CHAPTER 1

INTRODUCTION

In comparison to other nations, Indian towns have weak capacity for assembling trash. Therefore, managing the garbage causes the Indian government problems. Due to population growth, there are now more issues with waste disposal. The reason for the accumulation of rubbish in various parts of the municipality is poor trash collection and inadequate transportation infrastructure. In addition, improper waste management causes incurable diseases in living things and has an impact on plant life.

There are two ways that India's trash collection strategy might be implemented. The first option is a manual one; in this case, garbage collectors are involved in the process of gathering the trash from the bins as well as from the sides of the road. Time and gasoline will be wasted if the bins aren't filled or are only partially filled. The second method uses hardware-based resolution, where the sensors are positioned within the trash can and sense if the level of trash has reached the threshold level or not. When a price reaches the breaking point, the hardware system immediately alerts the supplier, who then sends the notification to the garbage collector. The trash collector attended the location after receiving the message and collected the trash from the containers.

Figure 1.1: Manual Approach

Figure 1. 2: Hardware Solution

The difficulty of collecting trash is much worse than the problem of garbage itself. Garbage collection typically has some drawbacks, such as using up extra resources, affecting performance, potentially causing issues with programme execution, and being incompatible with managing manual resources. Animal life is negatively affected physically and toxically by garbage dumps. Plastics found in rubbish are swallowed by animals, causing fatal wounds and digestive tract damage that cause malnutrition, stomach ulcers, decreased fitness, growth issues, and death. Problems arise when garbage is burned since burning plastics tends to release harmful chemicals like dioxins.

Figure 1. 3: Overflowing of garbage

"The ultimate test of man's conscience may be his willingness to sacrifice something today for future generations whose words of thanks will not be heard."— ***Gaylord Nelson***

According to the most recent figures, Urban India produces 62 million tonnes of municipal solid trash annually, the most of which is not effectively managed, collected, or processed. Furthermore, when it comes to the appropriate collection, we are heading in the incorrect direction. The answer lies in the timely and orderly collection of waste and in realising that no two households produce the same quantity of rubbish.

With six people living in my home, we generate a lot differently than our two-person neighbour's home. The amount of trash collected from each home in the colony varies each morning when the garbage collector arrives. Here is my project, which I'm creating in response to a simple problem that affects every modern household. This has as its goal not only timely gathering but also the best way to establish this.

India's urban population of 377 million produces 62 million tonnes of municipal solid waste (MSW) annually. All objects that people no longer need and either aim to discard or have already done so are considered waste. Any stuff that the owner, creator, or processor no longer needs. Any material that the owner, producer, or processor does not deem necessary.

1.1 Types of waste

1.1.1 On the basis of their physical state

1.1.1.1 Solid waste

For example, glass bottles, cutlery, plastic Containers, metals, and radioactive wastes are examples of solid wastes. Both biodegradable and non-biodegradable solid wastes are possible. Agricultural wastes, food wastes, paper wastes, by-products of food processing, manure, yard garbage, etc. are examples of biodegradable solid wastes. Plastic, metals, synthetic or radioactive trash, among other materials, are non-biodegradable wastes.

Figure 1. 4: Solid waste

1.1.2 On the basis of Bio-degradability

1.1.2.1 Biodegradable waste

These are the leftovers from our kitchens, which also contain rubbish from our gardens, etc. Moist waste is another name for biodegradable trash. This can produce manure when composted.

The length of time it takes for biodegradable garbage to break down depends on the material.

Figure 1. 5: Biodegradable waste

1.1.2.2 Non-Biodegradable wastes

These are the wastes, which also include worn-out newspapers, shards of glass, broken plastic, and so forth. Dry waste is another name for non-biodegradable waste. Dry wastes are recyclable and reusable. Non-biodegradable wastes are substantial pollutants and a matter for concern because they do not naturally degrade.

Figure 1. 6: Non-Biodegradable waste

1.1.3 On basis on effects on human health:

1.1.3.1 Hazardous waste

Any solid or liquid waste that could be harmful to people or the environment is referred to as hazardous waste. Many products fall under this category, but a few typical ones should be taken into account. Ignitable substances include anything that could quickly catch fire when exposed to heat, such as gasoline and propane. Corrosive materials can be found in acids, bases, or any item that contains one, such as drain cleaners and batteries. The soil can also be contaminated by metals, pesticides, lead, mercury, arsenic, and arsenic. Polluted soil is frequently found in or next to foundries, mines, painting industries, and agricultural hubs.

