“SMART WASTE MANAGEMENT SYSTEM”

A project report submitted in the partial fulfilment the award of degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

By

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Certified that the above-mentioned project has been duly carried out as per the norms of the college and statutes of the university.

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DEPARTMENT SEAL

DECLARATION

We declare that this project report titled **SMART WASTE MANAGEMENT SYSTEM** submitted in partial fulfillment of the degree of **B. Tech in ELECTRONICS and COMMUNICATION ENGINEERING** is a record of original work carried out by me under the supervision of **Mr. M. SATISH KUMAR**, and has not formed the basis forthe award of any other degree or diploma, in this or any other Institution or University. In keeping with the ethical practice in reporting scientific information, due acknowledgments have been made wherever the findings of others have been cited.

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ABSTRACT

In many places, it can be seen that the Municipal garbage bins are overflowing and they are not cleaned at proper time. As a result of which the consequences are severe. It includes overflow of garbage which results in land pollution, spread of diseases. It also creates unhygienic conditions for people, and ugliness to that place. There should be a system that can monitor the bin and can give the information of filling of the bin to the municipality using wireless sensor network so that the bin can be cleaned on time and the environment can be safeguarded. The Smart waste management system that identifies fullness of the bin using a wireless sensor network (WSN). The system provides a web interface to the cleaning authority so that they can monitor and clean the garbage bin. In this ultra-sonic sensors are used to determine the status of the dust bins. The status is read by Node-MCU and transmitted to the cloud server (THING SPEAK). The server controlled in the municipality office will read this data and determine which dust bin is to be emptied or full and timely inform to driver to collect waste.

Keywords: Municipal garbage bin, Ultrasonic sensor, Node MCU, Thing SPEAK, Monitoring.

CONTENTS

1.) INTRODUCTION

Waste management are the activities and actions required to manage waste from its inception to its final disposal. This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process. One of the main concerns with our environment has been solid waste management which impacts the health and environment of our society. A large portion of waste management practices deal with municipal solid waste (MSW) which is the bulk of the waste that is created by household, industrial, and commercial activity.

There are different types of waste:

1.Liquid waste.
2. Soild Rubbish.
3. Organic waste.
4. Recyclable waste.
5. Hazardous waste.

1.Liquid waste :-

• Liquid waste is commonly found both in households as well as in industries. This waste includes dirty water, organic liquids, wash water, waste detergents and even rainwater.

• You should also know that liquid waste can be classified into point and non-point source waste. All manufactured liquid waste is classified as point source waste. On the other hand, natural liquid waste is classified as non-point source waste.

• Tt is best get in touch with waste removal experts, such as 4 Waste Removals, to dispose of liquid waste properly.

2.Soild Rubbish :-

• Solid rubbish can include a variety of items found in your household along with commercial and industrial locations.

• Solid rubbish is commonly broken down into the following types:

• Plastic waste - This consists of bags, containers, jars, bottles and many other products that can be found in your household. Plastic is not biodegradable, but many types of plastic can be recycled. Plastic should not be mix in with your regular waste, it should be sorted and placed in your recycling bin.

• Paper/card waste -This includes packaging materials, newspapers, cardboards and other products. Paper can easily be recycled and reused so make sure to place them in your recycling bin or take them to your closest Brisbane recycling depot.

• Tins and metals - This can be found in various forms throughout your home. Most metals can be recycled. Consider taking these items to a scrap yard or your closest Brisbane recycling depot to dispose of this waste type properly.

• Ceramics and glass - These items can easily be recycled. Look for special glass recycling bins and bottle banks to dispose them correctly.

3.Organic waste :-

• Organic waste is another common household. All food waste, garden waste, manure and rotten meat are classified as organic waste. Over time, organic waste is turned into manure by microorganisms. However, this does not mean that you can dispose them anywhere.

• Organic waste in landfills causes the production of methane, so it must never be simply discarded with general waste. Instead, look to get a green bin from the Brisbane council, or hire a green skin bin or garden bag for proper waste disposal.

4.Recyclable waste :-

• Recyclable rubbish includes all waste items that can be converted into products that can be used again. Solid items such as paper, metals, furniture and organic waste can all be recycled.

• Instead of throwing these items in with regular waste, which then ends up in landfills, place them in your yellow recycling bin or take them to your local Brisbane recycling depot.

• If you're unsure whether an item is recyclable or not, look at the packaging or the diagrams on the lid of your yellow recycling bin. Most products will explicitly state whether they are recyclable or not.

5. Hazardous waste :-

• Hazardous waste includes all types of rubbish that are flammable, toxic, corrosive and reactive.

