PROJECT REPORT

SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITIAN CITIES

Submitted by

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CHAPTER1
INTRODUCTION

1.1 PROJECT OVERVIEW

We are living in an age where tasks and systems are fusing together with the power of IOT .The Internet of Things (IoT) shall be able to incorporate transparently and seamlessly a large number of different systems, while providing data for millions of people to use and capitalize. Building a general architecture for the IoT is hence a very complex task, mainly because of the extremely large variety of devices, link layer technologies, and services that may be involved in such a system.

One of the main concerns with our environment has been solid waste management which impacts the health and environment of our society. The detection, monitoring and management of wastes is one of the primary problems of the present era. The traditional way of manually monitoring the wastes in waste bins is a cumbersome process and utilizes more human effort, time and cost which can easily be avoided with our present technologies. This is our solution, a method in which waste management is automated. This is our IoT Smart Waste Management system, an innovative way that will help to keep the cities clean and healthy.

1.2 PURPOSE

One of the main concerns with our environment has been solid waste management which impacts the health and environment of our society. The detection, monitoring and management of wastes is one of the primary problems of the present era. The traditional way of manually monitoring the wastes in waste bins is a cumbersome process and utilizes more human effort, time and cost which can easily be avoided with our present technologies. This is our solution, a method in which waste management is automated. This is our IoT Smart Waste Management system, an innovative way that will help to keep the cities clean and healthy.

CHAPTER 2
LITERATURE SURVEY

2.1 EXISTING PROBLEM

Nowadays, there are tons of flats and apartments which have been built in the rapid urbanization area. 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. 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. Also, on rare days problems might arise that there is so much garbage that the truck doesn't have enough capacity .The idea struck us when we observed that the garbage truck use to go around the town to collect solid waste twice a day. Although this system was thorough it was very inefficient.

2.2 REFERENCES

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[4] Sharholy, M., Ahmad, K., Mahmood, G., Trivedi, R.C., 2008. Municipal Solid waste management in Indian cities. A review, Journal of Waste Management 28,459-467.

[5] Agarwal, A., Singhmar, A., Kulshrestha, M., Mittal, A.K., 2005. Municipal solid waste recycling and associated markets in Delhi, India. Journal of Resources, Conservation and Recycling 44(1), 73-90. Ashan, N., 1999.

2.2 PROBLEMSTATEMENTDEFINITION

Internet and its applications have become an integral part of today's human lifestyle. It has become an essential tool in every aspect. Due to the tremendous demand and necessity, went beyond connecting just computers into the web. The world is in a stage of upgradation, there is one stinking problem we have to deal with. Garbage! In our daily life, we see the pictures of garbage bins being overfull and all the garbage spills out. A big challenge in the urban cities is waste management not only in India but for most of the countries in the world. Hence, such a system has to be build which can eradicate this problem or at least reduce it to the minimum level .The waste collection process is a critical aspect for the service providers. The traditional way of manually monitoring the wastes in waste bins is a complex, and utilizes more human effort, time and cost which is not compatible with the present day technologies. In order to overcome all these problems, we are proposing the idea of a waste management system which helps in the management of waste with the least human interaction in order to maintain a clean environment. The people who need dust bins near their location can request it through logging onto our website. IoT Garbage Monitoring System monitors the garbage bins and informs about the level of garbage collected in the garbage bins via an SMS. If the dustbin is not cleaned in a specific time, then the record is sent to the higher authority who can take appropriate action. This system also helps to monitor the fake reports and hence can reduce corruption in the overall management system. It will stop overflowing of dustbins along roadsides and localities as smart bins are managed at real time.

