Visvesvaraya Technological University

Belgaum, Karnataka 590018

A Project Report on

"IoT Based Garbage Monitoring System"

Project Report submitted in partial fulfilment of the requirement for the award of the degree of

Bachelor of Engineering
In
Electrical & Electronics Engineering

Submitted by
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CMR INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

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Certificate

Certified that the project work entitled **"IoT based Garbage Monitoring System"** carried out by **Darshana Jain N (1CR17EE016), Deepika J (1CR17EE017), Deepika S (1CR17EE018), Hima M (1CR17EE024)** are bonafide students of CMR Institute of Technology, Bengaluru, in partial fulfillment for the award of Bachelor of Engineering in Electrical & Electronics Engineering of the Visvesvaraya Technological University, Belgaum, during the year 2020-2021. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

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DECLARATION

We, [**Darshana Jain N (1CR17EE016), Deepika J (1CR17EE017), Deepika S (1CR17EE018), Hima M (1CR17EE024)],** hereby declare that the report entitled **"IoT based Garbage Monitoring System"** has been carried out by us under the guidance of **Ms. Ranjitha R,** Assistant Professor, Department of Electrical & Electronics Engineering, CMR Institute of Technology, Bengaluru, in partial fulfilment of the requirement for the degree of **BACHELOR OF ENGINEERING in ELECTRICAL & ELECTRONICS ENGINEERING**, of Visvesvaraya Technological University, Belgaum during the academic year 2020-21. The work done in this report is original and it has not been submitted for any other degree in any university.

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Abstract

In recent decades, urbanization has increased tremendously. At the same phase, there is an increase in waste production. Waste management has been a crucial issue to be considered.
Smart bin is built on a microcontroller-based platform Arduino board which is interfaced with Ultrasonic sensor and Rain Sensor. The ultrasonic sensor is placed at the top of the dustbin which will measure the height of the dustbin. Arduino will be programmed in such a way that when the dustbin is being filled, a notification will pop up in Blynk app.
Once the garbage reaches the threshold level, the ultrasonic sensor will alert the required authority until the garbage in the dustbin is squashed. Once the dustbin is squashed, people can reuse the dustbin.
Once these smart bins are implemented on a large scale, by replacing our traditional bins present today, waste can be managed efficiently as it avoids unnecessary lumping of wastes on the roadside.
Foul smell from these rotten wastes that remain untreated for a long time, due to negligence of authorities and carelessness of public may lead to long term problems.
Breeding of insects and mosquitoes can create nuisance around promoting unclean environment. This may even cause dreadful diseases.

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CHAPTER 1

INTRODUCTION

Waste management is an efficient way of reducing abandoned garbage. Unfortunately, these practices are not widely implemented in the country. People have been negligent when it comes to proper waste disposal, ignoring labels and throwing recyclables that can still be reused. Garbage consists of the undesirable things left from City, Public area, Society, College, Homes etc.

Internet and its applications have become an integral part of today's human lifestyle. It has become an essential tool in every aspect.

Smart dustbin system is essential for cities that aim to reduce cost and manage resources and time. Optimizing the process of trash collection is the main purpose of the smart solutions provided by industry.

A big challenge in urban cities is solid waste management. Majority of viruses and bacterial infections develop in the polluted environment.

Nowadays, there are tons of flats and apartments which have been built in the rapid urbanization area. This is due to high housing demands which have been drastically risen as a result of migration from villages to cities to find work.

There are several issues faced by the residents of the flats. One of them is disposal of solid waste. Unlike private houses, the residents of all the apartments use a common dustbin, which tends to fill up very quickly.

This overflowing of garbage is a sanitary issue which might cause diseases like cholera and dengue.

Figure 1: Overflowing of garbage

Moreover it is a waste of fuel to travel around a complex or an area to find that some of the garbage are filled and some are not.

Therefore, the smart dustbin is a system which can eradicate this problem or at least reduce it to the minimum level.

OBJECTIVE

The main objective of the work is to develop a smart alert system for garbage clearance by giving an alert signal for instant cleaning of a dustbin when it is filled.

The purpose of this work is to present a cost-effective smart trash bin for localized and small-scale cases, such as small parks, university campus and hospitals.