Figure 1. 7: Hazardous waste

1.1.3.2 Non –hazardous wastes

Contrarily, non-hazardous garbage cannot be disposed of in a trash can or a sewer line due to the dangers involved, even though it does not directly endanger human health or the environment. Animal waste, paper, plastic, glass, textile waste, metals, and other non-toxic trash make up the majority of the waste created.

Figure 1. 8: Non Hazardous waste

1.2 Sources of waste

1.2.1 Residential

One of the main sources of solid wastes is residential areas and dwellings where people reside. Food wastes, plastics, paper, glass, leather, cardboard fragments, metals, yard wastes, ash, and special wastes such large home objects like electronic appliances, tyres, batteries, old mattresses, and used cooking oil are among the garbage from these locations. The majority of households have trash cans where residents can dispose of their solid wastes, and subsequently, a garbage collection company will empty the bin for further processing.

1.2.3 Commercial

Buildings and commercial facilities today are yet another significant source of solid waste. In this context, "commercial structures and facilities" includes lodging establishments, marketplaces, dining establishments, go-downs, shops, malls, and office buildings. Plastics and polymers, food waste, metals, paper, packaging materials, glass, cardboard, special wastes, and numerous other hazardous wastes are only a few of the solid wastes produced in these locations.

1.2.4 Industrial

Currently, one of the major sources of solid waste is industry. Construction sites, fabrication facilities, canning facilities, power and chemical plants, as well as light and heavy manufacturing sectors are among them. These industries generate solid waste in the form of special wastes, medical wastes, household wastes, food wastes, packaging wastes, ash, construction and demolition debris, and other hazardous wastes.

1.2.5 Municipal solid Waste (construction and demolition)

The solid waste dilemma that plagues most countries today is also greatly exacerbated by the urban areas. Cleaning of streets, garbage from parks and beaches, waste from wastewater treatment plants, landscaping, and waste from recreational areas, including sludge, are some of the solid waste generated by municipal services.

1.2.6 Treatment facilities

Manufacturing facilities that produce both heavy and light goods are also a significant source of solid waste. Refineries, power plants, processing facilities, mines, and facilities for the extraction and treatment of chemicals are among them. These plants also create industrial process wastes, undesirable items that don't meet specifications, plastic, and metal parts, to name a few.

1.2.7 Agriculture

Sources of solid wastes include crop farms, orchards, dairies, vineyards, and feedlots. They generate trash like animal waste, wasted food waste, agricultural waste, pesticide and fertiliser containers, and other dangerous materials.

1.2.8 Biomedical

This is a reference to businesses that manufacture chemicals and hospital and biomedical equipment. Different kinds of solid waste are created in hospitals. Syringes, bandages, worn-out gloves, pharmaceuticals, paper, plastic, food scraps, and chemicals are a few examples of these solid wastes. All of these need to be disposed of properly or they could pose a serious threat to the environment and the residents of these sites.

1.3 Solid waste

- Solid waste, also known as garbage, only refers to non-liquid wastes.

1.3.1 Three type of Solid Waste:

- Municipal solid trash or hazardous waste.
- Industrial garbage or household rubbish.
- Biomedical waste or hospital garbage.

1.3.3 Magnitude of a problem in India

- Waste creation per person is rising by 1.35 percent annually.
- Urban population growth averaging between 3 and 3.5 percent annually.
- The rate of growth in garbage production each year is about 6%.
- The amount of garbage produced daily per person ranges from 200 gm to 600 gm.
- The amount of solid garbage that is collected successfully ranges from 50% to 90% of the total waste produced.

Figure 1. 9:1 Dump yard

1.4 Public health importance of waste management

- Poor waste management and disposal leads to environmental contamination, which in turn breeds disease-carrying insects, scavenger animals, and rats.
- Public nuisance due to offensive odour and ugliness.
- Blocking of drainage systems.
- It may result in fire hazards.

1.5 The ideal waste management system:

- With the least amount of work for the customer, provides a personalised and robust treatment of wastes that has the least impact on the environment.
- Provide minimal impact on the city in terms of traffic, exhaust emissions, noise, traffic accidents, and waste spills. Provide maximum resource recovery from waste while minimising resource use to treat wastes.
- When building trash collection and treatment facilities, take appropriate architectural elements into account.
- Waste management techniques that are affordable.

CHAPTER 2

LITERATURE SURVEY

This chapter discussed and examined studies on the use of IOT for smart bins.