• These items can harm you as well as the environment and must be disposed of correctly. Therefore, I recommend you make use of a waste removal company for proper disposal of all hazardous waste.

Figure 1.1: waste cycling

2.INTERNET OF THINGS

2.1 CONCEPT OF IOT

Kevin Ashton firstly proposed the concept of IoT in 1999, and he referred the IoT as uniquely identifiable connected objects with radio-frequency identification (RFID) technology. However, the exact definition of IoT is still in the forming process that is subject to the perspectives taken. IoT was generally defined as "dynamic global network infrastructure with self-configuring capabilities based on standards and communication protocols"

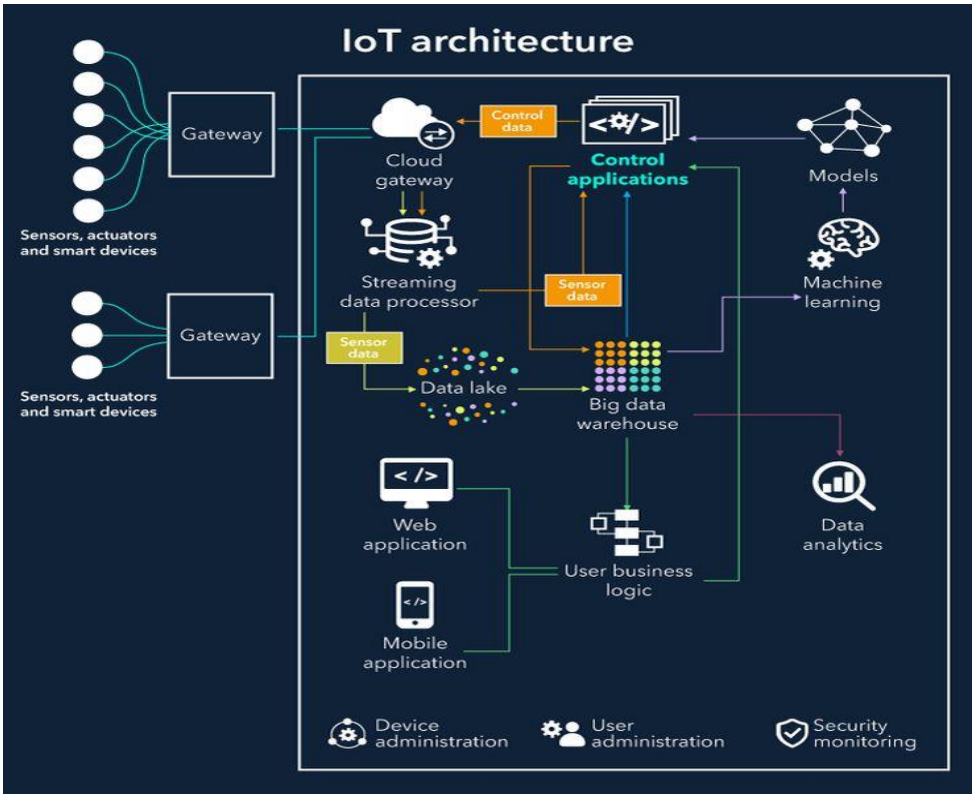
• Physical and virtual things in an IoT have their own identities and attributes and are capable of using intelligent interfaces and being integrated as an information network. In easy terms IoT can be treated as a set of connected devices that are uniquely identifiable.

• The words "Internet" and "Things" mean an inter-connected world-wide network based on sensors, communication, networking, and information processing technologies, which might be the new version of information and communications technology (ICT). To date, a number of technologies are involved in IoT, such as wireless sensor networks (WSNs), barcodes, intelligent sensing, RFID, NFCs, low energy wireless communications, cloud computing and so on.

• The IoT describes the next generation of Internet, where the physical things could be accessed and identified through the Internet. Depending on various technologies for the implementation, the definition of the IoT varies. However, the fundamental of IoT implies that objects in an IoT can be identified uniquely in the virtual representations. Within an IoT, all things are able to exchange data and if needed, process data according to predefined schemes.

2.2 ARCHITECHTURE OF IOT

A critical requirement of an IoT is that the things in the network must be connected to each other. IoT system architecture must guarantee the operations of IoT, which connects the physical and the virtual worlds. Design of IoT architecture involves many factors such as networking, communication, processes etc. In designing the architecture of IoT, the extensibility, scalability, and operability among devices should be taken into consideration. Due to the fact that things may move and need to interact with others in real-time mode, IoT architecture should be adaptive to make devices interact with other dynamically and support communication amongst them. In addition, IoT should possess the decentralized and heterogeneous nature.