CHAPTER 3

IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

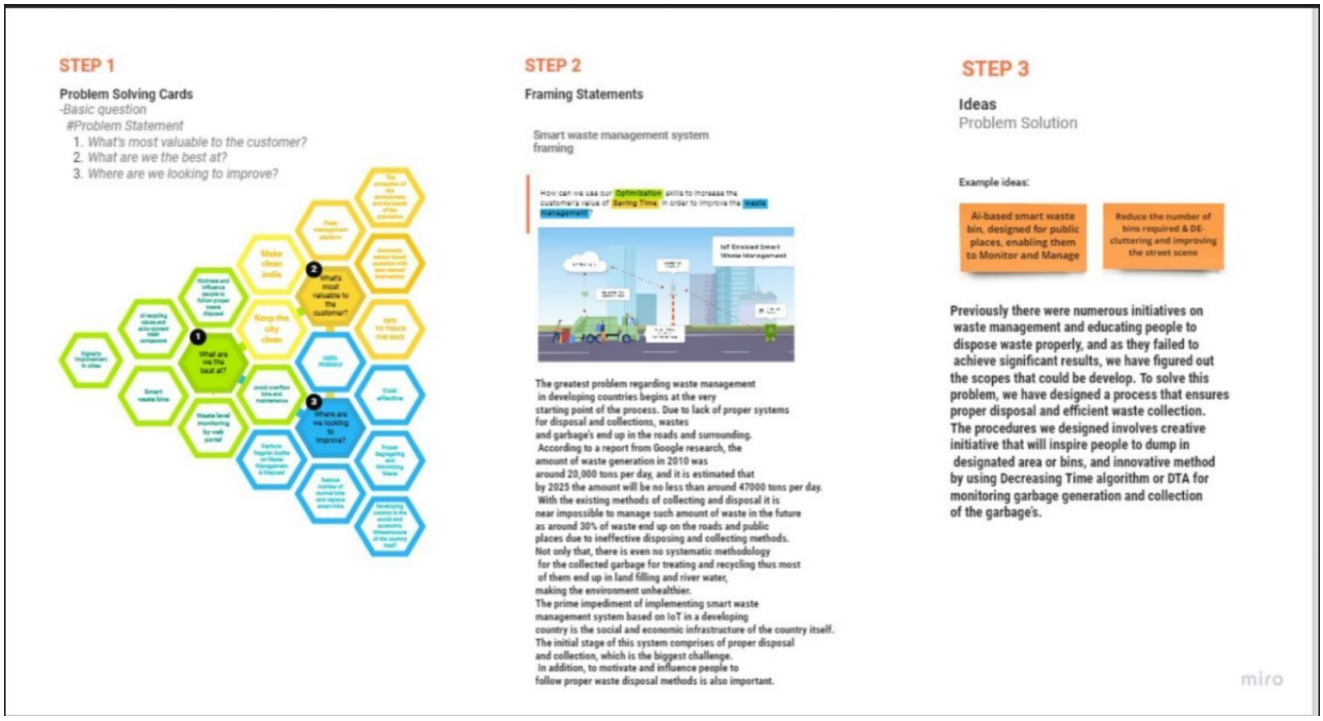
3.2 IDEATION&BRAINSTORMING

3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	This project deals with the problem of waste management in smart cities, where the garbage collection system is not optimized. This project enables the organizations to meet their needs of smart garbage management systems. This system allows the authorised person to know the fill level of each garbage bin in a locality or city at all times, to give a cost-effective and time-saving route to the truck drivers.
2.	Idea / Solution description	The key research objectives are as follows: • The proposed system would be able to automate the solid waste monitoring process and management of the overall collection process using IOT (Internet of Things). • The Proposed system consists of main subsystems namely Smart Trash System(STS) and Smart Monitoring and Controlling Hut(SMCH). • In the proposed system, whenever the waste bin gets filled this is acknowledged by placing the circuit at the waste bin, which transmits it to the receiver at the desired place in the area or spot. • In the proposed system, the received signal indicates the waste bin status at the monitoring and controlling system.
3.	Novelty / Uniqueness	We are going to establish SWM in our college but the real hard thing is that janitor (cleaner) don't know to operate these thing practically so here our team planned to build a wrist band to them, that indicate via light blinking when the dustbin fill and this is Uniqueness we made here beside from project constrain.

4.	Social Impact / Customer Satisfaction	From the public perception as worst impacts of present solid waste disposal practices are seen direct social impacts such as neighbourhood of landfills to communities, breeding of pests and loss in property values
5.	Business Model (Revenue Model)	Waste Management organises its operations into two reportable business segments: Solid Waste, comprising the Company's waste collection, transfer, recycling and resource recovery, and disposal services, which are operated and managed locally by the Company's various subsidiaries, which focus on distinct geographic areas; and Corporate and Other, comprising the Company's other activities, including its development and operation of landfill gas-toenergy facilities in the INDIA, and its recycling brokerage services, as well as various corporate functions.
6.	Scalability of the Solution	In this regard, smart city design has been increasingly studied and discussed around the world to solve this problem. Following this approach, this paper presented an efficient IoTbased and real-time waste management model for improving the living environment in cities, focused on a citizen perspective. The proposed system uses sensor and communication technologies where waste data is collected from the smart bin, in real-time, and then transmitted to an online platform where citizens can access and check the availability of the compartments scattered around a city.