The simplest method was suggested in the study [1] Smart Garbage Management in Smart Cities using IOT. Utilizing ultrasonic sensors, the level of trash gathered in the trashcan is detected, and a GSM system notifies the permitted room of the situation. A microcontroller called Arduino is used to connect the GSM system with the sensor system. Additionally, a GUI is created to view the needed information about the trash for several chosen places. This could facilitate effective garbage collection management. The extent of the trash inside the trashcan is determined by the level detector, which is made up of IR sensors. Microcontrollers receive the level detector's output. Four infrared sensors are used to show the various levels of garbage gathered inside the trash can that is positioned in a public area. The output from the fourth infrared receiver fully drops once the bin reaches its maximum level (actively low). This output is sent to the microcontroller so that it can use the GSM module to send the message to space. There is a room where all the actions are managed at the receiver. There is a room where all the actions are managed at the receiver. When the level of trash reaches its peak, this strategy ensures that trash cans will be cleaned as quickly as possible. A record is sent to the higher authority, who can take necessary action against the concerned contractor, if the trash can isn't cleaned within a certain amount of time. This approach also aids in examining phoney reports, which helps to lessen corruption within the management system. This lowers the total number of pickup truck trips and, as a result, lowers the overall cost of the garbage collection. It most importantly contributes to maintaining cleanliness in society. As a result, the efficient garbage management system increases the effectiveness of trash collection. [2] illustrates yet another approach to trash management, which has been described below. A dustbin has been fitted with a microcontroller-based system that displays the state of the bin (amount of trash) on a browser with an html page using Wi-Fi. The dustbin also has an Infrared wireless system and a central system. All results are now updated on an HTML website. This reduces the need for labour and resources. The smart garbage can might be viewed as an expensive bin when considering the amount of dustbins required in India given the demand for advanced technology in the modern era. To reduce its cost, they have therefore utilised based sensors. In this instance, the required data was sent and received using a Wi-Fi module. However, because a weight sensor is used, it will only be able to detect how much garbage is in the trashcan and not how much of what proportion. Instead of the contractor's office, the cleaning vehicle receives the notification. So, garbage cans are controlled.

For the Indian town of Asansol, a spatial data system for the collection of solid waste has been proposed in [3]. To track and schedule trucks that travel a specific route is the goal of this research. The DSS processes the information from the bins, and if it is accurate, it is forwarded to those in charge of this specific location's waste collection as well as to the traffic police. The trucker doesn't waste time waiting; instead, he or she moves on to the next location while also dynamically retelling the route. When the issue is resolved, the system retraces one of the available vehicles' path, collecting the trash from the unlocked container. It works in conjunction with dynamic routing algorithms to increase waste collection efficiency. An analysis of research on garbage collecting in developing nations from 2005 to 2011 is offered in [4], along with issues faced by these nations in the waste collection sector. The research focuses on identifying the stakeholder's actions/behavior and assessing the key variables affecting how they play a part in the garbage collection process. On actual data, the models used in the survey were tested. The study contrasts historical and contemporary approaches, using data from 1960 to 2013. The survey's findings point to the development and adoption of solid waste collection methods in emerging nations as being important. The biggest problem is that waste collection doesn't take advantage of IOT innovation. Although some systems use enhanced scheduling and routing by utilising cutting-edge ICT algorithms, models don't use real-time data from the garbage collection. The status of the dumpsters was not regarded as part of rubbish collection. Although they take into account various ways for waste collection, none of the surveys under consideration provide a model that might leverage IOT technology for smart cities. A sophisticated Decision web (DSS) was suggested in the paper [5] for effective rubbish collection in smart cities. In this case, truck drivers exchange data in real time. so that waste collection and dynamic route optimization can be done. For the purpose of documenting troublesome regions and providing authorities with proof, surveillance cameras are integrated. A city's residents should receive top-notch service from the waste collection system. Two primary targets are aimed at by system architecture. The first goal is to offer customers software as a service (SaaS) goods. These clients are primarily private businesses engaged in waste collecting. . The second key goal is to create a system that enables interdependent communication between all the parties involved in the supply chain for commodities and the use of solid waste in smart cities. In this research, an entirely original cloud-based waste collection system for smart cities was described. The system intends to provide services for all parties interested in this sector, from local government to citizens. The planning, however, is solely focused on offering SaaS services to commercial waste management organisations.

An IR sensor is utilised in this paper [6] in order to perhaps identify the amount of trash. The electrical components can detect the rays that the IR sensor generates even if they are undetectable to the human eye. IR transmitter and IR receiver make up it. The National Instruments myRIO-1900 collects the infrared sensor's output. The host computer and NI myRIO-1900 are connected using the USB. The expansion ports on connectors A and B are interchangeable with the mini-system ports on connector C. The sensor is used to gauge how full the bin is. The degree of filled rubbish is indicated through the graphical user interface. The sensor detects the bin's level. When the blinking LED is clicked, all the information, including the state of the bin and the date and time that it was filled and emptied, is displayed. However, this method does not guarantee that the rubbish is cleaned, and the cost of transportation is another concern.