This helps in cleaning the garbage when the dustbin is full, by which we can avoid people from throwing the waste on roads or streets.

CHAPTER 2

LITERATURE REVIEW

Paper[1]: S. K. Amponsah and S. Salhi, "The investigation of a class of capacitated arc routing problems: the collection of garbage in developing countries," Waste Management, vol. 24, (7), pp. 711-721, 2004.

The paper highlights that the collection, transport and disposal of solid waste, which is a highly visible and important municipal service, involves a large expenditure but receives, scant attention. This problem is even more crucial for large cities in developing countries due to the hot weather. A constructive heuristic which takes into account the environmental aspect as well as the cost is proposed to solve the routing aspect of garbage collection. This is based on a look-ahead strategy which is enhanced by two additional mechanisms. Interesting results were obtained when tested on instances with and without the presence of the effect of the environment.

Paper[2]: FetulhakAbdurahman, SileshiAweke, Chera Assefa "Automated Garbage Monitoring System Using Arduino"iosr Journal of Computer Engineering (IOSR-JCE), Volume 20, Issue 1, Ver. I (Jan.- Feb. 2018)

In this paper, the level of the garbage is detected with the help of ultrasonic sensor and sent to the authorized agency for garbage collection through a GSM system. PIR sensor is used to detect the motion of the people coming to the garbage bin with the trash while the bin is at full status and block adding of any more garbage to the bin through informing them by a speaker. The GSM and the peripheral sensors used are interfaced through the Arduino microcontroller. A GUI is also developed to monitor the desired information related to the garbage bins for different selected locations. Depending on the received messages through the GSM at control room it is displayed on LCD and the authorized person inform the drivers to collect the garbage on time. This will capably help to monitor the garbage collection to make the environment smart, clean and safe.

Paper[3]: S.Kalel, P.Alane2, K. Gaikwad, “GSM based Garbage Monitoring System”

In the present day scenario, many times we see that the garbage bins or dust bin are placed at public placed in the cities are overflow due to an increase in the waste every day. It creates an unhygienic condition for the peoples and creates bad smell around the surroundings this leads in spreading some deadly diseases and human illness, to avoid such an attenuation we are planning to design “GSM based garbage monitoring system for smart cities”. In this proposed system there are multiple dustbins located throughout the city or the campus, these dustbins are provided with low cost embedded device which helps in tracking level of garbage bins and a unique ID will be provided for every dustbin in the city so that it is easy to identify which garbage bin is full. When the level reaches threshold limits, the device will transmit the level along with unique ID provided. These details can be accessed by the concern authorities from their place with the help of GSM and immediate action can be made to clean the dustbins.

Paper[4]: M. Sharholy et al, "Municipal solid waste management in Indian cities – A review," Waste Management, vol. 28, (2), pp. 459-467, 2008.

The paper highlights the improper management of municipal solid waste (MSW) which causes hazards to inhabitants. Various studies reveal that about 90% of MSW is disposed of unscientifically in open dumps and landfills, creating problems to public health and the environment. In the present study, an attempt has been made to provide a comprehensive review of the characteristics, generation, collection and transportation, disposal and treatment technologies of MSW practiced in India. The management of MSW requires proper infrastructure, maintenance and upgrade for all activities. In the present study, an attempt has been made to provide a comprehensive review of MSWM for Indian cities to evaluate the current status and identify the problems of MSWM. The study also aims at encouraging competent authorities/researchers to work towards the improvement of the present system through suggestions and recommendations.

CHAPTER 3

METHODOLOGY

Algorithm:

Step 1: Start

Step 2: Initialize Arduino, Ultrasonic Sensor, & ESP8266.

Step 3: Measures the distance from the lid to the object in the Trash can.

Step 4: The distance information is displayed in the mobile app.

Step 5: When the bin is full, a notification is sent.

