Smart Helmet (IoT Based)

Ayushi Khandelwal, Himani Jain, Bhavya Jain, Arpit Khandelwal, Harsh Vijay, Akshay Kumar, Santosh Kumar Singh

Abstract— This paper gives description of a smart helmet which is based on IOT system to avoid accidents during vehicle riding results due to recklessness of riders towards helmet as it won't allow the vehicle to start until the riders wears the helmet. It consist of two modules one for the bike and other for the helmet. The bike module will act as a server and the helmet module will act as a client and the modules will act as an aggregated system when proper connectivity is established between the server and client module. As soon as the wi-fi connection is interrupted the bike will stop passing current to the ignition coil and hence stop it's functioning.

Index Terms— Smart helmet, IoT, server-client, Wi-fi, NodeMCU , Secure.

1 Introduction

IOT is a network of inter related devices sharing information and data, this ability to share information makes a device smart, thus smart device is nothing but a device working over IOT with other devices. Smart helmet works basically on the IOT platform with server-client connectivity[1]. The NodeMCU in the bike module will act as a server which will set-up the connectivity with the helmet module getting the power source from the ignition in the engine. NodeMCU is an open source IoT platform. It includes firmware and hardware part. firmware works on the ESP8266 Wi-Fi SoC from Espressif Systems and hardware works on ESP-12 module. Lua scripting language is use by this firmware. ESP8266 features are : It is open source , Interactive , Programmable , Low cost , simple ,smart , wi-fi enabled , USB-TTL included device. It works on XTOS operating system having memory 128kBytes and Storage 4M bytes. It is powered by USB. For coding, Arduino IDE used. It has 10 GPIO pins, some ground pins and two types of power voltage 3.3v, 5v (used with 3.3v Regulator which inbuilt on Board using Pin Vin). It also consist a relay which is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it). Relay is connected to the server and is used to control the motor vehicle functionality to turn on or off the bike as desired, relay is integrated with the ignition coil in the vehicle which supply high voltage current to spark plug and keep running the engine, with the help of relay NodeMCU (SERVER)controls the current supply to the ignition coil and directly control engine functioning . An Organic-LED is also present in bike module connected to bike display panel which will show the current status of the system. O-LED is a Light Emitting diode in which the electroluminescent layer is a film of organic compound (millions of small LED lights) that emits light in response to an electric current. The display connects to NodeMCU (Server) using only four wires – two for power (VCC and GND) and two for data (serial clock SCL and serial data SDA), making the wiring very simple. The data connection is I2C (I²C, IIC or Inter-Integrated Circuit) and this interface is also called TWI (Two Wire Interface)[2]. OLED display is used to current state of the system, when the rider starts the motor vehicle and don't wear helmet OLED display warning "Please wear helmet " and when the rider wears the helmet it is display message " Helmet used".

The Helmet module consist of Node MCU use for handshaking with server (Bike Module) and a Capacitive touch sensor. Capacitive sensor (sometimes capacitance sensor) uses technology based on capacitive coupling, that can detect and measure anything that is conductive or has a dielectric different from air. This principle allows capacitive touch sensor to detect the presence of human head inside a helmet which sends signal over iot to allow displaying of corresponding message on OLED panel and allowing rider to start the bike for a ride.

2 Problem Formulation

Every year around numerous people get badly injured or died due to their recklessness toward helmet and that's the reason Central Govt. along with the state legislatives is taking several steps for the compulsion of helmet during the ride. In India , per year around 39,975 deaths occur due to not wearing helmet and around 36,678 seriously injured. Keeping this initiative in mind this smart helmet is developed which won't allow the rider to access the bike until it wears the helmet [3].

3 Proposed Solution and assumption

In this section we first discuss the background of IoT and then implementation of proposed solution model of Smart Helmet.