3.METHODOLOGY and BLOCK DIAGRAM

3.1METHODOLOGY

3.2 BLOCK DIAGRAM

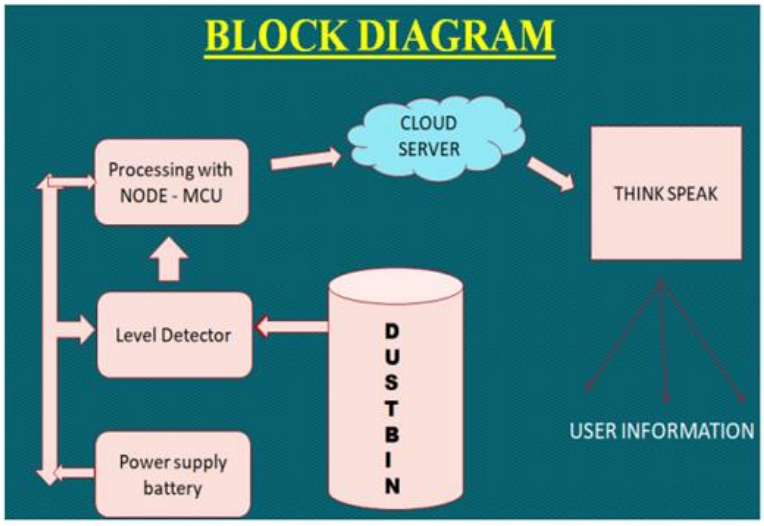


Figure 4.2: Block diagram

4.COMPONENTS USED

4.1 HARDWARE REQUIREMENTS

1. IR Sensor

2. Node MCU.

3. Batter or power supply.

4. Jamper wires.

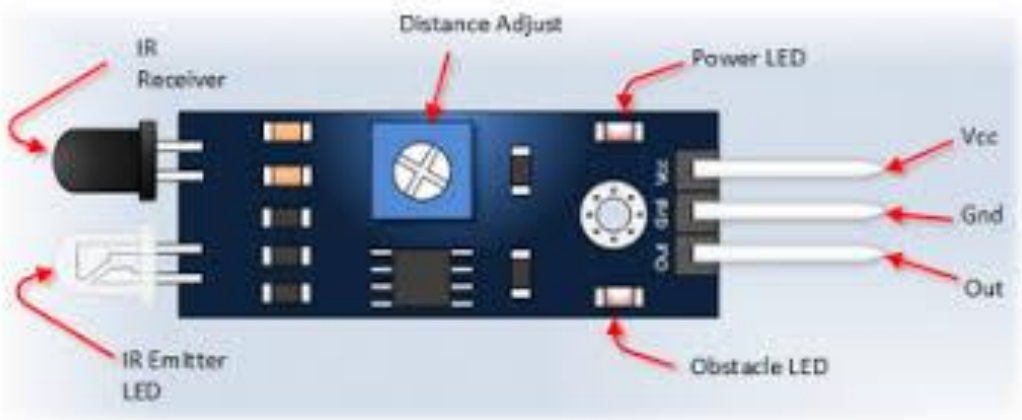
1.IR SENSOR :-

• IR sensors detect general movement, but do not give information on who or what moved.

• IR sensor is configured in a differential mode, it specifically becomes applicable as a motion detector device. In this mode, when a movement is detected within the "line of sight" of the sensor, a pair of complementary pulses are processed at the output pin of the sensor.

• A **passive infrared sensor** (**PIR sensor**) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. PIR sensors are commonly used in security alarms and automatic lighting applications. PIR sensors detect general movement, but do not give information on who or what moved. For that purpose, an imaging IR sensor is required.

• PIR sensors are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector". The term *passive* refers to the fact that PIR devices do not radiate energy for detection purposes. They work entirely by detecting infrared radiation (radiant heat) emitted by or reflected from objects.



2. Node MCU :-

• Node MCU Development board is featured with WI-FI capability, analog pin, digital pins and serial communication protocols.

