Smart Bin: A Swachh Bharat Approach using NodeMcu

A Mini Project Report

Submitted

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To

THE DEPARTMENT OF MECHANICAL ENGINEERING

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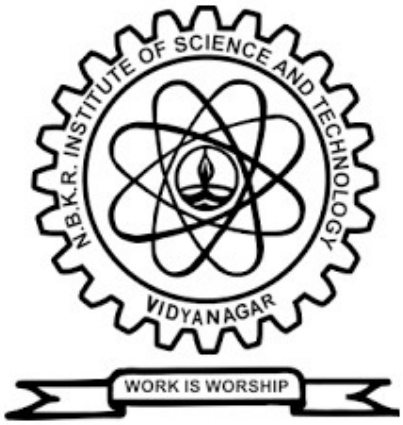

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CERTIFICATE

This is to certify that the mini project report entitled **"Smart Bin: A Swachh Bharat Approach using NodeMcu"** is a bonafide work done by

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In the Department of Mechanical Engineering in partial fulfillment of the academic year 2021-22(III B. Tech, II Semester)

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ABSTRACT

In present Mini Project Work, the Smart Bin is made using Ultrasonic sensor, Lcd screen, Buzzer and NodeMcu attached to the bin. The ultrasonic sensor is a device that is used to measure the distance to an object with the help of sound waves. The NodeMcu is an open-source firmware and development kit that helps to Prototype IOT product within a few script lines or codes. NodeMcu it is like Arduino Hardware with an Input Output built in the Board itself, it has also a Wi-Fi built in to connect directly to internet to control our things online. The user has the provision to register on the applications by using Mail.

This project proposes a smart waste management system that alerts the municipal authorities by displaying a flash message on their application.

ACKNOWLEDGEMENT

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CHAPTER-1
INTRODUCTION

1.1 Definition of INTERNET OF THINGS(IOT):

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers UIDs and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. A *thing* in the internet of things can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low or any other natural or man-made object that can be assigned an Internet Protocol (IP) address and is able to transfer data over a network.

1.1.2 How does Internet of Things (IoT) Work?

An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data.

1.1.3 History of IoT:

The concept of adding sensors and intelligence to physical objects was first discussed in the 1980s, when some university students decided to modify a Coca-Cola vending machine to track its contents remotely. But the technology was bulky and progress was limited. The term ‘Internet of Things’ was coined in 1999 by the computer scientist Kevin Ashton. While working at Procter & Gamble, Ashton proposed putting radio-frequency identification (RFID) chips on products to track them through a supply chain. He reportedly worked the then-buzzword ‘internet’ into

his proposal to get the executives' attention. And the phrase stuck.Over the next decade, public interest in IoT technology began to take off, as more and more connected devices came to market.In 2000, LG announced the first smart refrigerator, in 2007 the first iPhone was launched and by 2008, the number of connected devices exceeded the number of people on the planet.In 2009, Google started testing driverless cars and in 2011, Google's Nest smart thermostat hit the market, which allowed remote control of central heating.

1.2 Role of Swachh Bharath Mission:

The Nirmal Bharat Abhiyan has been restructured into the Swachh Bharat Mission (Gramin). The SBM(G) was launched on 2nd October 2014 to ensure cleanliness in India and make it Open Defecation Free (ODF) in Five Years. It seeks to improve the levels of cleanliness in rural areas through Solid and Liquid Waste Management activities and making Gram Panchayats Open Defecation Free (ODF), clean and sanitized.

Technology will be used on a large scale to convert waste into wealth in rural India in the forms of biofertilizer and different forms of energy. More than 15,000 tons of plastic waste is generated in India every day, of which 6,000 tons remain uncollected and littered, the government today said. As per a report of a Task Force constituted by erstwhile Planning Commission in 2014, 62 million tons of municipal solid waste is generated annually in urban areas, he said. However, as per the CPCB report in 2014-15, 51.4 million tons of solid waste is generated in the country, of which 91 per cent was collected, and 27 per cent was treated and remaining 73 per cent disposed of at dump sites. "Central Pollution Control Board has estimated the generation of 15,342 tons of plastic waste in the country, out of which, 9,205 tons were reported to be recycled and leaving 6,137 tons uncollected and littered".

CHAPTER-2
COMPONENTS OF SMART BIN

2.1 NODEMCU (ESP8266 Wi-Fi Module):

Proposed method for this smart dustbin is use of Wi-Fi module which is more beneficious than using GSM module. The hardware components used in this method are Arduino UNO, NODEMCU, Ultrasonic sensor, Servo Motor. Now we are going to see each and every hardware component in detail. Arduino UNO: It is a microcontroller board which has fourteen digital input/output pins, six analog inputs, USB connection, power jack, 16MHz quartz crystal, ICSP header, and a reset button. The components such as Servo Motor and Ultrasonic Sensor are connected to this board and the first part code is dumped into this board. After the dumping of the code, the sensors start working according to the code written. When the sensors do not work as expected then the reset button should be pressed so that the code and the microcontroller restart and the sensors start working. This UNO board and 1.0 version of Arduino IDE are the reference versions of Arduino. UNO means one in Italian which denotes the version of the device

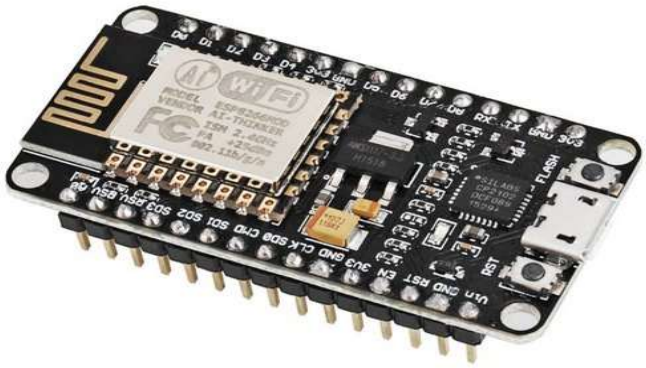

Fig 2.1: NODEMCU (ESP–12E Wi-Fi Module)

2.1.1 The difference in using ESPlorer and Arduino IDE:

Well, there is a programming language difference we can say while developing an application for NodeMCU using ESPlorer IDE and Arduino IDE. We need to code in C\C++ programming language if we are using Arduino IDE for developing NodeMCU applications and Lua language if we are using ESPlorer IDE. Basically, NodeMCU is Lua Interpreter, so it can understand Lua script easily. When we write Lua scripts for NodeMCU and send/upload it to NodeMCU, then they will get executes sequentially. It will not build a binary firmware file of code for NodeMCU to write. It will send Lua script as it is to NodeMCU to get executed.

In Arduino IDE when we write and compile code, the ESP8266 toolchain in the background creates a binary firmware file of code we wrote. And when we upload it to NodeMCU then it will flash all NodeMCU firmware with newly generated binary firmware code. In fact, it writes the complete firmware.