Here, **Kalsiwal Mansai [7]** uses IOT for Smart Cities to develop a methodology for waste management. The extent of waste material in the trash can has been determined in this proposed system with the aid of an ultrasonic sensor, and it will be continuously communicated to the permitted room through a GSM module. The sensor system is interfaced using a microcontroller. Additionally, a GUI is created to manage the necessary data related to the trash for several chosen sites. The MATLAB-based GUI is the characteristic that sets this system apart from others the most. . The master and slave units are necessary for this setup. It is probably a good idea to put the slave unit in the trash can and the master unit in the room. The Arduino Uno board, which includes an Atmega328 IC, an ultrasonic sensor, and a GSM module, makes up the slave unit. The complete circuit is mounted on top of the trash can. The ultrasonic sensor's trigger pulse continuously sends waves into the bin, and the echo pulse then receives those waves and delivers them back to the ultrasonic sensor. An ultrasonic sensor continuously monitors the amount of trash in the trash can. The Arduino Uno board is instructed by the ultrasonic sensor to adjust the room's rubbish level once it reaches a predetermined level through GSM and SMS. When an SMS is received at a room in the master unit, the GUI in that unit will automatically alert the floor's cleaner and show the approximate share of garbage pickup for that floor.

CHAPTER 3

METHODOLOGY

3.1 Components Used:

1) Node MCU 8266
2) Ultrasonic Sensor
3) Battery / Power bank
4) Green/ Red/ White LED's
5) Zero Circuit Board

3.1.1 NODE MCU 8266:

An inexpensive ESP8266-based CPU with built-in WiFi is called the Node MCU ESP8266. Although Node MCU is not a true Arduino, it is near enough to allow for the use of the Arduino IDE and library of code. It is quite capable and, like all Arduino devices, can be programmed to work with a variety of sensors and gadgets by connecting them to a computer.

Figure 3. 1: NODE MCU 8266

3.1.1.1 Power USB:-

The USB cable from a computer can be used to power the Node MCU board. All that is necessary is to connect the USB cable to the USB connection.

3.1.1.2 Voltage Regulator

The voltage regulator's job is to steady the DC voltages used by the processor and other components while regulating the voltage supplied to the Node MCU.

3.1.1.3 Digital IO/OP

Six of the 13 digital I/O pins on the Node MCU board, or PWM (Pulse Width Modulation) output, are present on the board. These pins can be configured to work as digital input pins to read logic values or as digital output pins to operate various modules like LEDs, relays, etc (0 or 1). PWM can be produced using the labelled pins.

3.1.2 ULTRASONIC SENSOR

Like bats, the HC-SR04 ultrasonic sensor uses SONAR to determine how far away an item is. It provides exceptional non-contact range detection from 2 cm to 400 cm or 1 inch to 13 feet in an easy-to-use compact with high accuracy and consistent readings. Although soft materials like cloth can be challenging to detect acoustically, the operation is unaffected by sunshine or dark materials. It includes an ultrasonic transmitter and receiver module in its entirety.

Technical Specifications:

- Power Supply − +5V
- Working Current − 15mA
- Effectual Angle − <15 °
- Resolution − 0.3 cm
- Ranging Distance − 2cm – 200cm.

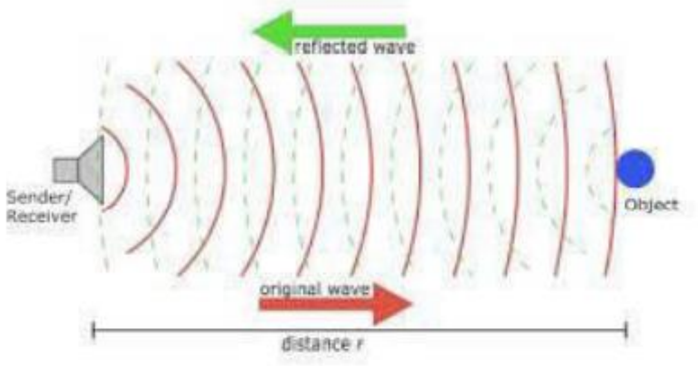


Figure 3. 2 Ultrasonic Sensor

3.1.3. BATTERY

9-volt batteries are made for long-lasting, low current applications.

Figure 3. 3 Battery

3.1.4. LED

Figure 3. 4 LED

3.1.5 ZERO PCB

Zero PCB, sometimes referred to as perfboard or DOT PCB, is essentially a general-purpose printed circuit board (PCB). It is a sheet of thin, inflexible copper with pre-drilled holes at at 2.54mm (0.1 inch) intervals over a grid. A circular or square copper pad surrounds each hole so that component leads can be placed into them and soldered around them without short-circuiting other leads or surrounding pads. Solder the leads of the component together or link them with a suitable conducting wire to form a connection.