• Node MCU has two versions namely
a)ESP 8266

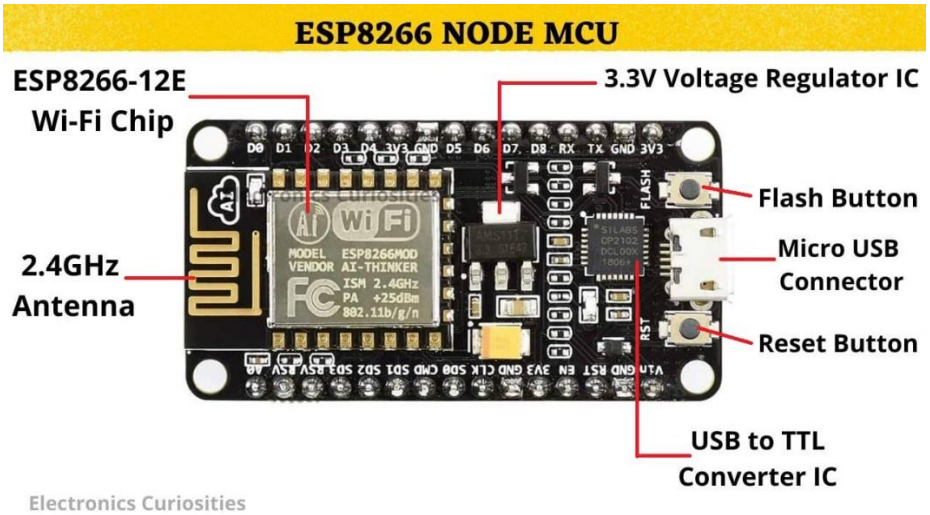
b)ESP 32 (This version is used in this project)

• **ESP32** is a series of low-cost, low-power system-on-chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth.

• The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, an Xtensa LX7 dual-core microprocessor, or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules.

• Commonly found either on device specific PCBs or on a range of development boards with GPIO pins and various connectors depending on the model and manufacturer of the board.

• ESP32 is created and developed by Espressif Systems, a Chinese company based in Shanghai, and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP8266 microcontroller.



3. Battery or power supply :-

• Power supply to the Node Mcu

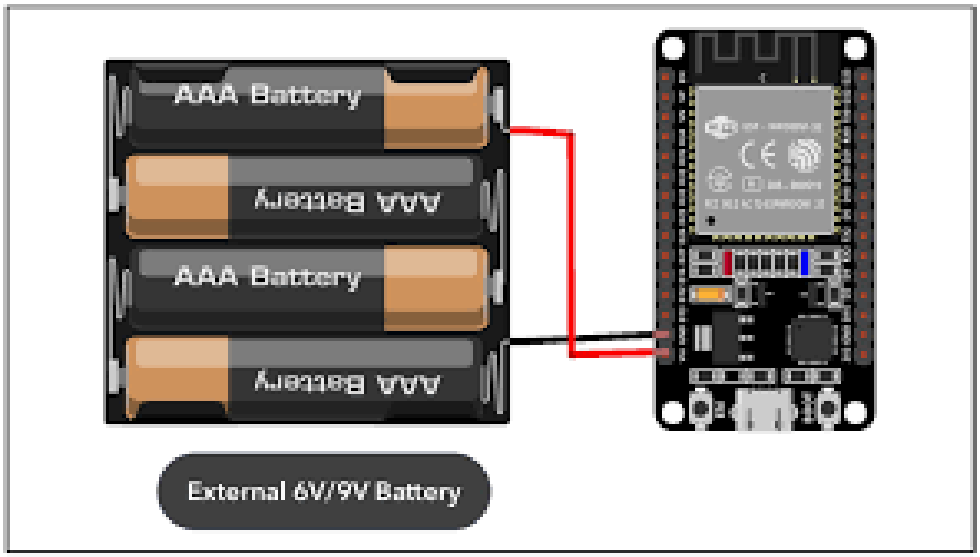
• A **power supply** is an electrical device that supplies electric power to an electrical load.

The main purpose of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load.

• As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power.

• Examples of the latter include power supplies found in desktop computers and consumer electronics devices.

• Other functions that power supplies may perform include limiting the current drawn by the load to safe levels, shutting off the current in the event of an electrical fault, power conditioning to prevent electronic noise or voltage surges on the input from reaching the load, power-factor correction, and storing energy so it can continue to power the load in the event of a temporary interruption in the source power (uninterruptible power supply).



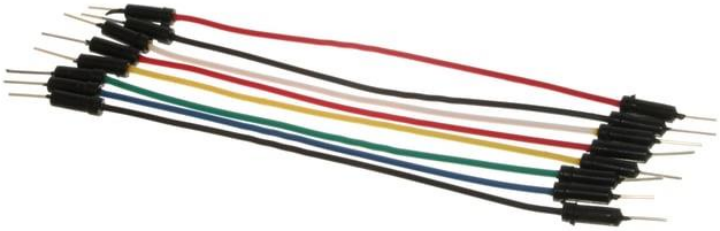
4. Jamper wires :-

• Used for the connecting Node MCU, IR sensor and battery.