3.4 PROBLEM SOLUTION FIT



CHAPTER 4

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Detailed bin inventory.	All monitored bins and stands can be seen on the map, and you can visit them at any time via the Street View feature from Google. Bins or stands are visible on the map as green, orange or red circles. You can see bin details in the Dashboard – capacity, waste type, last measurement, GPS location and collection schedule or pick recognition.
FR-2	Real time bin monitoring.	The Dashboard displays real-time data on fill-levels of bins monitored by smart sensors. In addition to the % of fill-level, based on the historical data, the tool predicts when the bin will become full, one of the functionalities that are not included even in the best waste management software.. Sensors recognize picks as well; so you can check when the bin was last collected. With real-time data and predictions, you can eliminate the overflowing bins and stop collecting half-empty ones.
FR-3	Expensive bins.	We help you identify bins that drive up your collection costs. The tool calculates a rating for each bin in terms of collection costs. The tool considers the average distance depo-bindischarge in the area. The tool assigns bin a rating (1-10) and calculates distance from depo-bin discharge.
FR-4	Adjust bin distribution.	Ensure the most optimal distribution of bins. Identify areas with either dense or sparse bin distribution. Make sure all trash types are represented within a stand. Based on the historical data, you can adjust bin capacity or location where necessary.

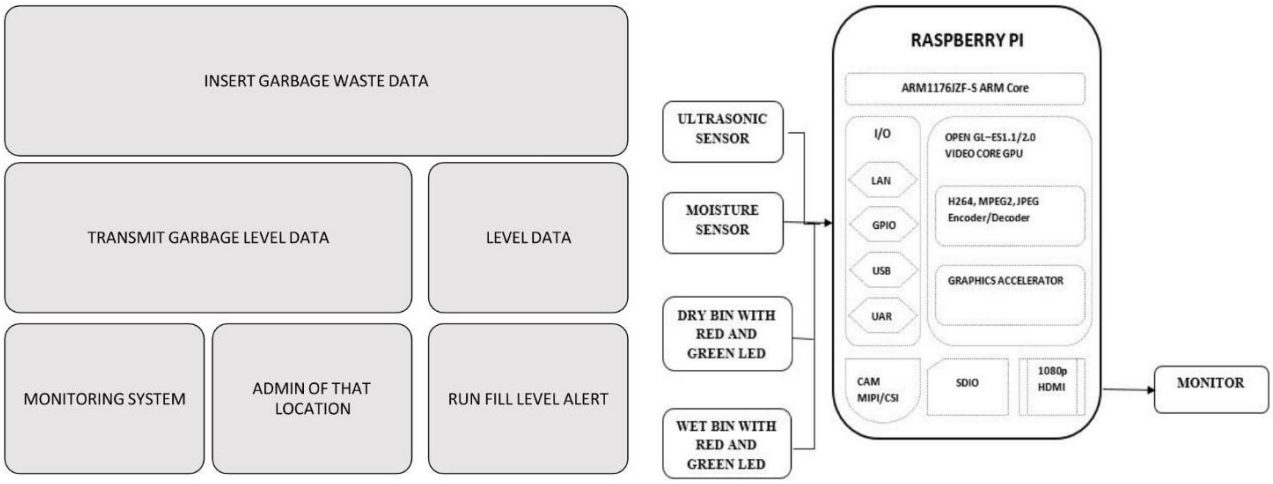
FR-5	Eliminate unefficient picks.	Eliminate the collection of half-empty bins. The sensors recognize picks. By using real-time data on fill-levels and pick recognition, we can show you how full the bins you collect are.
		The report shows how full the bin was when picked. You immediately see any inefficient picks below 80% full.
FR-6	Plan waste collection routes.	The tool semi-automates waste collection route planning. Based on current bin fill-levels and predictions of reaching full capacity, you are ready to respond and schedule waste collection. You can compare planned vs. executed routes to identify any inconsistencies.