Step 6: Control room sends the message to the driver

Step 7: Driver loads the garbage from the dustbin into the vehicle and thus it is emptied

Step 8: Stop

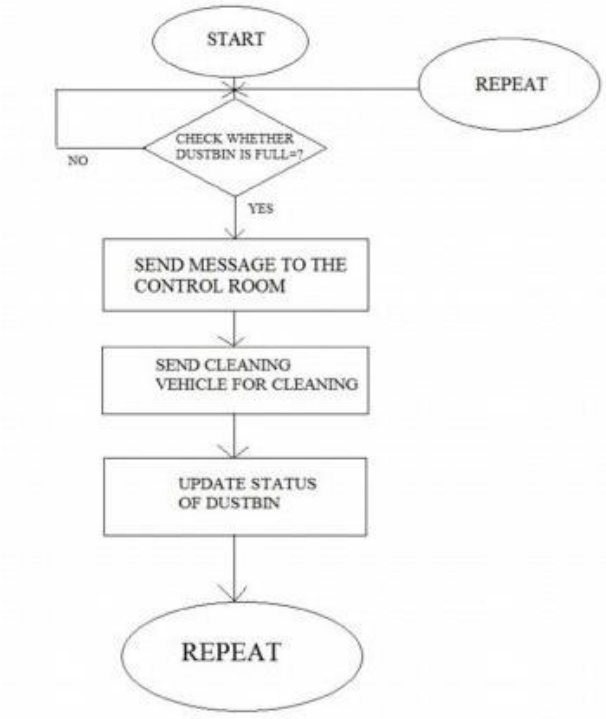

Figure 2: Flowchart

CHAPTER 4

PROPOSED MODEL

4.1 COMPONENTS REQUIRED

Hardware requirements:

- HC-SR04 ULTRASONIC SENSOR
- MICROCONTROLLER BOARD
- Wi-Fi MODULE ESP8266
- CONNECTING WIRES

Software requirement:

- ARDUINO IDE
- BLYNK APP

4.1.1 HC-SR04 ULTRASONIC SENSOR

The HC-SR04 Ultrasonic sensor has 4 pins: Vcc, Trigger, Echo and Ground respectively. The module has two openings on the front which forms the Ultrasonic transmitter and Receiver. The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module. To measure the distance the sound has travelled we use the formula: Distance = (Time x Speed of Sound) / 2. The "2" is in the formula because the sound has to travel back and forth. First the sound travels away from the sensor, and then it bounces off of a surface and returns back. Speed of sound = 340m/s. Ultrasonic sensors are not affected by colour or transparency of objects and can be used in dark environments.

<u>HC-SR04 SENSOR FEATURES:</u>

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz

Figure 3: Ultrasonic Sensor

Pin Number	Pin Name	Description
1	Vcc	The Vcc pin powers the sensor, typically with +5V
2	Trig	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending Ultrasonic wave.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	GND	This pin is connected to the Ground of the system.

Table 1: Pin Number and Function of Ultrasonic sensor

4.1.2 NODEMCU

The NodeMCU (Node Microcontroller Unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK (software development kit). The NodeMCU is available in various package styles. Common to all the designs is the base ESP8266 core. Designs based on the architecture have maintained the standard 30-pin layout. Some designs use the more common narrow (0.9″) footprint, while others use a wide (1.1″) footprint. The most common models of the NodeMCU are the Amica (based on the standard narrow pin-spacing) and the LoLin which has the wider pin spacing and larger board. Amica NodeMCU measures 49mm x 26mm with a standard pin space of 0.1" between pins and 0.9" between rows.