• A **jump wire** (also known as **jumper**, **jumper wire**, **DuPont wire**) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

• Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

• There are three types of jumper wire: Female-to-Female, Male-to-Male, and Male-to-Female. The reason we call it Male-to-Female is because it has the outstanding tip in one end as well as a sunk female end. Male-to-Male means both side are male and Female-to-Female means both ends are female.



4.2 SOFT WARE REQUIREMENTS

1.Thing Speak :-

• Thing Speak is an open-source software that helps users communicate with internet-enabled devices and analyze data.

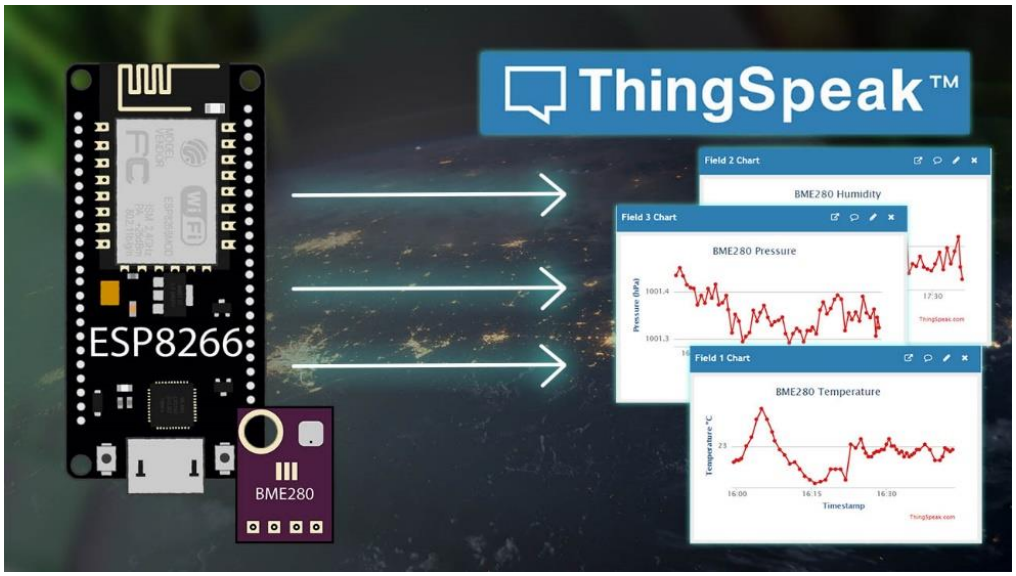
•It enables sensors, instruments, and websites to send data to the cloud where it is stored in either a private or a public channel.

• **Thing Speak** is an open-source software written in Ruby which allows users to communicate with internet enabled devices. It facilitates data access, retrieval and logging of data by providing an API to both the devices and social network websites.

• Thing Speak was originally launched by io Bridge in 2010 as a service in support of IoT applications.

•Thing Speak has integrated support from the numerical computing software MATLAB from MathWorks, allowing Thing Speak users to analyze and visualize uploaded data using MATLAB without requiring the purchase of a MATLAB license from MathWorks.

•Thing Speak has been the subject of articles in specialized "Maker" websites like Instructables , Code project, and Channel 9.



2. Arduino IDE :-

The Arduino Integrated Development Environment (IDE) is a free, popular programming tool that helps users write code, upload programs, and communicate with Arduino boards. It includes a text editor, a message area, a text console, and a toolbar with buttons for common functions.

- **Text editor**: For writing code
- **Message area**: Displays messages
- **Text console**: Displays output from the Arduino board

- **Toolbar**: Contains buttons for common functions
- **Menus**: A series of menus
- **Autocomplete**: Speeds up development time
- **Remote Sketchbook**: Allows users to pull, edit, and push sketches to the Arduino Cloud
- **Debugging**: Allows users to set up debuggers and debug a program

5. **STAGES IN WASTE MANAGEMENT**

Our project involves in three stages :-

1. Sensorwork.

2. Fixing the sensor to the garbage bin.

3. Thingspeak.

1.Sensorwork :-

•As we discussed above the sensors used are NodeMCU,ultra sonic sensor.

•Ultrasonic sensor connected to Wi-Fi module i.e., NodeMCU, Ultrasonic sensor sense the depth of the bin and timely inform to the sensor (full/empty).

•As we know that NodeMCU is having Wi-Fi connection it will receives the information and sends the information to cloud server.