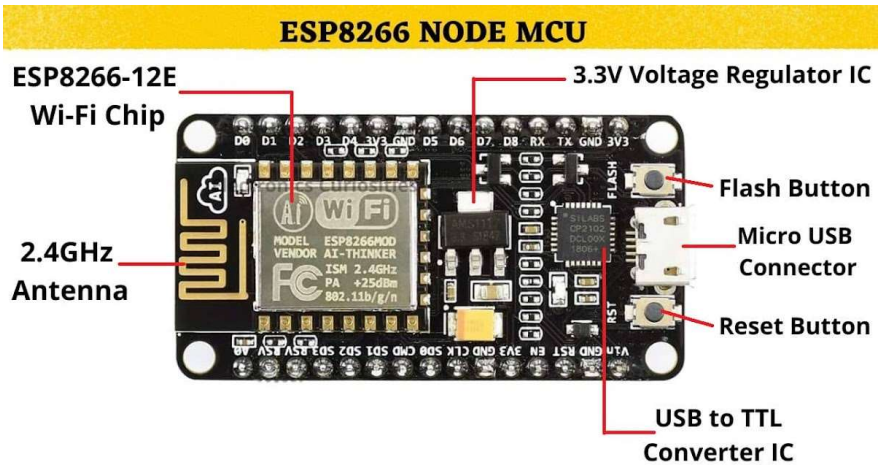

Fig 2.2

2.1.2 ESP8266-12E Wi-Fi Chip with Antenna:

This esp8266-12E or simply esp-12E chip is a member of the esp. series. There are 15 modules ranging from esp01 to esp15. These are mostly used for IoT applications due to their small form factor and low price.

2.1.3 Processor:

The latest ESP12E board integrates a **Tensilica LX106 32-bit RISC processor**, which achieves extra-low power consumption and reaches a maximum clock speed of 160 MHz

Uploading a program in ESP-12E using the micro USB cable is difficult as it requires a separate 3.3 voltage regulator, reset button, some resistors, and a USB to TTL converter IC

The development board Nodemcu ESP8266 module has everything mentioned above, thus it is easy to program it from your laptop/PC. Nodemcu ESP8266 has an Esp12e chip, a USB port to upload programs, and for power supply. It also has a reset and boot button.

Hence the Nodemcu is a better choice over the esp12e chip as it is easy to use, is breadboard friendly, and comes at the same price.

2.2 Ultrasonic Sensor:

The ultrasonic sensor is a device that is used to measure the distance to an object with the help of sound waves. It sends out a high-frequency sound pulse and determines how long it takes for the echo reflect back to it. The sensor has got a transmitter and a receiver on it to transmit-receive the sound pulse. The ultrasonic sensor can detect even the transparent objects as it can reflect off glass and liquid as well. It is resistant to mist and dirt. It also has the ability to detect complex shapes.

Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target.

In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. The formula for this calculation is D = ½ T x C (where D is the distance, T is the time, and C is the speed of sound ~ 343meters/second). For example, if a scientist set up an ultrasonic sensor aimed at a box and it took 0.025 seconds for the sound to bounce back, the distance between the ultrasonic sensor and the box would be:

D = 0.5 x 0.025 x 343

Fig 2.3: Ultrasonic sensor

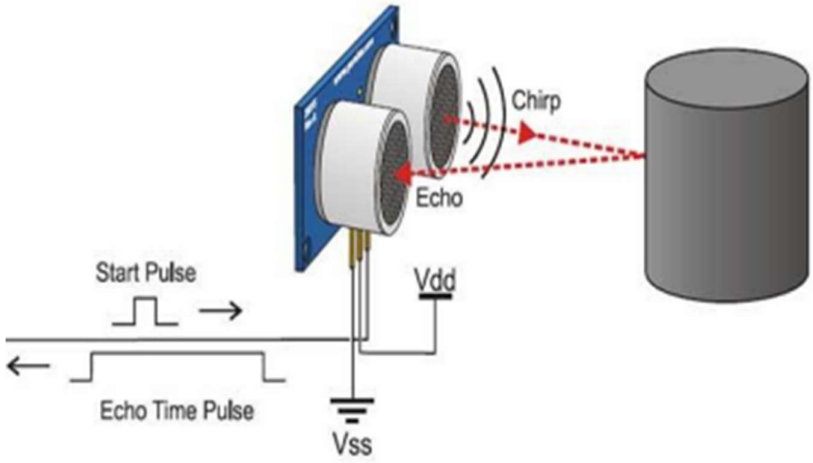

Fig 2.4: Ultrasonic Sensor circuit diagram

2.3 Generations of NODEMCU:

There are three official versions of the Nodemcu:

1.NODEMCU Devkit 0.9 or Nodemcu V1

2. NODEMCU Devkit 1.0° or Nodemcu V2

3.Lolin and Amica Nodemcu or Nodemcu V3

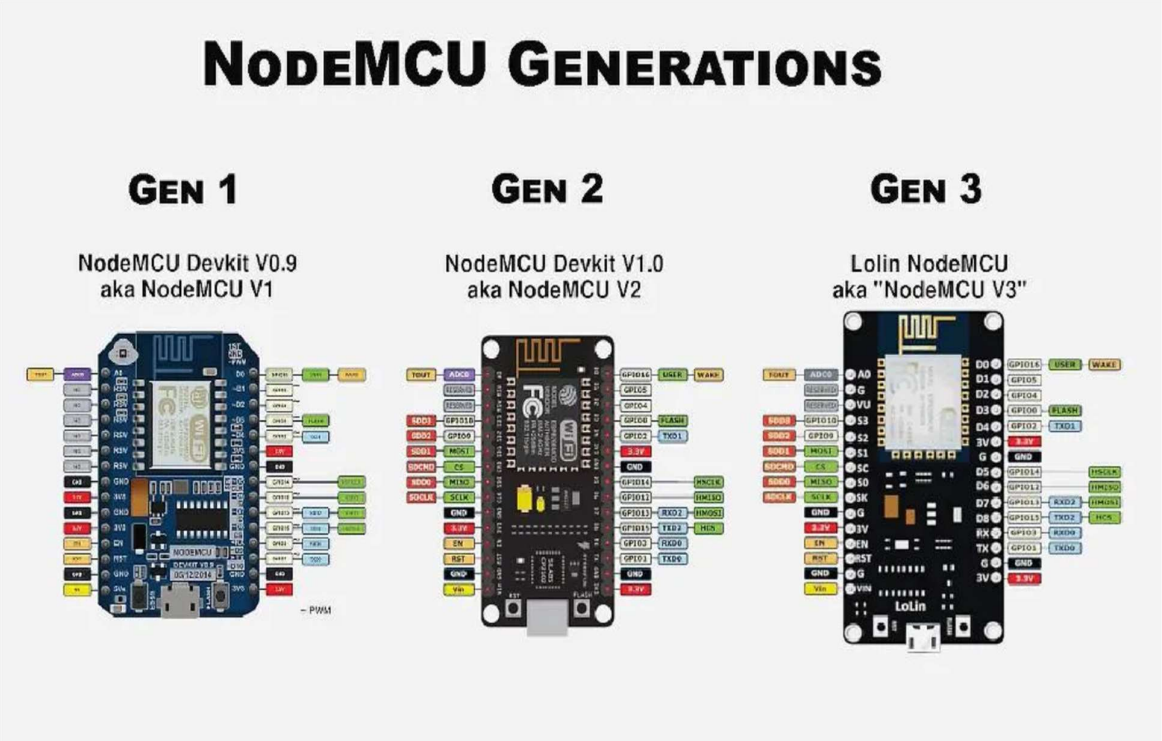

Fig 2.5: generations of NODEMCU

- **Nodemcu ESP8266 Wi-Fi Module Specifications:**

Microcontroller	ESP-8266 32-bit
Nodemcu Model	**Amica**(official)
Clock Speed	80-160 MHz
USB **to Serial**	**CP2102**

USB Connector	Micro USB
Input Voltage	4.5V-10V
Flash Memory/SRAM	4 MB / 128 KB
Wi-Fi Built-In	802.11 b/g/n
Temperature Range	-40C – 125C

Table – 1

- **Useful Pins in ESP Board:**

The below figure, there is a total of 17 GPIO (General Purpose Input Output) pins. Out of which only 11 pins are best to use. These 11 pins are mentioned in the table given below. We can use those pins as an input or output.