4.2 NON FUNCTIONAL REQUIREMENTS

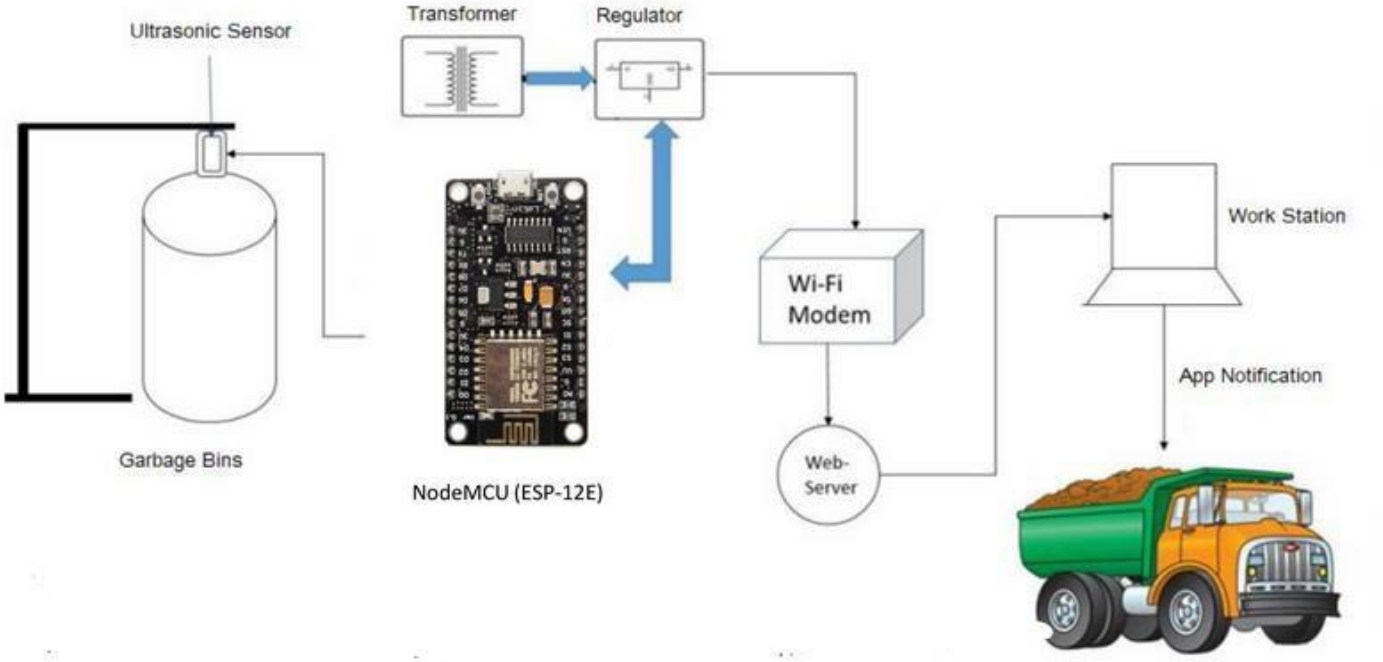
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	IoT device verifies that usability is a special and important perspective to analyze user requirements, which can further improve the design quality. In the design process with user experience as the core, the analysis of users' product usability can indeed help designers better understand users' potential needs in waste management, behavior and experience.
NFR-2	**Security**	Use a reusable bottles Use reusable grocery bags Purchase wisely and recycle Avoid single use food and drink containers.
NFR-3	**Reliability**	Smart waste management is also about creating better working conditions for waste collectors and drivers. Instead of driving the same collection routes and servicing empty bins, waste collectors will spend their time more efficiently, taking care of bins that need servicing.
NFR-4	**Performance**	The Smart Sensors use ultrasound technology to measure the fill levels (along with other data) in bins several times a day. Using a variety of IoT networks ((NB-IoT,GPRS), the sensors send the data to Sensoneo's Smart Waste Management Software System, a powerful cloud-based platform, for datadriven daily operations, available also as a waste management app. Customers are hence provided data-driven decision making, and optimization of waste collection routes, frequencies, and vehicle loads resulting in route reduction by at least 30%.