2.Fixing the sensors to the garbage bin.

•The sensors are connected at the top of the dustbin, the gures are given below

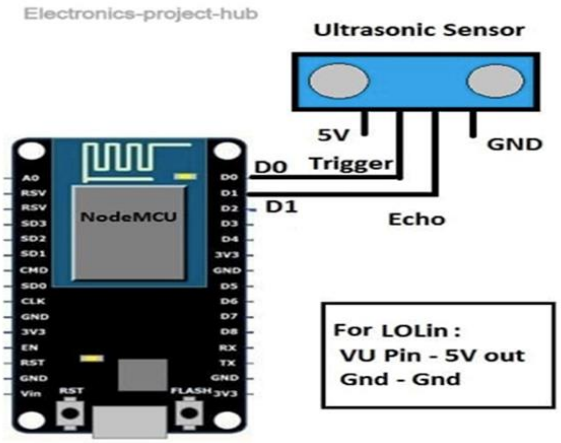


Figure 6.1: Module

3.ThingSPEAK.

•All sensor data transferred to the cloud server, it will show the statistics of the bin graphically.

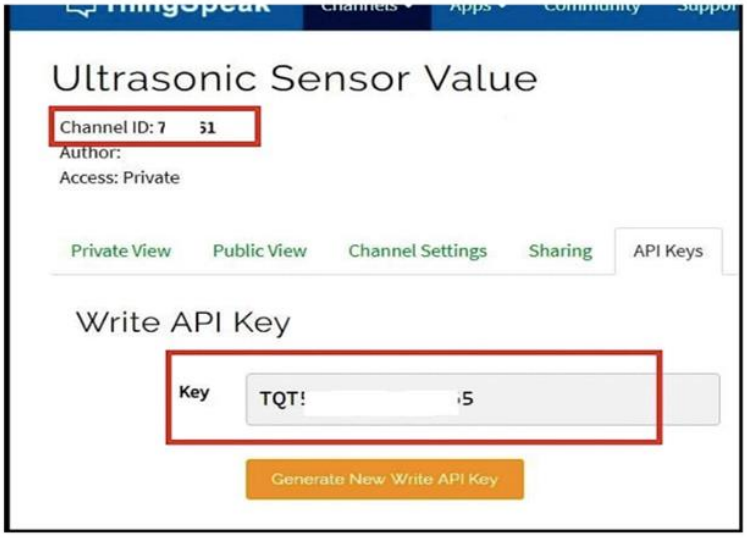


Figure 6.4: Api page

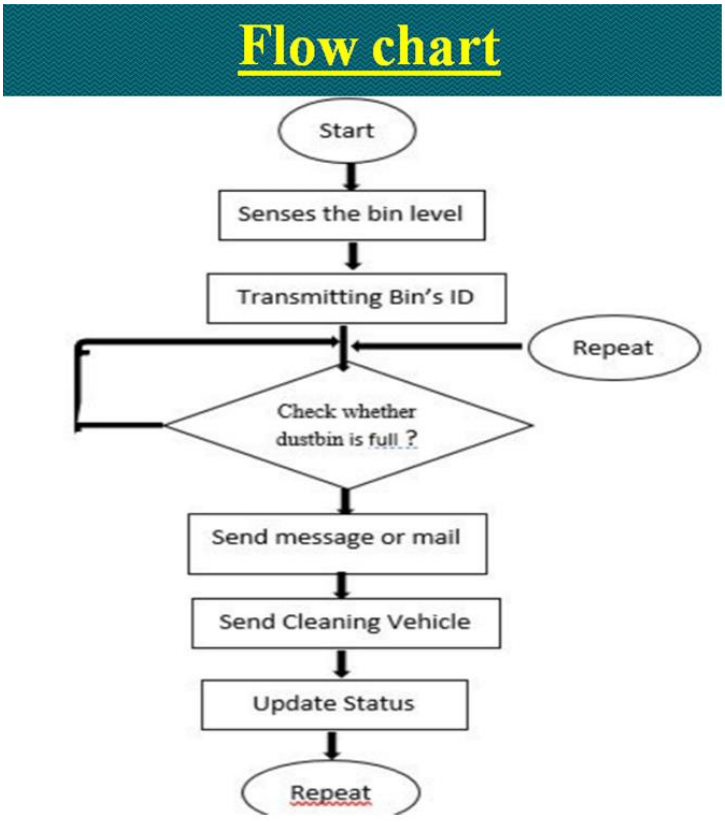


Figure 6.6: Flow chart

6.ADVANTAGES AND DISADVANTAGES

6.1 ADVANTAGES OF THE PROJECT

• Cost reduction, Our smart waste logistics solution reduces waste collection frequency dramatically, which enables you to save on fuel, labor, and fleet maintenance costs.