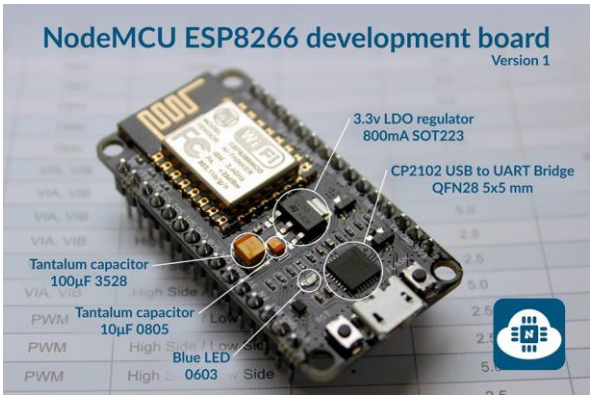

Figure 4: NodeMCU

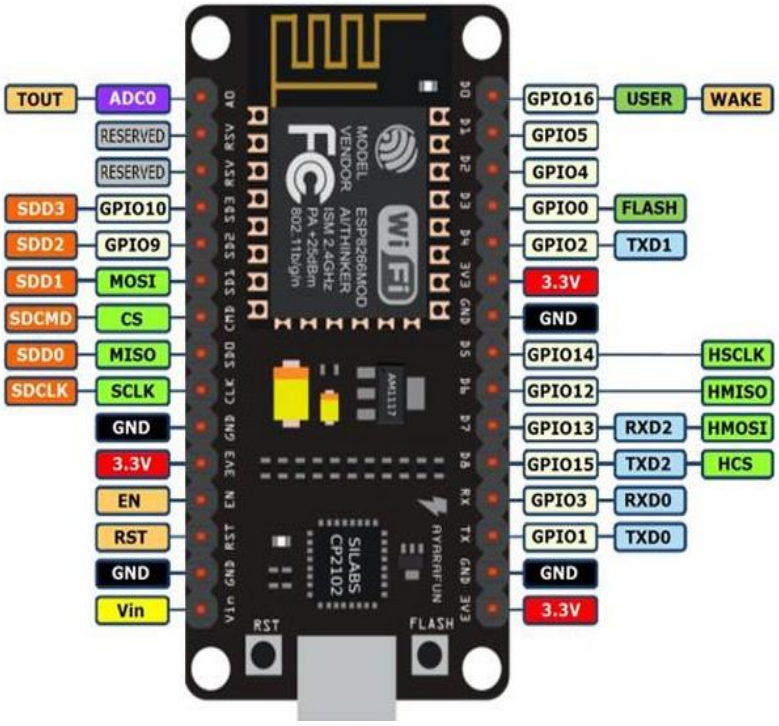

Figure 5: Pin configuration of NodeMCU

NodeMCU ESP8266 Specifications & Features

- Operating Voltage: 3.3V
- Input Voltage: 4.5-10V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UART / SPI / I2C: 1 / 1 / 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included on-board, Enabling Plug n Play

4.1.3 ARDUINO IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop that are compiled and linked with a program. The Arduino development environment contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. Software written using Arduino are called sketches. These sketches are written in the text editor.

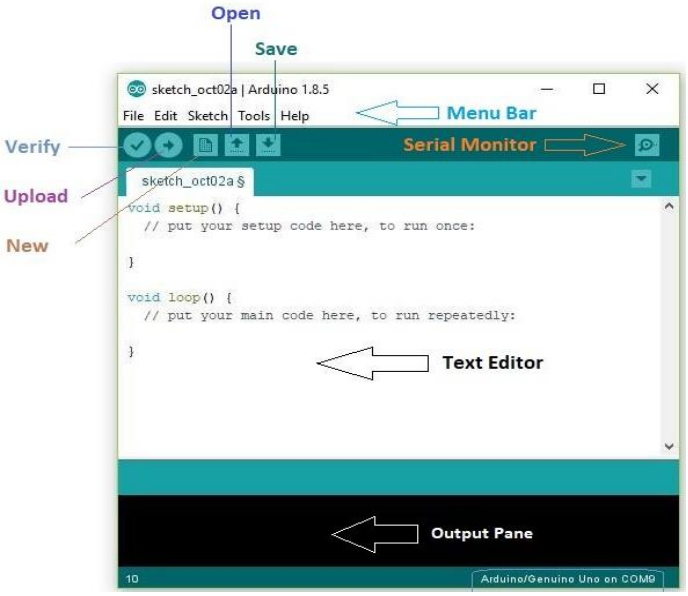

Figure 6: Arduino IDE

4.1.4 BLYNK APP

Blynk is a Platform with iOS and Android apps to control Arduino, Raspberry Pi and the likes over the internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets. Blynk is not tied to some specific board or shield. Instead, it's supporting hardware of your choice. Whether the microcontroller board is linked to the Internet over Wi-Fi, Ethernet or this new ESP8266 chip, Blynk will get it online and ready for the Internet of Things. Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.