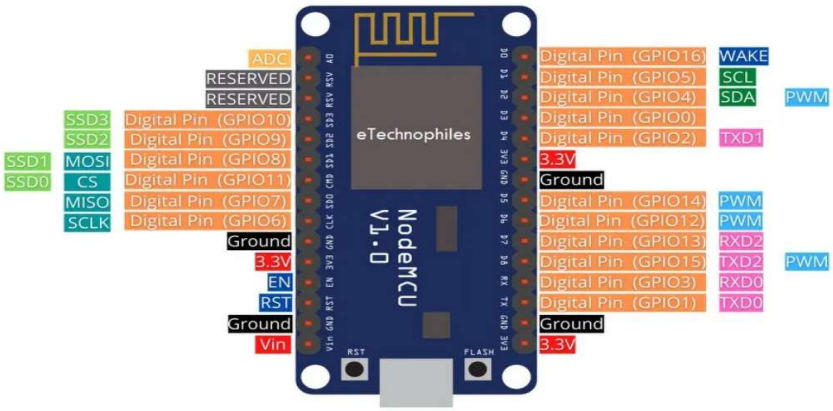

Fig 2.6: Pins in NODEMCU Board

- **Pins in NODEMCU board:**

Pin Name	GPIO	Input	Output
D0	16	pull-up	pull-up
D1	5	OK	OK
D2	4	OK	OK
D3	0	pull-up	OK
D4	2	pull-up	OK
D5	14	OK	OK
D6	12	OK	OK
D7	13	OK	OK
D8	15	pull-down	OK
RX	3	pull-up	NO
A0	ADC0	Analog	NO

Table – 2

2.4 LCD Display:

Nowadays, we always use the devices which are made up of LCDs such as CD players, DVD players, digital watches, computers, etc. These are commonly used in the screen industries to replace the utilization of CRTs. Cathode Ray Tubes use huge power when compared with LCDs, and CRTs heavier as well as bigger. These devices are thinner as well power consumption is extremely less. The LCD 16×2 working principle is, it blocks the light rather than dissipate. This article discusses an overview of LCD 16X2, pin configuration and its working.

Thus, this is all about LCD 16×2 datasheet, which includes what is a 16X2 LCD, pin configuration, working principle, and its applications. The main advantages of this LCD device include power consumption is less and low cost. The

main disadvantages of this LCD device include it occupies a large area, slow devices and also lifespan of these devices will be reduced due to direct current. So these LCDs use AC supply with less than 500Hz frequency.

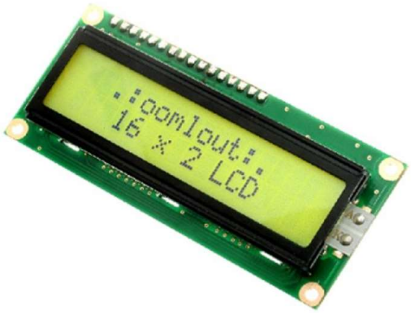

Fig 2.7: LCD Screen (16×2)

2.4 Buzzer:

An audio signalling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.

The pin configuration of the buzzer is shown below. It includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the '-'symbol or short terminal and it is connected to the GND terminal.

Fig 2.8: Buzzer pin configuration

2.5 Blynk App:

The main focus of the Blynk platform is to make it super-easy to develop the mobile phone application. As you will see in this course, developing a mobile app that can talk to your Arduino is as easy as dragging a widget and configuring a pin with Blynk, you can control an LED or a motor from your mobile phone with literally zero programming. This is actually the first experiment that I will demonstrate in this course. But don't let this simplicity make you think that Blynk is only useful for trivial applications. Blynk is a robust and scalable tool that is used by hobbyists and the industry alike. You can use it to monitor the soil humidity of your vegetable garden and turn on the water, or open up your garage door, with your phone. You can also use it to control smart furniture that can learn from your routines, or embed IoT and AI to traditional industrial products such as a boiler, or for improving the integrity and safety of oilfields.
Blynk is free to use for personal use and prototyping. Their business model generates profits by selling subscriptions to businesses that want to publish Blynk-powered apps for their hardware products or services.

Fig 2.9: Blynk App logo

CHAPTER – 3
INSTALLATION OF CODE IN NODEMCU AND MAKING OF BLYNK APP CONTROLLS

3.1 About Arduino software:

Code installation in Nodemcu by using **Arduino IDE software**, Arduino is an open-source electronics platform based on easy-to-use hardware and software. Nodemcu boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

All Nodemcu boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

3.2 Downloading Arduino software:

- Open chrome and find the Arduino software in model 1.8.18.
- Make sure the network to pc and select the software file in site and download.

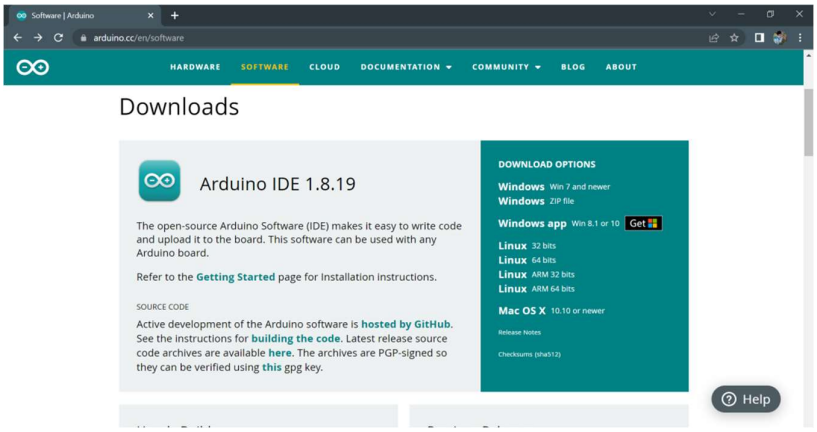

Fig 3.1

- Then install the file in the pc.
- Open the downloaded software.

3.3 Nodemcu Installation:

Step 1: Suitable USB.

First you must have your Arduino board (you can choose your favorite board) and a USB cable. In case you use Arduino UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, you will need a standard USB cable (A plug to B plug), the kind you would connect to a USB printer as shown in the following image.

Step 2: power on the NODEMCU.

In Nodemcu board, automatically power draw either the USB is connected to the computer or an external power supply. Then connect the Nodemcu board to your computer using USB cable. The blue light power LED should glow and automatically the wi-fi will turn on and connect the power usb to the computer to load the code into the board.