• Improved cleanliness, Indensely populated areas, a rapid waste generation often leads to over flowing waste bins and unsightly streets. Our solution enables waste collections staff to read all levels in real time and receive notifications of waste over flows.

•CO2 reduction, Collecting garbage is a very pollutant heavy proposition. Our solution offers you the means to have less trucks on the road for less time, which means less green house gas emissions, less noise pollution, and less road wear.

Smart waste management systems have many advantages, including:

- **Reduced environmental impact**

Smart waste management systems can help cities and towns reduce their environmental footprint. They can reduce greenhouse gas emissions and fuel consumption by optimizing waste collection routes and minimizing unnecessary collections.

- **Improved public health**

Smart waste management systems can help improve public health by reducing illegal dumping and overflowing waste.

- **Increased recycling rates**

Smart waste management systems can help increase recycling rates.

- **Cost efficiency**

Smart waste management systems can help reduce operating costs by optimizing vehicle routes and minimizing fuel usage.

- **Data-driven decision making**

Smart waste management systems can help with data-driven decision making by collecting data from smart bins to establish a waste and recycling baseline.

- **Improved community well-being**

Smart waste management systems can help improve community well-being by maintaining cleaner spaces and preventing waste overflow.

- **Better routing**

Smart waste management systems can help with better routing by reducing the number of times rubbish trucks need to stop at bins.

- **Reduced traffic congestion**

Smart waste management systems can help with traffic congestion by reducing the number of times rubbish trucks need to stop at bins

6.2 DISADVANTAGES OF THE PROJECT

• Sensor nodes used in the dustbins have limited memory size.

•The trainining has to be provided to the people involved in the smart waste management system.

• System requires more number of waste bins for separate waste. Collection as per population in the city. This results in to high initial cost due to expensive smart dustbins compare to other methods.

PSEUDO CODE :-

```
#include <WiFi.h>
#include <HTTPClient.h>

// WiFi credentials
const char* ssid = "your_SSID";  // Replace with your Wi-Fi network name
const char* password = "your_PASSWORD";  // Replace with your Wi-Fi password

// ThingSpeak details
const char* apiKey = "your_THINGSPEAK_WRITE_API_KEY";  // Replace with your ThingSpeak API key
const char* server = "http://api.thingspeak.com";

// IR sensor pins
int partialSensorPin = 13;  // GPIO pin for partial fullness sensor
int completeSensorPin = 14;  // GPIO pin for complete fullness sensor

int partialStatus = 0;  // Variable to store partial fullness status
int completeStatus = 0; // Variable to store complete fullness status

void setup() {
  Serial.begin(115200);  // Initialize serial communication for debugging

  // Connect to Wi-Fi
  WiFi.begin(ssid, password);
  Serial.print("Connecting to WiFi...");
  while (WiFi.status() != WL_CONNECTED) {
```

```
    delay(500);
    Serial.print(".");
  }
  Serial.println("\nWiFi connected.");

  // Set the IR sensor pin modes
  pinMode(partialSensorPin, INPUT);
  pinMode(completeSensorPin, INPUT);
}

void loop() {
  // Read the IR sensor values
  partialStatus = digitalRead(partialSensorPin);  // Check partial fullness
  completeStatus = digitalRead(completeSensorPin);  // Check complete fullness

  // Display the statuses in the Serial Monitor
  Serial.print("Partial Fullness: ");
  Serial.println(partialStatus ? "Detected" : "Not Detected");
  Serial.print("Complete Fullness: ");
  Serial.println(completeStatus ? "Detected" : "Not Detected");

  // Send the data to ThingSpeak
  sendDataToThingSpeak(partialStatus, completeStatus);

  delay(5000);  // Delay between readings
}

// Function to send data to ThingSpeak
void sendDataToThingSpeak(int partial, int complete) {
```

```
 if (WiFi.status() == WL_CONNECTED) {
  HTTPClient http;

  // Prepare the URL for the ThingSpeak update
  String url = String(server) + "/update?api_key=" + apiKey +
               "&field1=" + String(partial) +  // Field1: Partial fullness status
               "&field2=" + String(complete);  // Field2: Complete fullness status

  http.begin(url);  // Start connection to ThingSpeak
  int httpResponseCode = http.GET();  // Send GET request to ThingSpeak

  if (httpResponseCode > 0) {
   Serial.print("ThingSpeak Response: ");
   Serial.println(httpResponseCode);  // Print the response from ThingSpeak
  } else {
   Serial.print("Error in sending data: ");
   Serial.println(http.errorToString(httpResponseCode));  // Print error message
  }

  http.end();  // Close the connection
 } else {
  Serial.println("WiFi not connected, cannot send data to ThingSpeak");
 }
}
```