There are three major components in the platform:

- Blynk App - allows to you create amazing interfaces for your projects using various widgets we provide.
- Blynk Server - responsible for all the communications between the smart phone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. It is open-source and can easily handle thousands of devices.
- Blynk Libraries - for all the popular hardware platforms - enable communication with the server and process all the incoming and out coming commands.

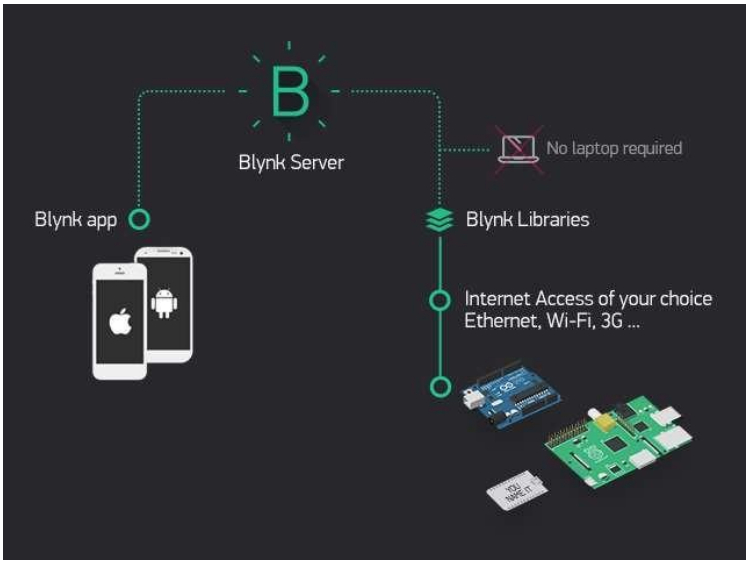

Figure 7: BLYNK APP

4.2 WORKING

Garbage level detection is done by the ultrasonic sensor (HC-SR04). The ultrasonic sensor is placed on top of the dustbin facing the bottom.

The ultrasonic sensor is used to detect the distance from top of the lid to top of the garbage inside the trashcan and we can set a threshold value according to the size of trash can.

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module. The echo in the sensor senses the waves and calculates the distance of the object.

If the distance will be less than or equal to the threshold value, which implies that the Trash can is full of garbage and we will print the message “Dustin bin is filled! Please come and collect the waste” and if the distance will be more than this threshold value, then we will print the distance from the lid to the top of the garbage, which means that there is still space left in the trashcan.

The BLYNK android app displays the distance of the garbage from the lid inside the bin when the distance is more than threshold value. When the distance is less than or equal to the threshold value, then a notification will be sent to the mobile.