Figure 3. 5 Zero PCB

3.2 Software's used:

The Arduino Integrated Development Environment (IDE) is a cross-platform programme that runs on Linux, Windows, and Mac OS and is created using C and C++ functions. Additionally, it is employed to create and upload software to Arduino-compatible devices.

Open-source software called Arduino IDE is primarily used to write and build code into Arduino Modules.

Due to the standard Arduino software's quick and simple code compilation capabilities, even those without prior technical knowledge can get started with it.

It runs on the Java Platform, which provides built-in functions and commands that are crucial for debugging, updating, and compiling the code, and is simple to access on a variety of operating systems, including MAC-OS, Windows, and Linux.

3.3 CIRCUIT DIAGRAM

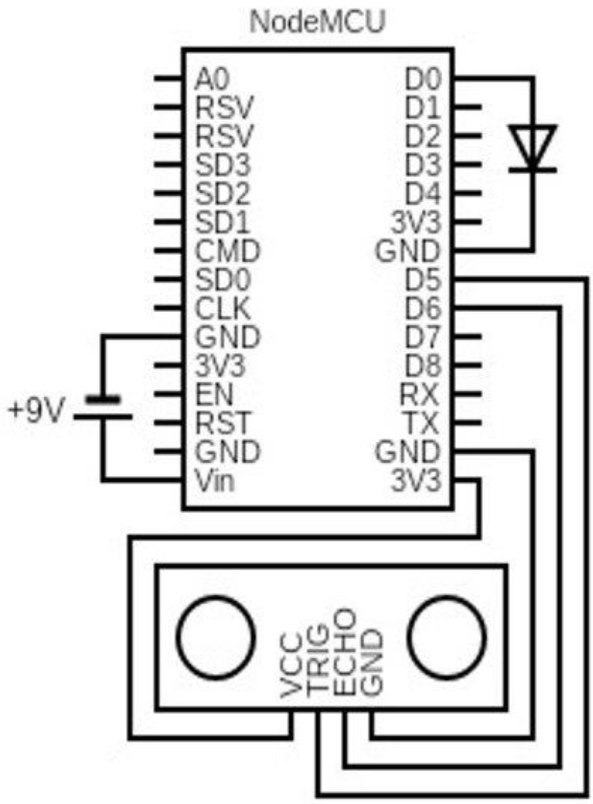


Figure 3. 6 Circuit Diagram

The node MCU in the circuit diagram above is an esp8266 module in our case. According to the diagram, the module is an ultrasonic sensor and has four pins: VCC, trig, echo, and GND. A 9-volt battery powers the device.