Step 3: Launch Arduino software:

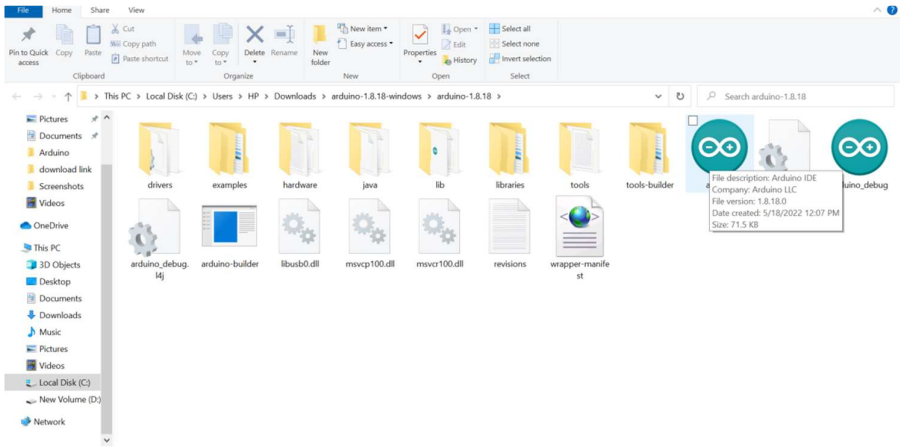

Fig 3.2

After download, You need to unzip the downloaded file of Arduino and install the file. Open the installed by clicking two times on the Arduino software icon in computer to import the code of a smart bin.

Step 4: Open project.

Now click on the file option and select new then automatically it opens the new page of Arduino IDE. Here we can write a new code. As shown in fig.

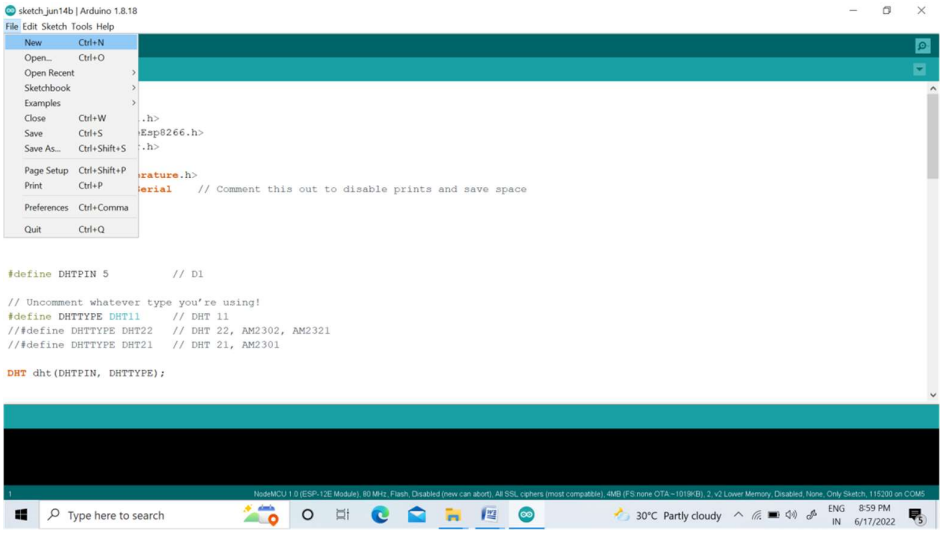

Fig 3.3

Step 5: Select the Arduino Board.

To avoid any error while uploading your program to the board, you must select the correct Nodemcu board name, which matches with board connected to your computer. Go to Tool →Board and select your board. Here, we have select Nodemcu board according to your tutorial, but you must select the name matching the board that you are using so that we can import the code to our ESP Board.

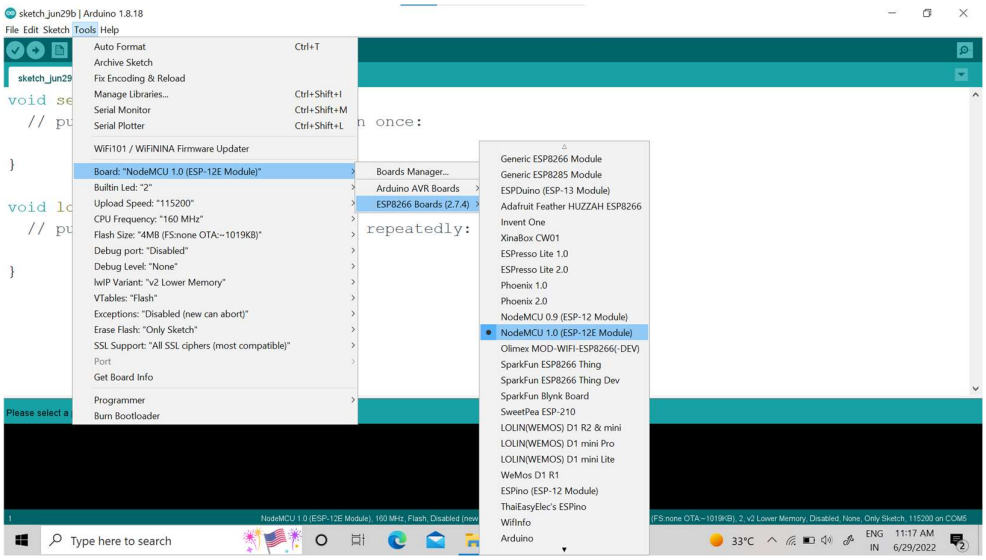

Fig 3.4

Step 6: Select your port.

Select the serial device of the Nodemcu board. Go to Tool → Serial port menu. This is likely to be COM3 or COM5. In this step you can install the CP210

driver in wed browser. To find out, any disconnect you Nodemcu board and reopen the menu, the entry that disappears should be of the Nodemcu Board. Reconnect the board and select that serial port.

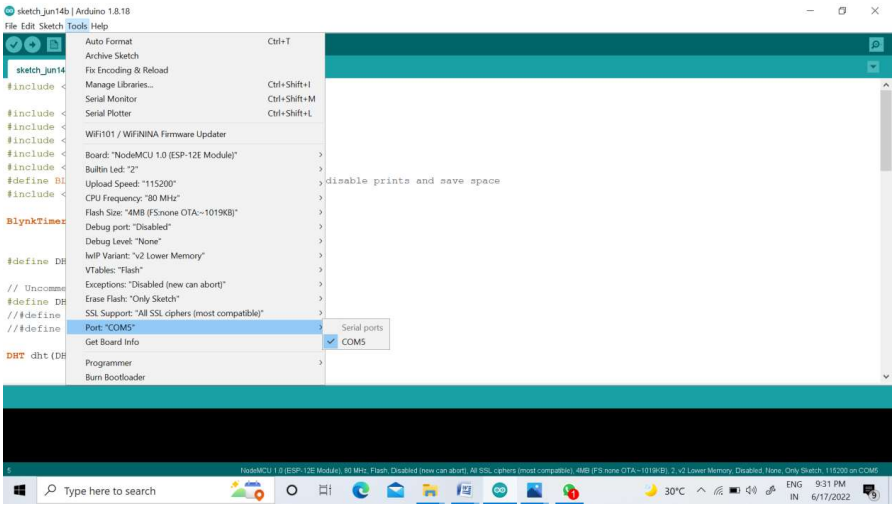

Fig 3.5

Step 7: Install libraries:

Go to the Sketch →Include Library → Manage Libraries →Double click

In this project we install three libraries.