3.1 Background of IoT

IoT is a network of inter related devices sharing information and data , this ability to share information makes a device smart , thus smart device is nothing but a device working over IoT with other devices. The Internet of Things consists of any device operate through the Internet. This includes almost anything you can think of, ranging from cellphones to building maintenance to the jet engine of an airplane. Medical devices, such as a heart monitor implant or a biochip tran-

- *Dr. Santosh Kumar Singh is currently working as associate profrssor in electronic engineering in JECRC, Jaipur, 302022. E-mail: drsantosh.it@jecrc.ac.in*

sponder in a farm animal, can transfer data over a network and are members the IoT. We have used IoT to empower our helmet and thus it can be called a smart helmet. Entire system working over IoT seamlessly to ensure proper working of helmet module with bike module so that bike turns on only and only if rider wears helmet.
Capacitive touch sensor detects human presence and sends positive response to bike which further allows rider to kick start or self-start the vehicle. This sharing of information is all because of IoT.

3.2 Implementation of proposed solution

This project focuses to avoid accidents during vehicle riding results due to recklessness of riders towards helmet.

In this model, two NodeMCU are used for connectivity, first one in Bike module and another one in Helmet module. Server-Client communication is established between both MCU. It consist of two level security system 1.Password protected 2.String Synchronization. Helmet module acts as access point (Client) it has fix IP address and password so it can connect uniquely with Bike module which acts as Station (Server). Client request to server to connect by sending the string then Server replies client by sending another string , then a successful connection is established between client and server (i.e. Helmet and Bike respectively).
Bike module consist of NodeMCU , Capacitive touch sensor and a buzzer . The basic connections between them is shown in Fig 1.

Fig 1 : Helmet Module

Helmet Module consist of NodeMCU, O-LED and Relay. The basic connections between them is shown in Fig 2

Fig 2 : Bike Module

When rider turn on the bike the O-LED display present in bike module shows warning "PLEASE WEAR HELMET". When rider wears the Helmet and set the clip for power supply to helmet module then capacitive touch sensor detect the presence of human head inside helmet and client (Helmet module) ask to server(Bike module) for handshaking which will establish by using a specific IP address and Password then O-LED display shows "HELMET USED" and buzzer beeps . Then the server side turns on the relay an electromagnet switch which allow current flow to ignition coil which is necessary to start the motor vehicle. The circuit diagram of Client and server is shown in Fig. 3 and Fig. 4 respectively