3.4 SOFTWARE CODE:

```
#include <ESP8266WiFi.h>

#include "Adafruit_MQTT.h"

#include "Adafruit_MQTT_Client.h"

#include <DHT.h>

#include <Servo.h>


//define sound velocity in cm/uS

#define SOUND_VELOCITY 0.034


#define WLAN_SSID       "vernon-gg"

#define WLAN_PASS       "nikilvgoveas"


#define AIO_SERVER      "io.adafruit.com"

#define AIO_SERVERPORT  1883

#define AIO_USERNAME    "vernon789"

#define AIO_KEY         "aio_rYVw78DWeQuqXSI2rVUYZhB9OBfV"


Servo servo;

int pos = 0;


const int trigPin = 12;//d6 on the board // ultrasound1 //
```

```
const int echoPin = 14;//d5 on the board

const int trigPin2 = 13;//d7on the board // ultrasound2 //open close reading
const int echoPin2 = 15;//d8 on the board

int white_led = 5;//d1 on the board
int red_led = 4;//d2 on the board

int green_led = 0;//d3 on the board

int distan;// stores how much the dustbin is filled
int distan2;//stores how far person is from the bin

WiFiClient client;
Adafruit_MQTT_Client mqtt(&client, AIO_SERVER, AIO_SERVERPORT,
AIO_USERNAME, AIO_KEY);

Adafruit_MQTT_Publish distance = Adafruit_MQTT_Publish(&mqtt, AIO_USERNAME
"/feeds/distance");

void MQTT_connect();

void setup() {
  Serial.begin(115200);
  delay(10);
```

```
  pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
  pinMode(echoPin, INPUT); // Sets the echoPin as an Input

pinMode(trigPin2, OUTPUT); // Sets the trigPin as an Output
  pinMode(echoPin2, INPUT); // Sets the echoPin as an Input

pinMode(white_led,OUTPUT );
pinMode(red_led,OUTPUT);
pinMode(green_led,OUTPUT);

 servo.attach(2);  //D4 on the board gpio 02
  servo.write(0); // initial position

  Serial.println(); Serial.println();
  Serial.print("Connecting to ");
  Serial.println(WLAN_SSID);

  WiFi.begin(WLAN_SSID, WLAN_PASS);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println();

  Serial.println("WiFi connected");
```

```
  Serial.println("IP address: ");

  Serial.println(WiFi.localIP());

}


void loop() {

delay(2000);

  MQTT_connect();

distan = ultra1() ; //measures how full is the dustbin

//distan2 = ultra2(); //used for opening and closing the lid


Serial.println(distan);

delay(100);


if(distan<10)//garbage above threshold

{

digitalWrite(red_led,HIGH);

digitalWrite(white_led,LOW);

servo_close();

}


if(distan>10 || distan< 20)//if dustbin is half full

{

 distan2 = ultra2();

 if(distan2<5)

 {
```

```
digitalWrite(red_led,LOW);

digitalWrite(green_led,HIGH);

digitalWrite(white_led,LOW);

Serial.println(distan2);

delay(20);

  servo_open();

 // delay(20);

  }

}


if(distan>20)//trash is below half level

{

 distan2 = ultra2();

 if(distan2<5)

 {

digitalWrite(red_led,LOW);

digitalWrite(green_led,LOW);

digitalWrite(white_led,HIGH);

Serial.println(distan2);

delay(20);

  servo_open();

 // delay(20);

  }

if (distan2>5)

{
```

```
 digitalWrite(white_led,HIGH);
 digitalWrite(red_led,LOW);
  servo_close();
  }
}


  if (! distance.publish(distan)) {
    Serial.println(" Failed");
  } else {
    Serial.println(" OK!");
  }
//if(distan2 < 10)
//{Serial.println(distan2);}


}


void MQTT_connect()
{
  int8_t ret;
  if (mqtt.connected())
  {
    return;
  }
 Serial.print("Connecting to MQTT... ");
```

```
  uint8_t retries = 3;

  while ((ret = mqtt.connect()) != 0) { // connect will return 0 for connected

       Serial.println(mqtt.connectErrorString(ret));

       Serial.println("Retrying MQTT connection in 5 seconds...");

       mqtt.disconnect();

       delay(5000);  // wait 5 seconds

       retries--;

       if (retries == 0) {

         // basically die and wait for WDT to reset me

         while (1);

       }

  }

  Serial.println("MQTT Connected!");

}


int ultra1() //sensor to check if dustbin empty

{

  long duration;

int distanceCm;

  // Clears the trigPin

  digitalWrite(trigPin, LOW);

  delayMicroseconds(2);

  // Sets the trigPin on HIGH state for 10 micro seconds

  digitalWrite(trigPin, HIGH);

  delayMicroseconds(10);
```

```
  digitalWrite(trigPin, LOW);

  // Reads the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin, HIGH);

  // Calculate the distance
  distanceCm = duration * SOUND_VELOCITY/2;

  // Prints the distance on the Serial Monitor
//  Serial.print("Distance (cm): ");
//  Serial.println(distanceCm);
  return distanceCm ;
  }

int ultra2() // sensor for opening and closing the lid
{
  long duration;
int distanceCm;
  // Clears the trigPin
  digitalWrite(trigPin2, LOW);
  delayMicroseconds(2);
  // Sets the trigPin on HIGH state for 10 micro seconds
  digitalWrite(trigPin2, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin2, LOW);
```

```
  // Reads the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin2, HIGH);


  // Calculate the distance
  distanceCm = duration * SOUND_VELOCITY/2;


// Prints the distance on the Serial Monitor
//  Serial.print("Distance (cm): ");
//  Serial.println(distanceCm);
  return distanceCm ;9
  }
 void servo_open()
 {
   servo.write(180);
   }
 void servo_close()
 {
   servo.write(0);
  }
```