- ESP8266WIFI.
- Blynk master.
- Liquid crystal i2c

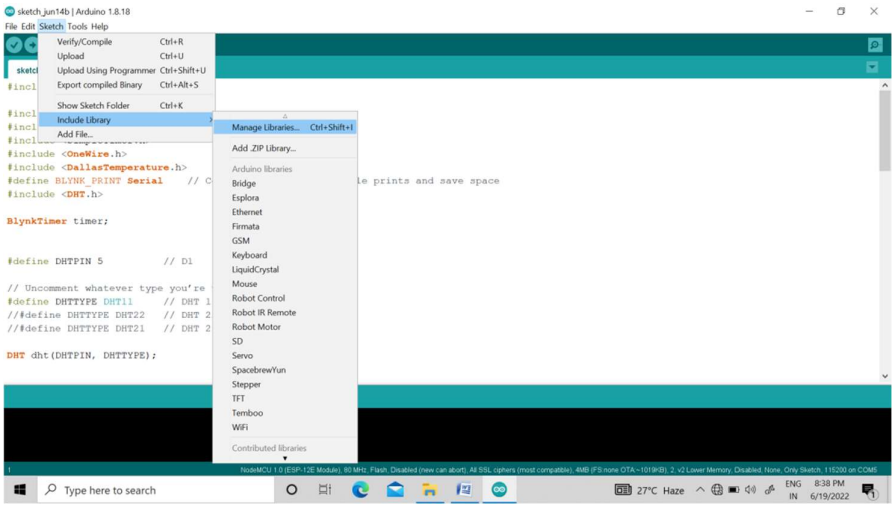

Fig 3.6

Step 8: Uploading the generated code into Nodemcu:

Now click on side arrows. Next, it will take some time to export the code to the Nodemcu board and the board will blink blue light it indicates that the code is exporting into a board. If the LED stops blinking, the message "Done uploading" will be displayed in the status bar.

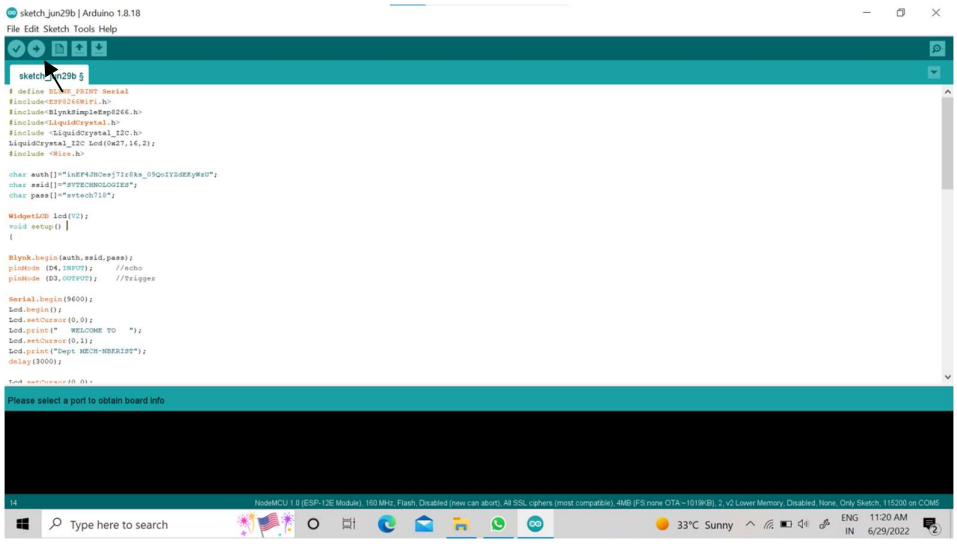

Fig 3.7

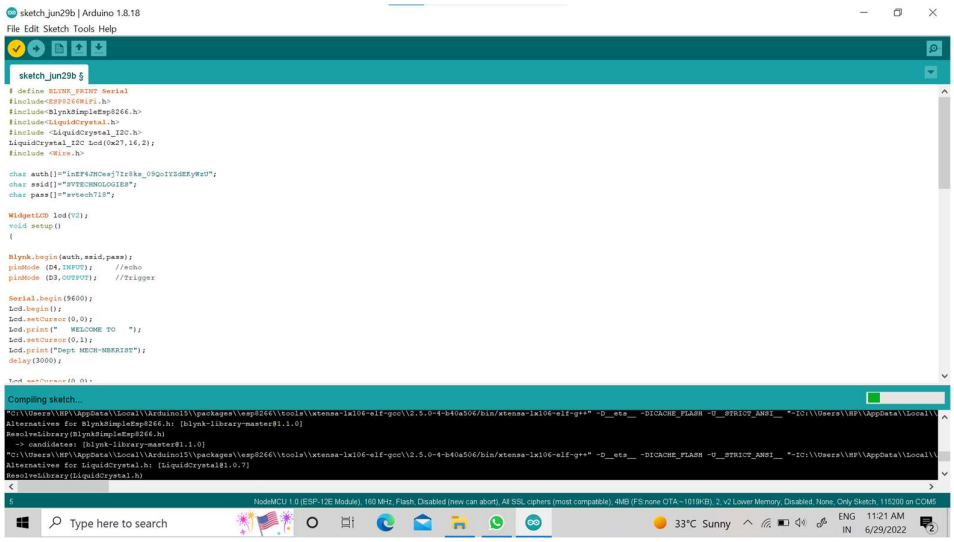

Fig 3.8

CHAPTER-4

CODE OF PROJECT WORK

4.1 Introducing the project name code:

```
# define BLYNK_PRINT Serial
#include<ESP8266WiFi.h>
#include<BlynkSimpleEsp8266.h>
#include<LiquidCrystal.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C Lcd(0x27,16,2);
#include <Wire.h>

char auth[]="inEF4JHCesj7Ir8ks_09QoIYZdEKyWzU";
char ssid[]="SMARTDUSTBIN";
char pass[]="smartbin";

WidgetLCD lcd(V2);
void setup()
{
```

4.2 Controls using Blynk App code:

```
Blynk.begin(auth,ssid,pass);
pinMode (D4,INPUT);     //echo
pinMode (D3,OUTPUT);    //Trigger
```

4.3 LCD display code:

```
Serial.begin(9600);
Lcd.begin();
Lcd.setCursor(0,0);
Lcd.print("   WELCOME TO   ");
Lcd.setCursor(0,1);
Lcd.print("Dept MECH-NBKRIST");
delay(3000);

Lcd.setCursor(0,0);
Lcd.print("  SMART DUSTBIN ");
Lcd.setCursor(0,1);
Lcd.print(" SWATCH BHARATH ");
delay(3000);

}
void loop()
{
float time, distance,level;
```

4.4 Ultrasonic Sensor calculation code:

```
digitalWrite(D3,LOW);
delayMicroseconds(2);
digitalWrite(D3,HIGH);
delayMicroseconds(10);
digitalWrite(D3,LOW);
delayMicroseconds(2);
digitalWrite(D3,HIGH);
delayMicroseconds(10);
time=pulseIn(D4,HIGH);
distance=time*340/20000;
level=20-distance;
Blynk.virtualWrite(V7,level);
Blynk.virtualWrite(V8,distance);

if(distance<18)
{
   lcd.print(0,0," DUSTBIN FILLED ");
   lcd.print(0,1," NEAR MECHANICAL BLOCK");
   Lcd.setCursor(0,0);
Lcd.print(" DUSTBIN FILLED ");
Lcd.setCursor(0,1);
Lcd.print("  PLEASE CLEAN  ");
delay(300);

  }

else
{
```

4.5 Result of Ultrasonic Sensor and Intimations:

```
 lcd.print(0,0,  "DUSTBIN IS EMPTY");
   lcd.print(0,1," **KEEP CLEAN** ");
Lcd.setCursor(0,0);
Lcd.print("DUSTBIN IS EMPTY");
Lcd.setCursor(0,1);
Lcd.print(" **KEEP CLEAN** ");
delay(300);
 }
 Blynk.run();
lcd.clear();
}
```