OUT PUT SCREENS :-

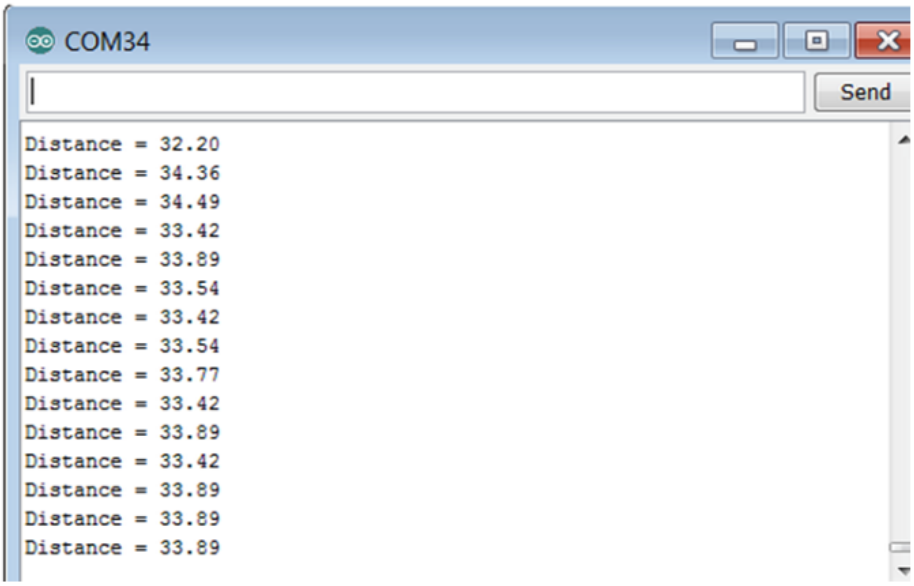


Figure 6.2: Digital values

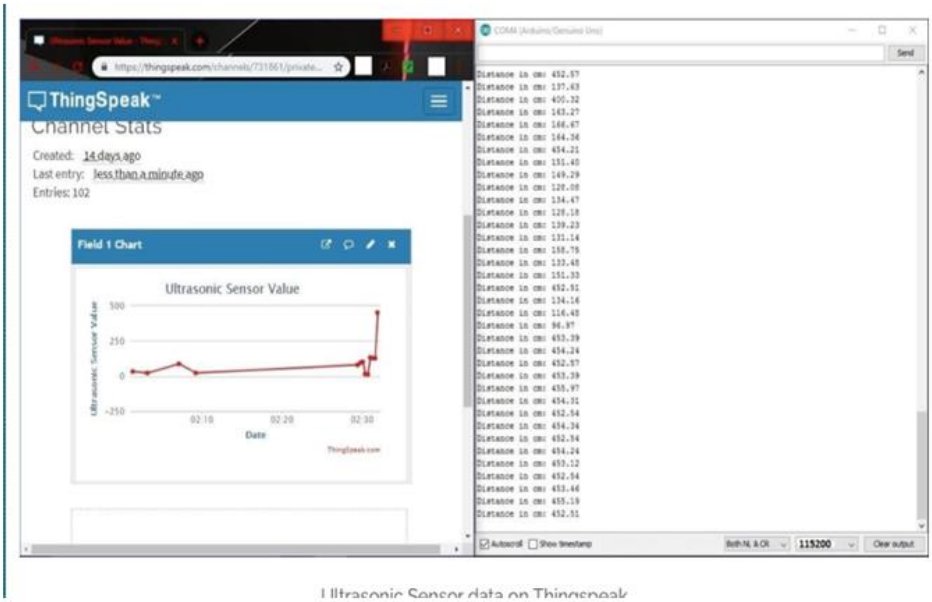


Figure 6.5: Statistics of bin

CONCLUSION :-

•The status of the bin has recorded graphically in cloud server.

•The information of the bin(full or empty) given to the drivers from the main office in the town.

•By executing this proposed frame work we can build up the sharp city thought and cost is reduced.

•By the productive utilization of sharp dust bins can the advantage is advanced. This frame work diminishes the improvement in the awe inspiring city, with the target that condition will be cleaned.

• In this frame work when garbage is full the data is send to the insisted individual.