3.5 Flow Chart:

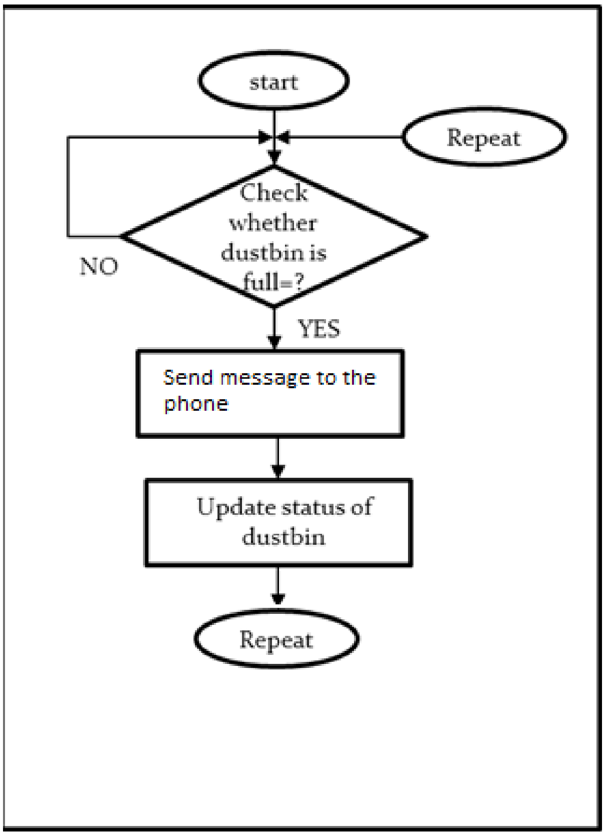
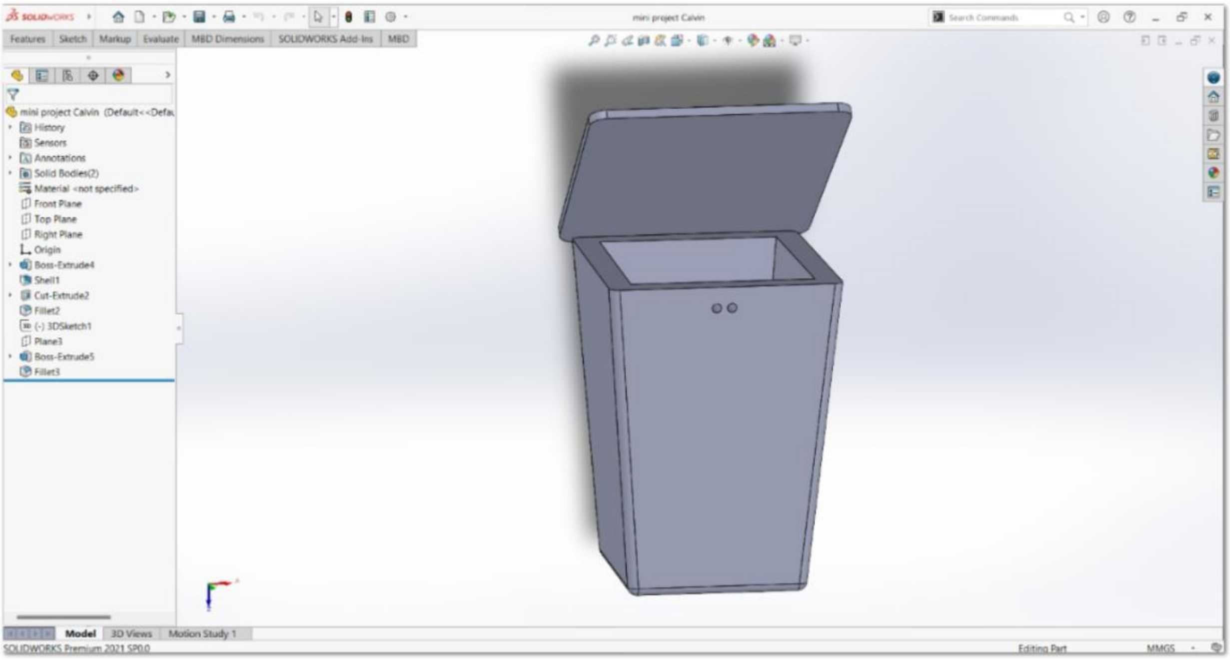