4.2 Arduinofull code:

```
# define BLYNK_PRINT Serial
#include&lt;ESP8266WiFi.h&gt;
#include&lt;BlynkSimpleEsp8266.h&gt;
#include&lt;LiquidCrystal.h&gt;
#include &lt;LiquidCrystal_I2C.h&gt;
LiquidCrystal_I2C Lcd(0x27,16,2);
#include &lt;Wire.h&gt;
char auth[]=&quot;inEF4JHCesj7Ir8ks_09QoIYZdEKyWzU&quot;;
char ssid[]=&quot;SMARTDUSTBIN&quot;;
char pass[]=&quot;smartbin&quot;;
WidgetLCD lcd(V2);
void setup()
{

Blynk.begin(auth,ssid,pass);
pinMode (D4,INPUT);     //echo
pinMode (D3,OUTPUT);    //Trigger

Serial.begin(9600);
Lcd.begin();
Lcd.setCursor(0,0);
Lcd.print(&quot;   WELCOME TO   &quot;);
Lcd.setCursor(0,1);
Lcd.print(&quot;DeptMECH-NBKRIST&quot;);
delay(3000);
Lcd.setCursor(0,0);
Lcd.print(&quot;  SMART DUSTBIN &quot;);
Lcd.setCursor(0,1);
Lcd.print(&quot; SWATCH BHARATH &quot;);
delay(3000);
}
void loop()
{
float time, distance,level;
digitalWrite(D3,LOW);
delayMicroseconds(2);
digitalWrite(D3,HIGH);
delayMicroseconds(10);
digitalWrite(D3,LOW);
delayMicroseconds(2);
digitalWrite(D3,HIGH);
```

```
delayMicroseconds(10);
time=pulseIn(D4,HIGH);
distance=time*340/20000;
level=20-distance;
Blynk.virtualWrite(V7,level);

Blynk.virtualWrite(V8,distance);
if(distance&lt;18)
{
   lcd.print(0,0,&quot; DUSTBIN FILLED &quot;);
   lcd.print(0,1,&quot; NEAR MECHANICAL BLOCK&quot;);
   Lcd.setCursor(0,0);
Lcd.print(&quot; DUSTBIN FILLED &quot;);
Lcd.setCursor(0,1);
Lcd.print(&quot;  PLEASE CLEAN  &quot;);
delay(300);
  }
else
{
 lcd.print(0,0,  &quot;DUSTBIN IS EMPTY&quot;);
   lcd.print(0,1,&quot; **KEEP CLEAN** &quot;);
Lcd.setCursor(0,0);
Lcd.print(&quot;DUSTBIN IS EMPTY&quot;);
Lcd.setCursor(0,1);
Lcd.print(&quot; **KEEP CLEAN** &quot;);
delay(300);
 }
 Blynk.run();
lcd.clear();
}
```

CHAPTER 5
WORKING

Working:

- After completion of uploading code into the Nodemcu board. we can directly connect Nodemcu to the pc.
- Next download the Blynk Legacy app in play store for mobile and Blue Stacks for laptops in it download the Blynk Legacy apk in pc.
- Open the Blynk Legacy app and then create a new account by using the Gmail account and create a password to it.
- Then login into Blynk account.

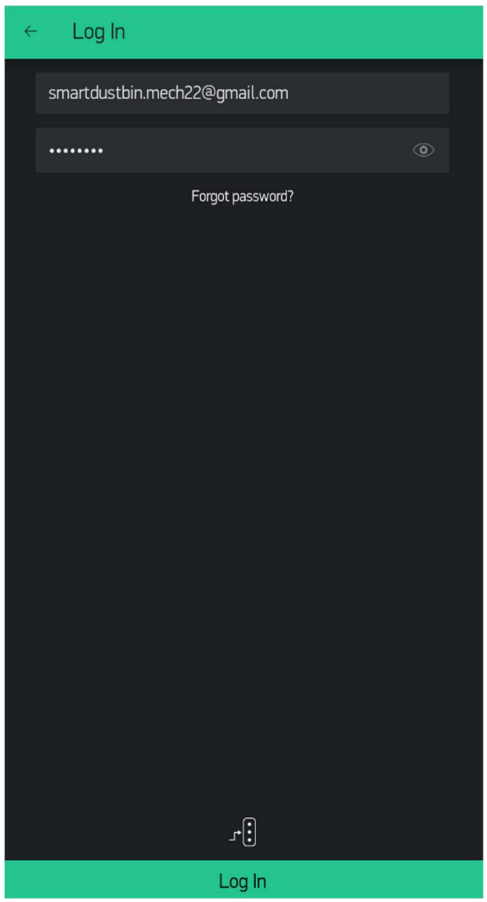

Fig 5.1

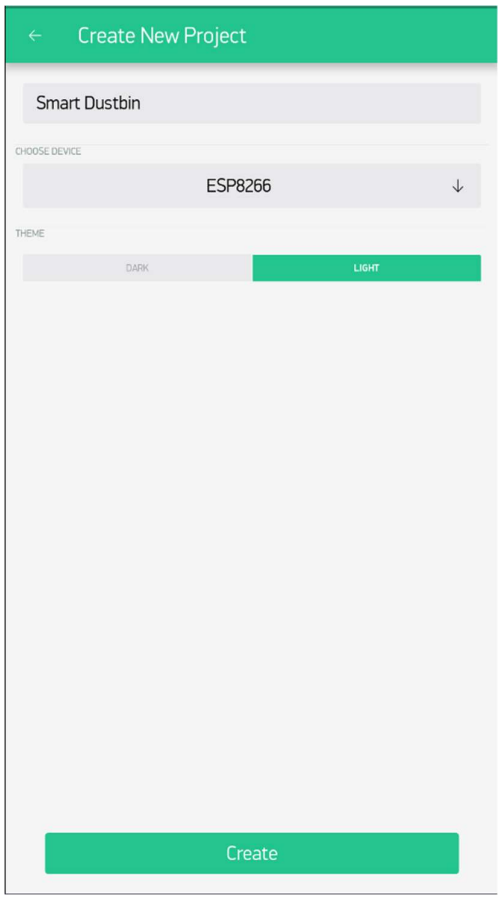

Fig 5.2

- Create the name of the project,
- Select the Nodemcu board when creating the project name.
- Position the icons on the level indicator and LCD display to display the smart bin values.
- Define the corresponding pins to the icons and set the maximum level (14) in the smart bin to display the level in the icons.