4.2.1 DATAFLOW DIAGRAM

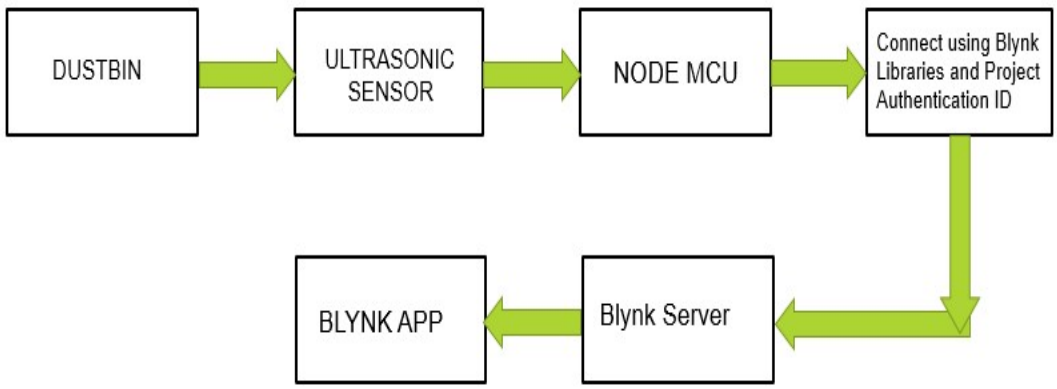

Figure 8: Dataflow Diagram

4.2.2 PIN DIAGRAM

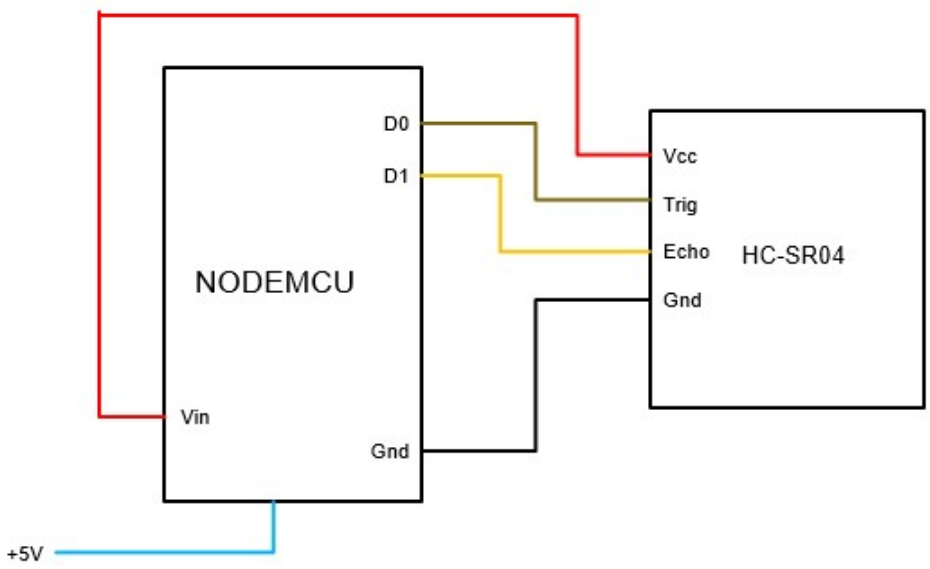

Figure 9: Pin Diagram

4.2.3 HARDWARE IMPLEMENTATION

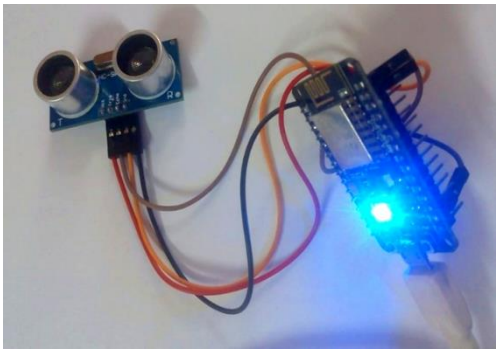

Figure 10: Circuit of HC-SR04 with NodeMCU

Figure 11: Circuit fixed to dustbin

4.2.4 SOFTWARE IMPLEMENTATION

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

//#define trig 2 // D4
//#define echo 0 // D3
//long duration = 0;
//int distance = 0;
const int trigger = 16; // D0
const int echo = 5; // D1
long T;
float distanceCM;

// You should get Auth Token in the Blynk App.
char auth[] = “auth_token";
char ssid[] = “wifi_name";   // your ssid
char pass[] = “xxxxxxxx"; // your Wi-Fi password
WidgetTerminal terminal(V0);

void setup()
{
  // Debug console
  pinMode(trigger, OUTPUT);  // Sets the trigger Pin as an Output
  pinMode(echo, INPUT);   // Sets the echo Pin as an Input
  Serial.begin(9600);  // Sets the console baud rate
  Blynk.begin(auth, ssid, pass);
  Blynk.virtualWrite(V0,"GARBAGE MANAGEMENT");
  Blynk.virtualWrite(V0,"\r\n");
  delay(2000); // delay of 2 seconds
}
```