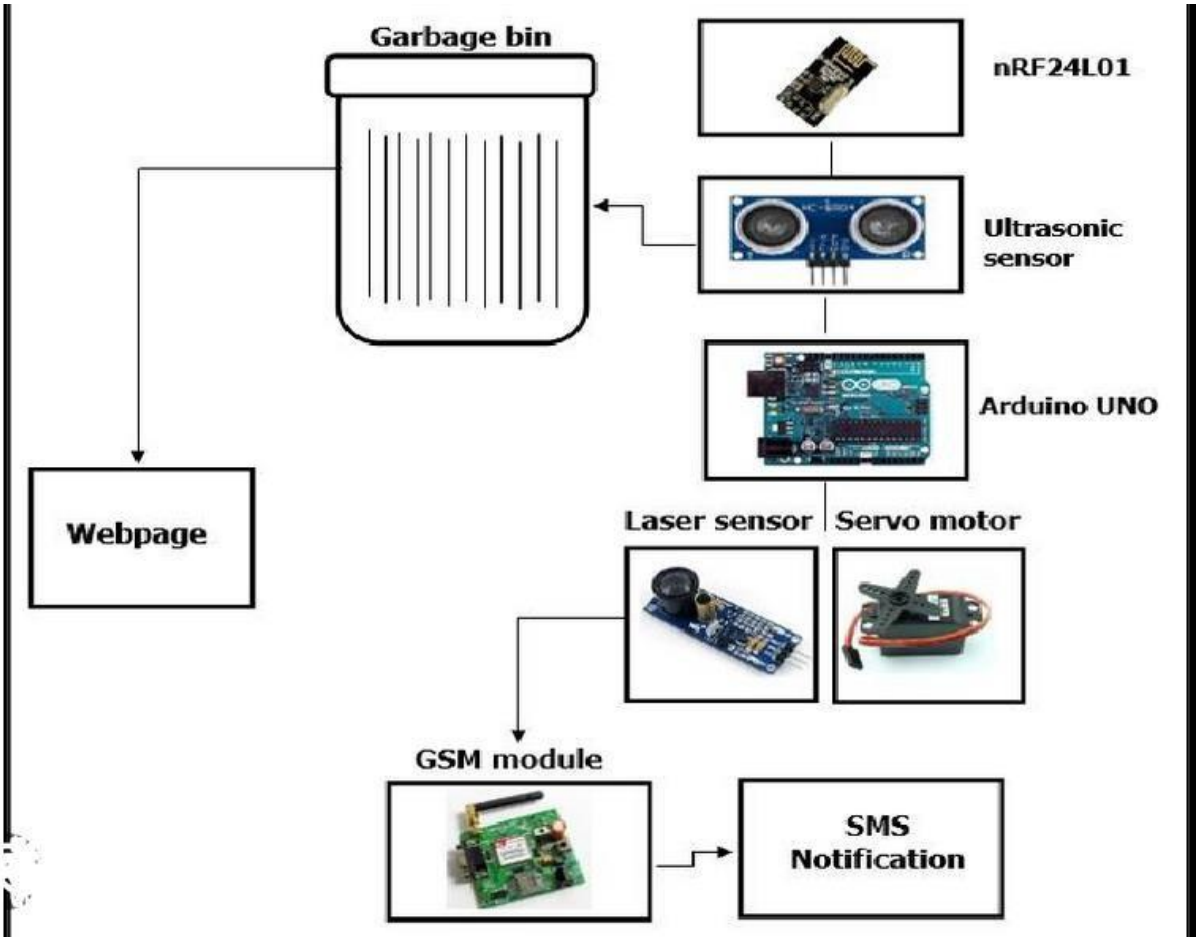
CHAPTER 5
PROJECT DESIGN

5.1 DATA FLOW DIAGRAM

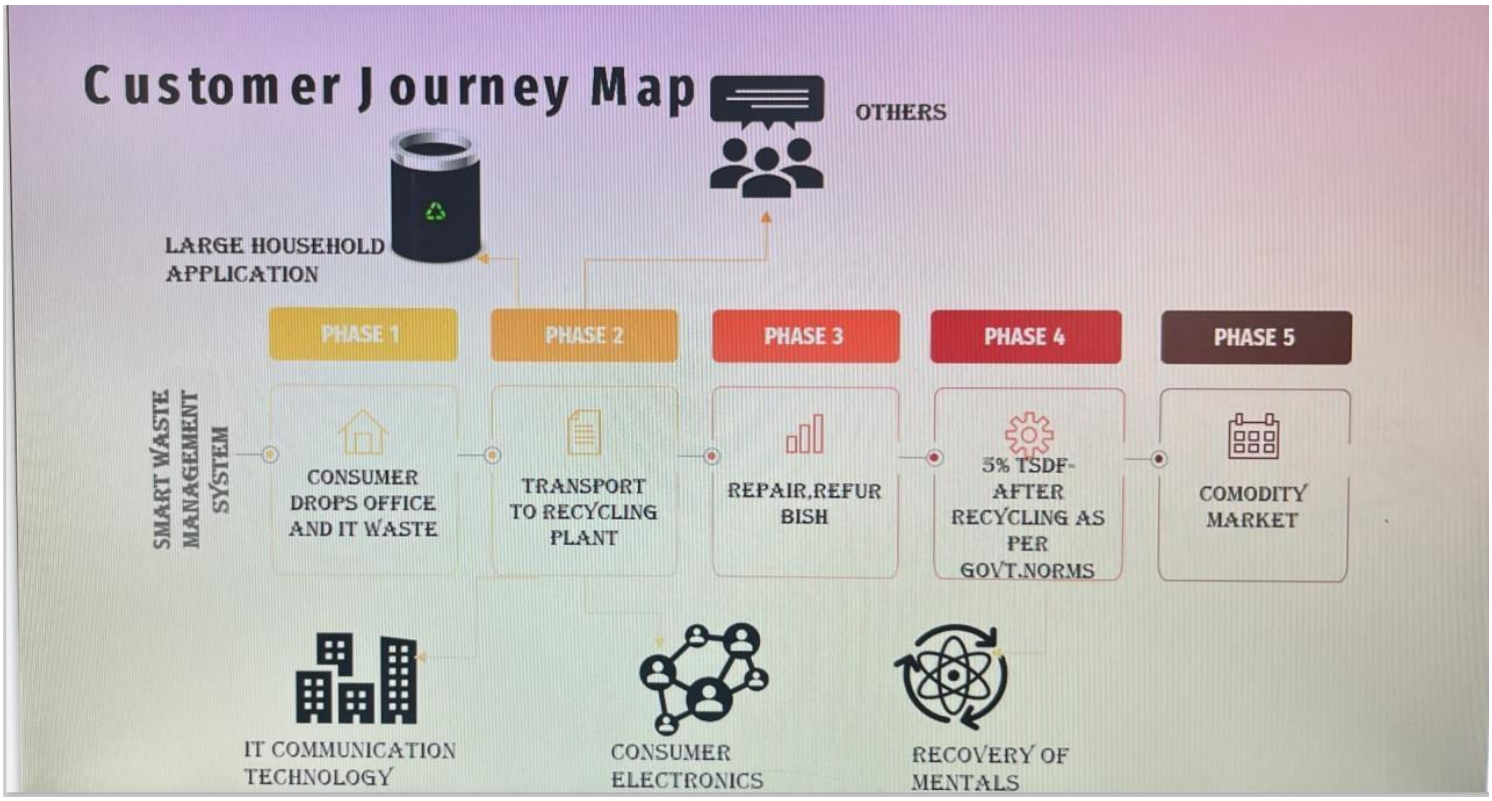


5.2 SOLUTION & TECHNICAL ARCHITECTURE




Garbage bin
nRF24L01
Ultrasonic sensor
Arduino UNO
Webpage
Laser sensor
Servo motor
GSM module
SMS Notification

5.3 USERS TORIES



CHAPTER 6

PROJECT PLANNING ANDSCHEDULING

2.1 ARDUINOUNO

Arduino is an open Source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware(called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package. The Arduino is a microcontroller board based on the ATmega8. It has 14 digital - input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the micro controller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or batterytogetstarted.

From all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the At mega 16U2 (At mega 8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2HWB line to ground, making it easier to put into DFU mode. Revision of the board has the following new features:

- Pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin ,the IOREF that allow the shields to adapt to the voltage.

Provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with5V and with the Arduino Due that operateswith3.3V.These condone is a not connected pin that is reserved for future purposes.

- Stronger RESET circuit.
- ATmega16U2replacethe8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and there reference model for the Arduino platform.