Fig 3.7 Flowchart

3.6 DESIGN OF THE BIN:



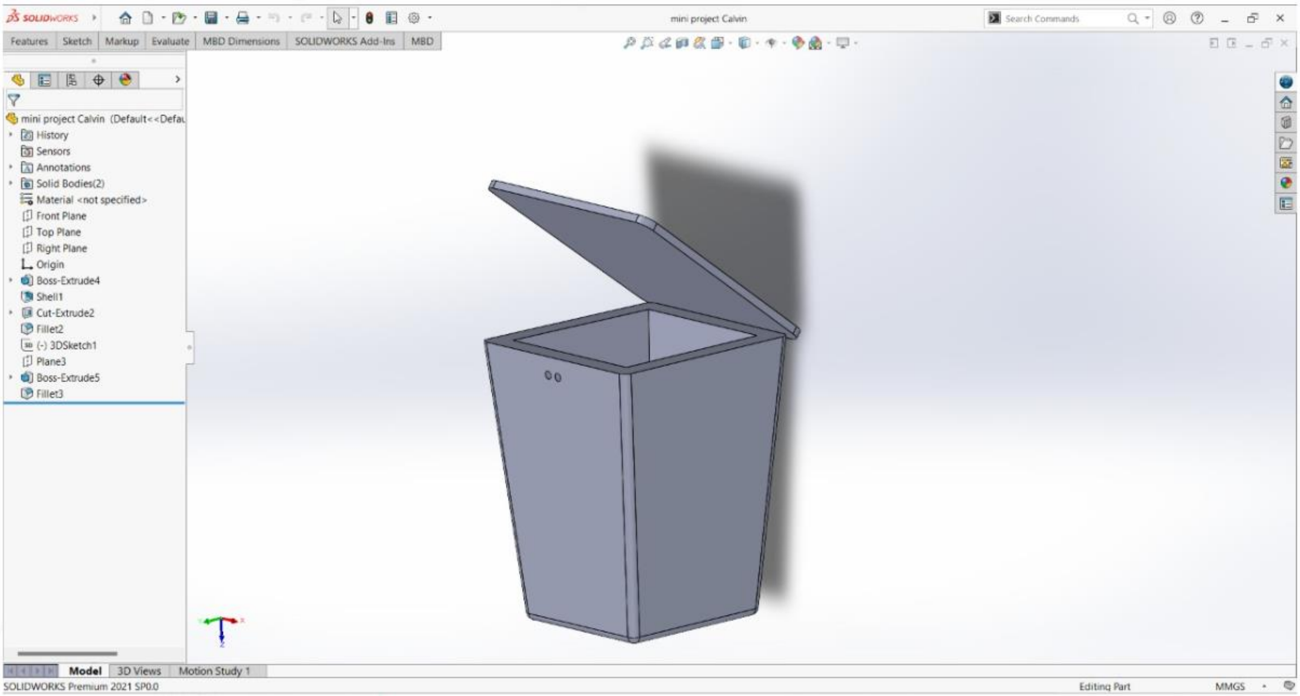


Figure 3. 4 Dust bin CAD final Design

CHAPTER 4

RESULTS

Here in this stage we conducted 2 trials to test our product.

- Trial 1: Bin was completely empty
- Trial 2: Bin was filled above threshold level (80%)

Figure 4.1 Empty Dustbin

Trial 1:

- Our first trial was conducted with the bin completely empty.
- The white led turns on, indicating the dustbin to be empty
- At the range of 5cms the lid of the dustbin opens

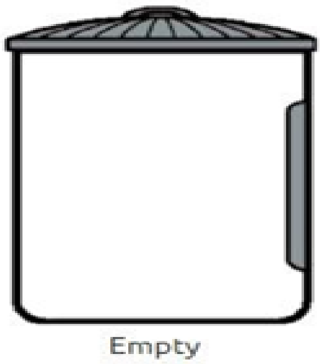


Figure 4.2 Empty Dustbin

Trial 2:

- In trial 2, we fill the bin level above 80% with solid waste.
- The red led turns on, indicating the dustbin is above threshold level (80%)
- At the range of 5 cms the lid of the dustbin doesn't open

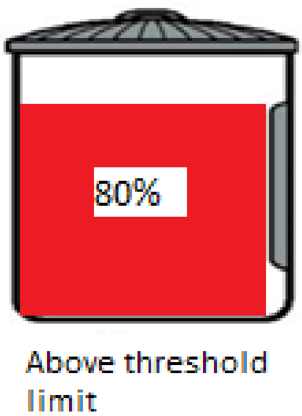


Figure 4.3: Bin filled 80%

CHAPTER 5

CONCLUSION

The generation of real-time data regarding the filling up of garbage bins situated at various remote sites offers a solution for the optimization of the waste collection process. The waste managers will be able to more effectively and efficiently route and schedule the movement of collection equipment with the use of this real-time information, which will improve their overall efficiency. As a result, trash bin overflow will be prevented. The suggested IOT-based methodology can generate these data with ease. The proposed hardware can be used with any type of bin (both with and without lids). This technology is dependable, economical, and simple to use. It also has improved functionality in lid- and lidless-situations and a straightforward installation process.

CHAPTER 6

FUTURE SCOPE

- This project is carried out on a modest scale for a community or collection of houses.

- By giving municipal trucks access to real-time information or by deploying smart cars that are tasked with collecting rubbish from all over, this initiative can be expanded significantly.

- The process of garbage segregation might be made relatively simple by the use of a sorting algorithm.

- The smart bin can be made effective by using a bacterial sensor or an odour sensor, which will help to maintain a genuinely clean, green, and healthy environment.

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