```
void loop()
{
  Blynk.run();
  //timer.run();
  sendSensor();
}

void sendSensor()
{
  digitalWrite(trigger, LOW); // Makes trigger pin low
  delay(1);
  digitalWrite(trigger, HIGH); // Makes trigger pin high
  delayMicroseconds(10); // trigger pin high for 10 micro seconds
  digitalWrite(trigger, LOW);
  T = pulseIn(echo, HIGH); // Read echo pin, time in microseconds
  distanceCM = T * 0.034;
  distanceCM = distanceCM / 2; // Calculating actual distance
  Serial.print("Distance: ");
  Serial.print(distanceCM); // Output distance on arduino serial monitor
  Serial.println("cm");
  Blynk.virtualWrite(V0,"Distance: ");
  Blynk.virtualWrite(V0,distanceCM);
  Blynk.virtualWrite(V0,"cm\r\n");
  delay(1000);

  if(distanceCM <= 5)
  {
    Blynk.notify(“Dustin bin is filled! Please come and collect the waste");
  }
  Blynk.virtualWrite(V0, distanceCM);
  delay(3000);  //Pause for 3 seconds and start measuring distance again
}
```

CHAPTER 5

SYSTEM TESTING

5.1 TEST APPROACH

The project is tested in two stages: software and hardware. The software part is to be tested via the Arduino IDE, whereas the hardware part has to be tested physically. It is necessary to check whether the system is working properly or not. To check whether the readings are accurate, we will check the distance pointed out by the sensor by a meter tape.

5.2 FEATURES TO BE TESTED

After building the whole circuit we test it. This project should satisfy some features. Features to be tested as follows:

- The ultrasonic sensor should give proper output. To check whether the output is accurate or not, the output of the sensor will be checked against a meter tape.
- The NodeMCU board should show the distance in the serial monitor and also display the message on Blynk app and send a notification to the phone when the dustbin is filled.
- The Blynk app should be checked.

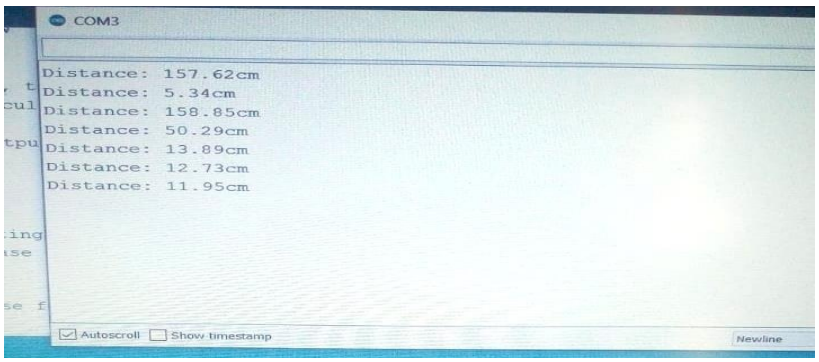

Figure 12: Distance displayed on serial monitor

5.3 TESTING TOOLS AND ENVIRONMENT

For testing of the project we require some tools, like to test Arduino program we require a software called Arduino IDE. Using this we can check the program that program is working properly or not. For hardware checking we require power supply and proper range of measurements and a meter tape. The garbage dump should have only solid waste. The NodeMCU should connect to the Blynk app and the app should show the output. For this the NodeMCU must connect first to the Wi-Fi hotspot.

5.4 TEST CASES

5.4.1 INPUT

Power supply is the basic need of any electronic circuit. Here we can use 5V DC battery to supply power to NodeMCU or sometimes we can give power directly from the computer.

5.4.2 EXPECTED OUTPUT

The expected output of this project should be a notification in the phone and also on the Blynk app when the dustbin is filled.

5.4.3 TESTING PROCEDURE

For testing first connect the circuit to the power supply is given to the NodeMCU using computer and it can also be done by using battery. In this way the whole testing circuit is built. Now we give input to the HC-SR04 by changing the level of solid garbage. Change in garbage level distance from the lid should be displayed.

