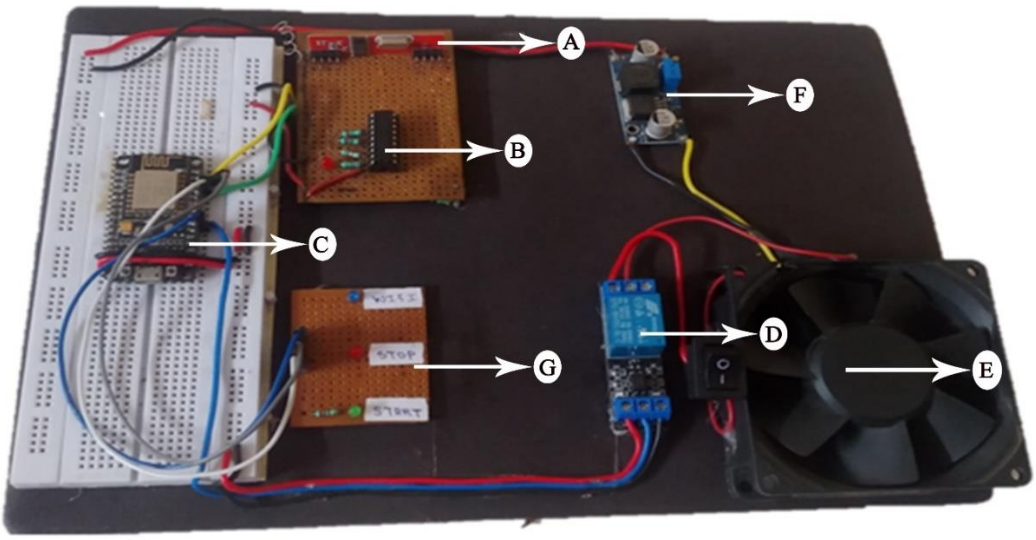

Fig.5.2 Implementation of receiver section

A - RF receiver
B - HT12D decoder IC
C - Node MCU ESP8266
D - Relay module
E - 12v dc fan
F - 5vto 12v boost converter
G – LED indication

The above Fig.5.2 is the final implementation of the receiver section. The RF receiver and the decoder IC are soldered on a dot board. The node MCU is placed on a breadboard and the Indication LEDs are soldered on a separate dot board. Here instead of a 12V DC bike starter motor, we have used a 12V DC motor fan. A relay module is fitted in between the 12V DC source and the starter motor. The starter motor is switched on only when the relay is turned on. The relay is switched by getting signals from the processing unit. Here the blue wire from the relay module to the processing unit is the signal transmitting wire of the relay. On the LED indication dot board there are three LEDs.The blue LED indicates the status of the connection of the receiver section with a network(mobile hotspot). The green LED indicates when the starter motor is turned on and the red LED indicates the starter motor is turned off.

Fig .5.3 Alert message received by the mobile

The above Fig.5.3 is the alert message received by the mobile when the rider consumes alcohol. The node MCU sends a request to the IFTTT server when the rider Consumes alcohol. Whenever the IFTTT server gets a request from the node MCU it responds to the request by sending an alert message to the specific mobile number which is already registered on the IFTTT website.

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

CONCLUSION:

Through this project, we have designed an innovative helmet that makes the driver mandatory to wear it throughout the driving session. It also checks whether the driver has consumed alcohol or not. If he hasn't consumed alcohol and also worn a helmet (also throughout the session) only then the vehicle connected to the helmet will turn on. If the driver consumed alcohol or did not wear a helmet while driving the vehicle, then our system will not allow the vehicle to turn on. And it has an inbuilt system that when triggered, sends a message alert to the driver.

FUTURE SCOPE:

In the future, we can extend our project by adding a GPS system that will send the precise location of the driver to the police and can easily be tracked. We can also build an online Fine generation system that can be sent to the driver to be paid before the mandated date when the driver consumed alcohol and drove the vehicle and also when the driver didn't wear a helmet.