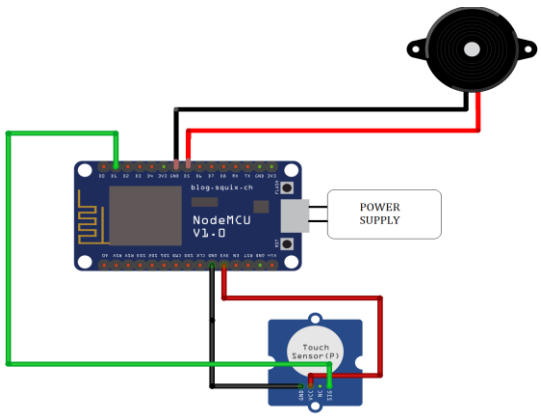

Fig 3 : Client side circuit diagram

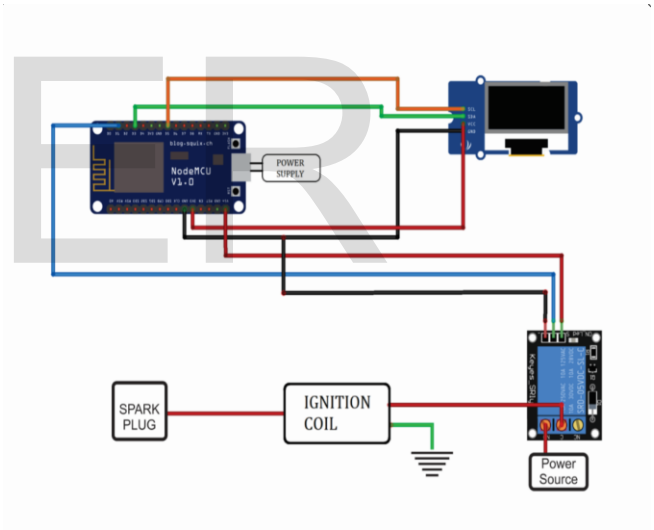

Fig 4 : Server side circuit diagram

The code for Server and client is implemented using Arduino IDE .Two different codes are used for interconnection between two NodeMCU. In server-client model the client sends the request to the server (Fig. 5) which is password encoded in the from of active-low signals and then the server respond to the client by sending same packet to the client after attaching one more packet to it (Fig. 6). This is inter-process communication which the is used by ESP8266 to connect with the server.

```
CLIENT_SIH_final §
#include <ESP8266WiFi.h>

int pin = 5;
int temp ;
int buzz = 14; //D5

char ssid[] = "JECRCAP1234";
char pass[] = "123456789";

IPAddress server(192,168,4,15);
WiFiClient client;

void setup() {
  Serial.begin(9600);
  WiFi.mode(WIFI_STA);
  WiFi.begin(ssid, pass);
  Serial.println();
  Serial.println("Connection to the AP");
```

Fig 5 : Client side code

```
SERVER_FINAL_SIH
#include <ESP8266WiFi.h>
#include <Wire.h>  // Only needed for Arduino 1.6.5 and earlier
#include "SSD1306.h" // alias for `#include "SSD1306Wire.h"`
SSD1306  display(0x3c, D3, D5);
WiFiServer server(80);
IPAddress IP(192,168,4,15);
IPAddress mask = (255, 255, 255, 0);

byte ledPin = 5;

void setup() {
  Serial.begin(9600);
  WiFi.mode(WIFI_AP);
  WiFi.softAP("JECRCAP1234", "123456789");
  WiFi.softAPConfig(IP, IP, mask);
  server.begin();
  pinMode(ledPin, OUTPUT);
  Serial.println();
  //erial.println("accesspoint_bare_01.ino");
  Serial.println("Server started ");
```

Fig 6 : Server side code

3.2 Limitations of earlier project

In traditional system transmitter and receiver is used but it is not robust in terms of security. There will be frequent channel conflict between different transmitter and receiver because they might use same channel when there are more than two system available in the arena. Also the transmitter only consist of 8x1 encoder which can take only 28 combinations and we can only generate 256 unique codes[4] but in NodeMCU we can generate infinite number of unique code. Also the ESP8266 is password protected which almost finishes the chances of the conflict among the incorrect modules.

4 Evaluation performance of model

The below performance were recorded during trials :

1) Helmet module take two second to start and get connected to the bike module when switched on.

2) Bike module take one second to start the server , to start OLED display and get connected to the helmet module[Client]

3) System take less than one second to detect human and to start the vehicle.

4) System takes ten second of delay [programmed 10 seconds] to stop the vehicle when rider removes the helmet, and gives a warning immediately.

4 Conclusion

This paper is contains the segments for the development of smart helmet which will ensure the safety of the rider by interrupting the ride without helmet and also inhibits the use of mobile phone during the ride. It also describes how the system is more reliable and robust than the earlier one which uses transmitter and receiver causing conflicts among the channels.

References

[1] Brown, Eric (20 September 2016). "21 Open Source Projects for IoT". *Linux.com. Retrieved* 23 October 2016.

[2] Kamtekar, K. T.; Monkman, A. P.; Bryce, M. R. (2010). "Recent Advances in White Organic Light-Emitting Materials and Devices (WOLEDs)". *Advanced Materials*. 22 (5): 572–582.

[3] Biswas, S.; Tatchikou, R.; Dion, F. (January 2006). "Vehicle-to-Vehicle wireless communication protocols for enhancing highway traffic safety". *IEEE Communications Magazine*. 44 (1): 74–82. doi:10.1109/mcom.2006.1580935.ISSN 0163-6804.

[4] Ellingson, Steven W. (2016). Radio systems Engineering. *Cambridge University Press*. pp. 16–17. TSBN 1316785165.