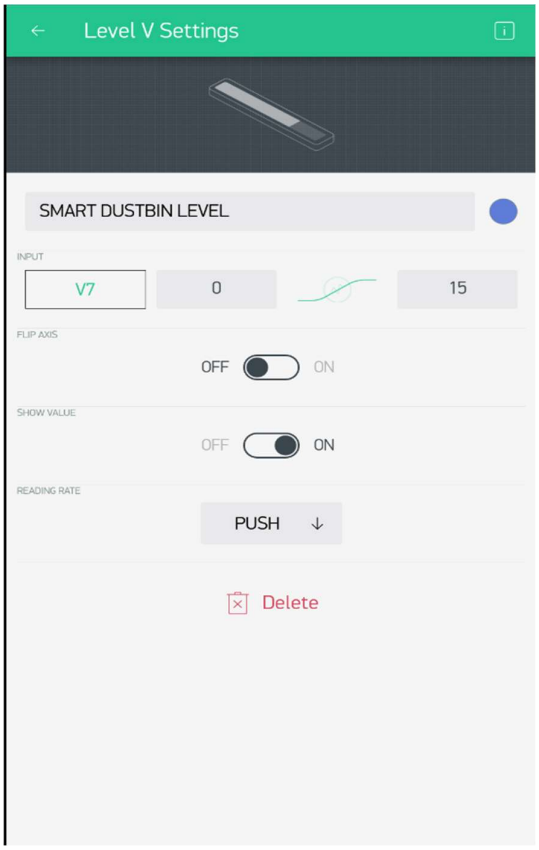

Fig 5.3

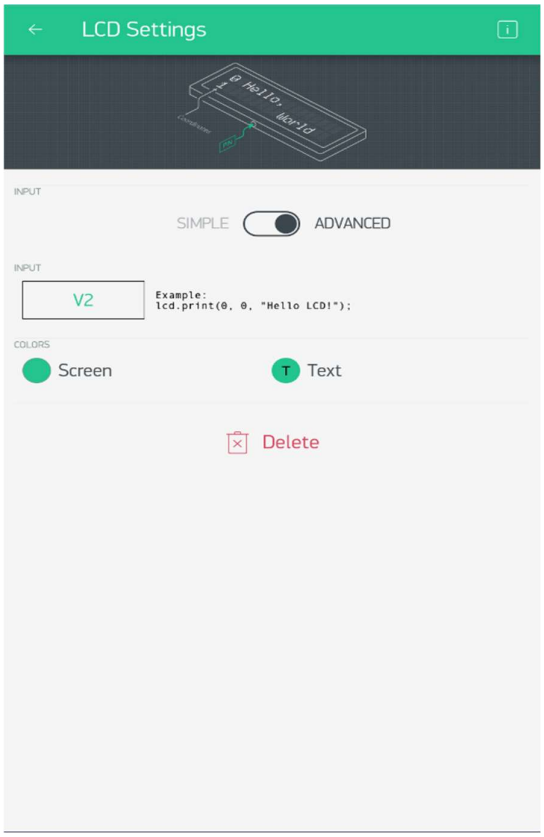

Fig 5.4

- Now create an event to monitor the audible signal and messages/alerts.
- Get alerts and indications of a smart bin.
- Adjust the respective computed value such as fill distance and vacuum distance using an ultrasound sensor formula.
- After positioning a pin, value and icon. Set the alert tone for making an audible sound when it goes offline or online, it makes massage alerts.
- Upon completion of all adjustments. Put out the massage alerts.

- When the smart bin is filled, it sends an "Dustbin is Filled" alert and for Empty, the alert message is "Dustbin is Empty".

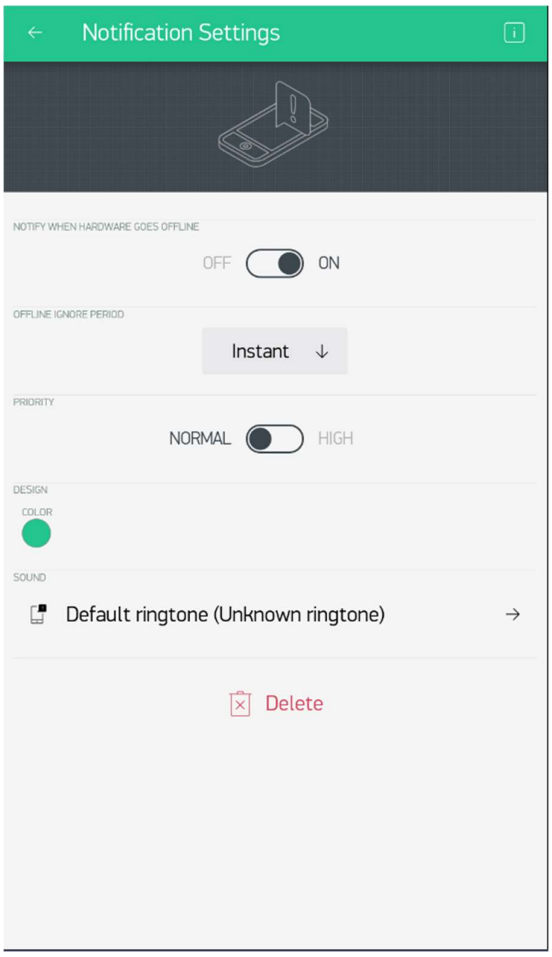

Fig 5.5

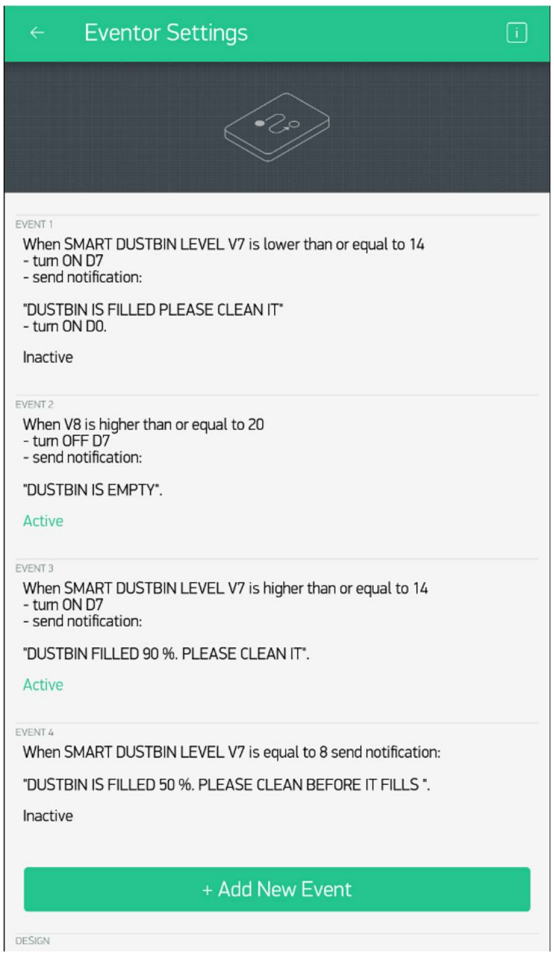

Fig 5.6

- When the smart bin is filled, it sends an "Dustbin is Filled" alert and for Empty, the alert message is "Dustbin is Empty".
- And for the prediction warning they send before filling: "Dustbin is Filled 90% Please clean it".

- In below figures, We can observe that Filling status of Dustbin.