Summary of testing procedure:

1. Connect the circuit according to the diagram
2. Give power to the system.
3. Vary garbage level for the ultrasonic sensor to give output.
4. Send the notification to mobile and Blynk app.

CHAPTER 6

RESULTS AND DISCUSSIONS

6.1 EXPERIMENT RESULT

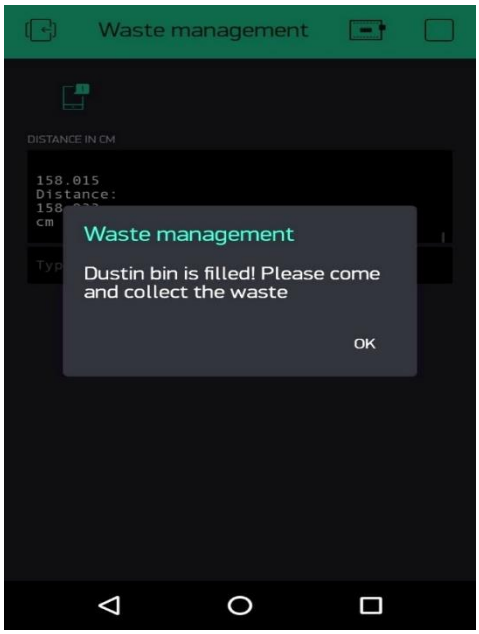

Figure 13: Screenshot of output in Blynk

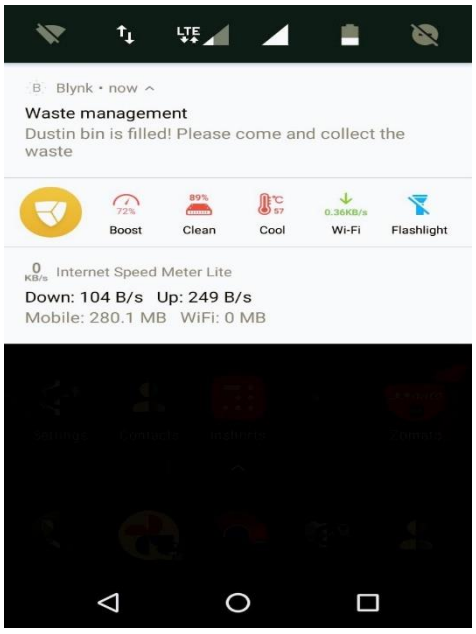

Figure 14: Output as a notification

6.2 ADVANTAGES & APPLICATIONS

- Very simple circuit
- Monitors the garbage bin.
- To keep our environment clean and green.
- Instantly the people are informed to empty the bin which prevents from over deposition of garbage in the bins.
- Reduces trips to areas where the bins still have a lot of capacity.
- It is easy to maintain and also cost - effective.
- This project is helpful in the government campaign “Swachh Bharat Abhiyan”.
- It can also play a vital role in the ‘Smart Cities Mission'.

CHAPTER 7

CONCLUSION AND FUTURE SCOPE

7.1 CONCLUSION

This Smart Dustbin can contribute a lot towards a clean and hygienic environment in building a smart city. It helps in avoiding overflow of garbage in the residential area. Therefore, the intelligent garbage monitoring system makes the garbage collection more economical. Garbage may consists of the unwanted material left over from City, Public area, Society, College, Homes etc. This project is related to the "Smart City" and based on "Internet of Things" (IOT). So for smart lifestyle, cleanliness is needed, and cleanliness begins with Garbage Bin.

But since the technology is new in India, proper awareness should be created among the public before it is implemented on a large scale. Otherwise, sensitive devices like sensors might be damaged due to the rough action of the users.

7.2 FUTURE SCOPE

Implementation is done only for a single bin.

Integration of many bins each with a unique id can be done.

Ultrasonic sensor is being used in this system to check the level of garbage in the dustbins but in future various other types of sensors can be used with the ultrasonic sensor to get more precise output.

Further, this system can be implemented by controlling garbage overflow in a smart way by separating it into Dry and Wet.

The restriction of coverage area can be lifted up by using GPS in the future.

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- Smart Garbage Monitoring System using IoT , 829 Mrs. Nethra M.V.O, V Joel, Rajat Gangwani, Munshad Ali, Computer Science Department, RR Institute of Technology, Bengaluru. International Journal of Scientific Research and Review (IJSRR) ISSN No.: 2279-543X Volume 07, Issue 05, May 2019 UGC Journal No.: 64650

- Garbage monitoring system using IoT, A Anitha, School of Information Technology and Engineering, VIT University, Vellore, Published under licence by IOP Publishing Ltd, IOP Conference Series: Materials Science and Engineering, Volume 263, Issue 4, 2017

- https://create.arduino.cc/projecthub/Technovation/smart-garbage-monitoring-system-using-arduino-101-3b813