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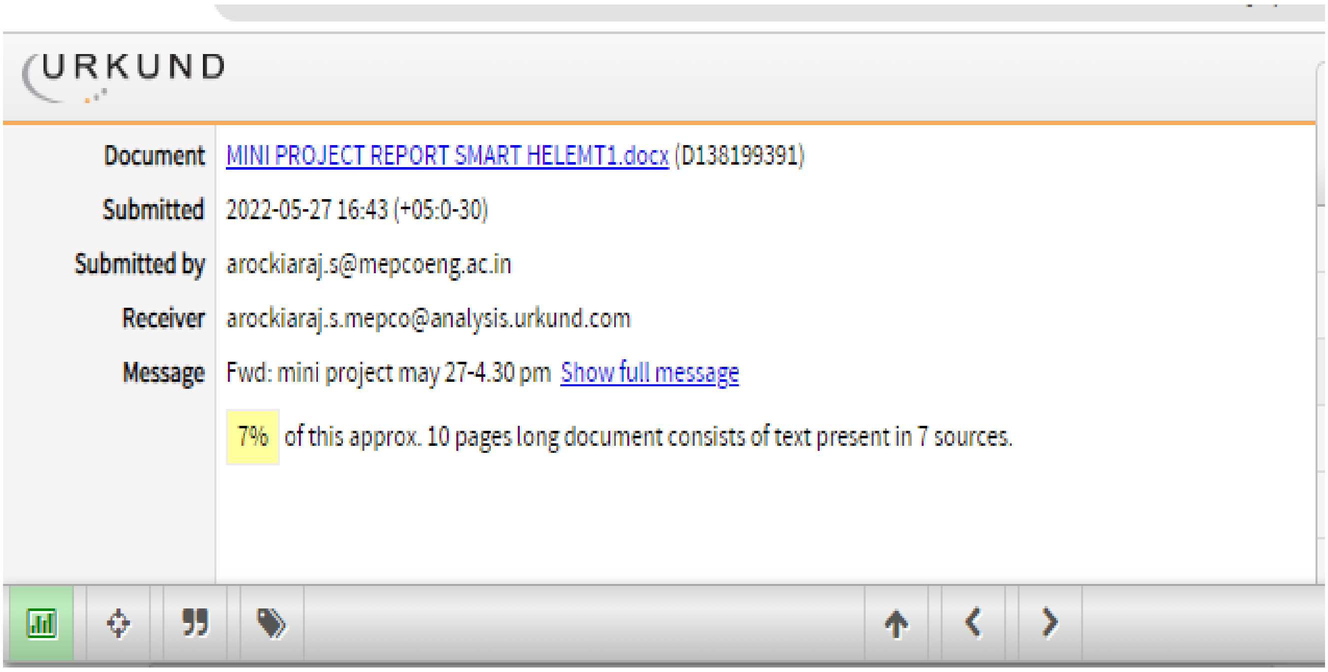
APPENDICES

Node MCU code:

```
#include <Wire.h>  // library for I2C protocol
#include <ESP8266WiFi.h>
int sensorValue=1;
int button=1;

const char* ssid = "username";
const char* password = "nothanksss";

const char* host = "maker.ifttt.com";
boolean flag= true;
WiFiClient client;
void setup() {
    Serial.begin(115200);
    pinMode(D0, INPUT); //yellow wire
    pinMode(D1, OUTPUT); //red led
    pinMode(D2, OUTPUT); //green led
    pinMode(D3, INPUT);   //green wire
    pinMode(D5, OUTPUT);  //MOTOR
    pinMode(D6, OUTPUT); //wifi
    digitalWrite(D6, LOW);
     WiFiClient client;
    while((!(WiFi.status() == WL_CONNECTED)))
    {
      connectToWifi();
    }

  }

void loop() {

 sensorValue = digitalRead(D0);
Serial.print("sensor:");
 Serial.println(sensorValue);
 button=digitalRead(D3);
  Serial.print("button:");
 Serial.println(button);

      const int HttpPort1 = 80;
      if (!client.connect(host, HttpPort1))
      {
```

```
        Serial.println("oops!!connection failed");
        digitalWrite(D6,LOW);
        return;
      }

    if(sensorValue==0){          //alcohol detected
      message();
      Serial.println("alchol detected");
      digitalWrite(D5,LOW);
      digitalWrite(D1,HIGH);
      digitalWrite(D2,LOW);

      delay(600000);
      }

    else if(button==0 && sensorValue ==1)  {         // helmet weared and no alcohol
      Serial.println("bike is started");
      digitalWrite(D5, HIGH);
      digitalWrite(D1, LOW);
      digitalWrite(D2, HIGH);
       }
    else if(button == 1)
   {
    Serial.println("no helmet");
    digitalWrite(D5, LOW);
    digitalWrite(D1, HIGH);
    digitalWrite(D2, LOW);
    }

  delay(250);
  // Determine the status

}
void message(){

  if (flag == true)
       {
          String url_link =
"/trigger/mini_project/with/key/k9ourc3v5_oNnyHGwDsHp_EtVcCEp2gCfh13SkTQBoq";
          Serial.print("Requesting URL_LINK: ");
          Serial.println(url_link);
          client.print(String("GET ") + url_link + " HTTP/1.1\r\n" + "Host- " + host + "\r\n" +
"Connection status: closed\r\n\r\n");
          flag= false;
```

```
        }
}
void connectToWifi()
{
  int i=0;
  Serial.println("Connecting to WIFI network");
  WiFi.begin(ssid, password);
  while((!(WiFi.status() == WL_CONNECTED)))
  {
    Serial.println(" - .-");
    i++;
    delay(280);
    if( i>10 )
    {
     connectToWifi();
    }
   }
 Serial.println(".");
   digitalWrite(D6,HIGH);
   Serial.println("WiFi connected successfully");
}
```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