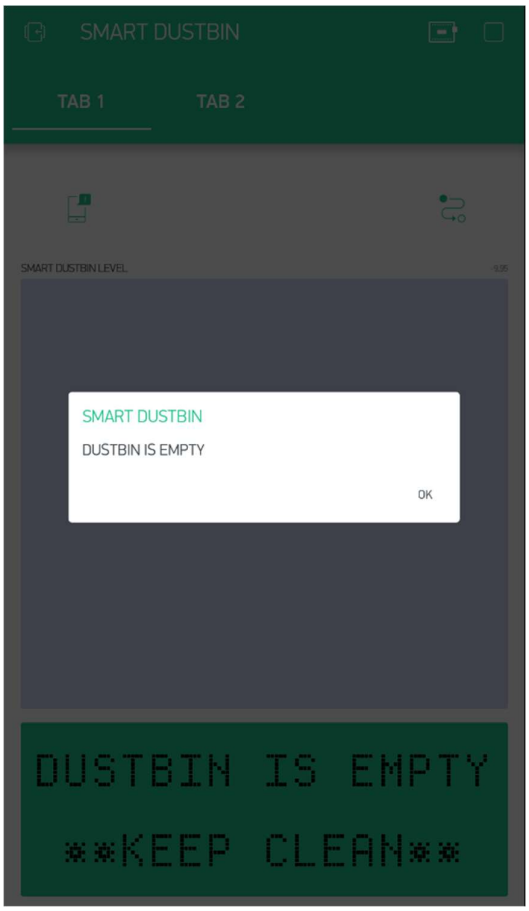

Fig 5.7

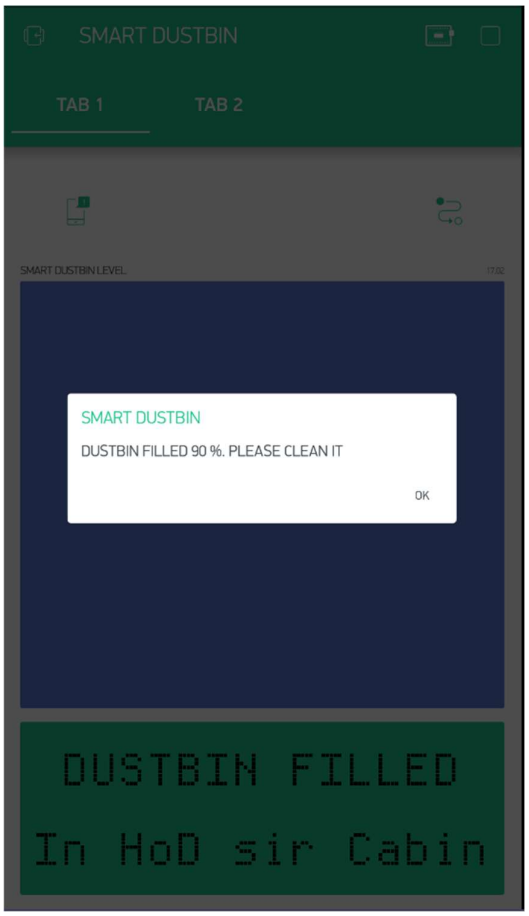

Fig 5.8

- In Fig 5.7 it is showing that Dustbin is Empty.
- In Fig 5.8 it is showing that Dustbin is Filled 90%.

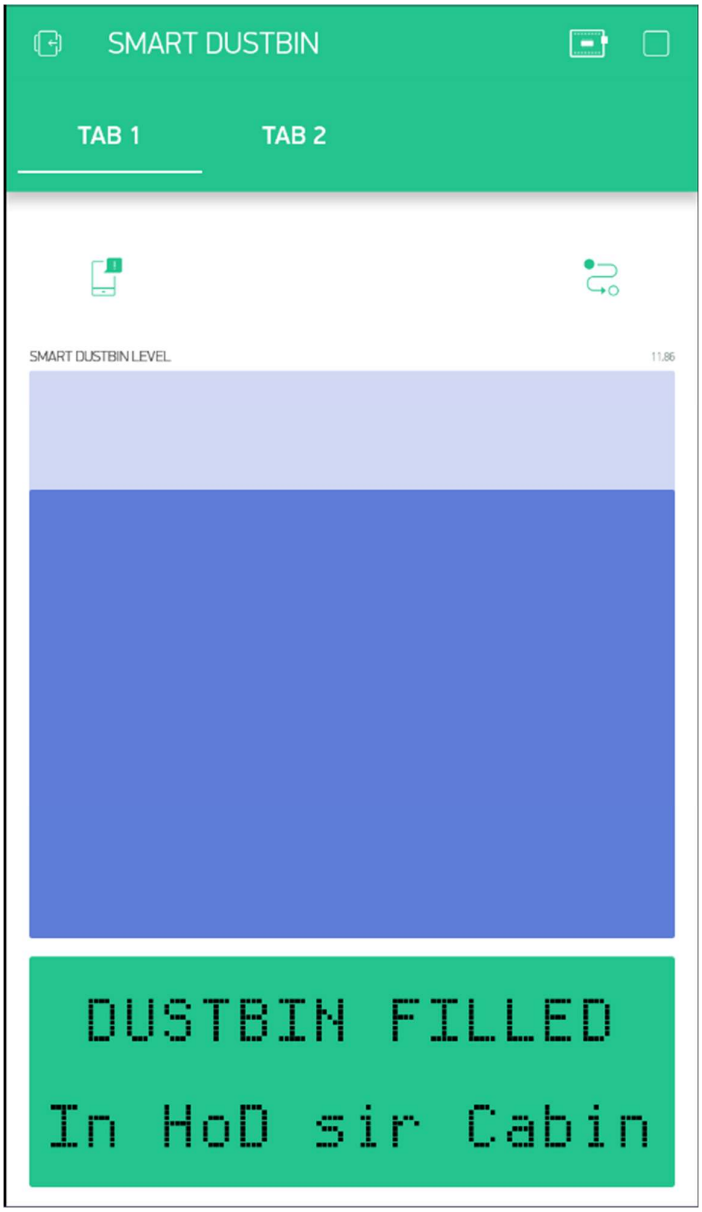

Fig 5.9

- So, the NODEMCU will controlled by the Blynk app By using the above icons and created events.

CHAPTER 6

RESULT AND DISCUSSIONS

6.1 Result:

Hence, the working of Smart bin by using NodeMcu and the installation of code by using Arduino IDE 1.8.16 software and created account in Blynk app and setting the respective pins on the board by soldering them with jumper wires to NodeMcu. Then created icons to the level indicator and for LCD screen and setting up the respective pins to the level indicator and the LCD screen with suitable values in Blynk app and then created events to alert the user by showing notifications in Blynk app and checked the prototype was done successfully.

6.2 Discussions:

❖ Features:

- Integrated low power 32-bit MCU
- Integrated TCP/IP protocol stack
- Integrated PLL, regulators, and power management units
- Supports antenna diversity
- Wi-Fi 2.4 GHz, support WPA/WPA2
- Support STA/AP/STA+AP operation modes
- Support Smart Link Function for both Android and IOS devices
- Deep sleep power < 5uA
- Wake up and transmit packets in < 2ms
- Standby power consumption of < 1.0mW (DTIM3)
- Operating temperature range -40C ~ 125C

❖ Applications:

- Smart power plugs
- Home automation

- Mesh network
- Industrial wireless control
- Baby monitors
- IP Cameras
- Sensor networks
- Wi-Fi location-aware devices
- Security ID tags
- Wi-Fi position system beacons

CHAPTER 7
REFERENCES AND CONCLUSION

7.1 Conclusion:

A proper waste management system is important for the development of any country. For a populated country like India, waste management is an important concern. We are try to give an effective solution to the waste management issue by our project named Smart Bin: A Swachh Bharat Approach using NodeMcu. As the step of implementation, we have completed the system analysis, checking of all components and the design of the system. We are completed the prototype. We truly hope that our system can make wonders in the Swachh Bharath venture.

7.2 Bibliography:

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- Daniel V., Puglia P.A., and M. Puglia (2007). "RFID-A Guide to Radio Frequency Identification", Technology Research Corporation.
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