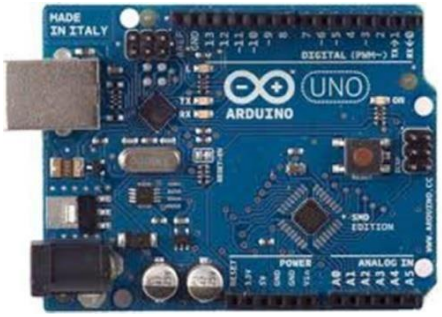


Figure2:ARDUINOUNOBOARD

Parameters For Arduino UNO Description

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage(recommended)	7-12V
Input Voltage(limits)	6-20V
Digital I/O Pins	14
Analog Input Pins	6
DC Current per I/O Pin	40mA
DCCurrentfor3.3VPin	50mA

Flash Memory	32KB(ATmega328)ofwhich0.5KBused by Bootloader
SRAM	2KB(ATmega328)
EEPROM	1KB(ATmega328)
Clock Speed	16MHz

Length	68.6mm
Width	53.4mm
Weight	53g m

Table1.SpecificationsofArduino

2.2 HC-SR04 ULTRA SONIC SENSOR.

HC

SR04 isanultrasonicsensorwhichisusedformeasuringthedistancebetweenthetopofthe lid to the top of the garbage.

PINNUMBER	PINNAME	DESCRIPTION
1.	VCC	TheVccpinpowersthesensor,typicallywith+5V
2.	Trigger	Trigger pin is an Input pin. This pin has to be kept high for10ustoinitializemeasurementbysendingUSwe
3.	Echo	Echo pin is an Output pin. This pin goes high Period of time which will be equal to the time taken
4.	GND	For the US wave to return back to the sensor. This pin is connected to the Ground of the system.

HC-SR04SENSORFEATURES

- Operating voltage:+5V
- TheoreticalMeasuringDistance:2cmto450cm
- Accuracy:3mm
- Measuring angle covered: <15°
- Operating Current: <15ma
- OperatingFrequency:40Hz

2.2.3 ULTRASONIC SENSOR WORKING

The **HC-SR04 Ultrasonic (US) sensor** isa 4 pin module, whose pin names are Vcc , Trigger, Echo and Ground respectively. This sensor is a very popular sensor use in many applications where measuring distance or sensing objects are required. The module hast wo eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that is

$$\text{Distance} = \text{Speed} \times \text{Time}$$

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 sensorthis reflected wave is observed by the Ultrasonic receiver module. Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

:HCSR04 ULTRASONIC SENSOR

2.3 GSM MODULE.

GSM/GPRS module is used to establish communication between a computer and a **GSM-GPRS system**. **Global System for Mobile communication (GSM)** is anarchitecture used for mobile communication in most of the countries. **GlobalPacket Radio Service (GPRS)** isan extension of GSM that enables higher data transmission rate. **GSM/GPRS module consists of a**

GSM/GPRS mode assembled together with power supply circuit and communic ation interfaces (like RS-232, USB, etc) for computer. GSM/GPRS MODEM is a class of wireless MODEM devices that are designed for communication of a computer with the GSM and GPRS network. It requires a **SIM(Subscriber Identity Module)** card just like mobile phones to activate communication with the network. Also they have **IMEI** (International Mobile Equipment Identity) number similar to mobile phonesfor their identification. A GSM/GPRSMODEM can performthe following operations:

1. Receive, sender delete SMS messages in a SIM.
2. Read, add, search phonebook entries of the SIM.
3. Make, Receive, orrejecta voice

call.The MODE M needs

ATcommands,forinteractingwithprocessororcontroller,whicharecommunicatedt

hroughserialcommunication.Thesecommandsaresentbythecontroller/processor.

The MODEM sends back a result after it receives a command. Different

ATcommandssupportedbytheMODEMcanbesentbytheprocessor/controller/comp

uter to interact with the **GSM and GPRS cellular network**.

AGSM modem is a wireless modem that works with a GSMwireless network. A wireless modem behaves like a dial-up modem. The main difference between the mis that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives datathrough radio waves.

A GSM modem can be an external device or a PC Card / PCMCIA

Typically an external PC Card/PC MCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card /PCMCIA Card slots of a laptop computer. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

ASIM card contains the followinginformation:

- Subscribertelephonenumber(MSIS)
- Internationalsubscribernumber(**IMSI,InternationalMobileSubscriberIdentity)**
- StateoftheSIMcard
- Servicecode(operator)
- Authenticationkey

- PIN(*Personal Identification Code*)
- PUK(*Personal Unlock Code*)

ComputersuseATcommandstocontrolmodems.BothGSMmodemsanddial-upmodems support a common set of standard AT commands. In addition to the standardAT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the extended AT commands, the following operations can be performed:

- Reading, writing and deleting SMS messages.
- Sending SMS messages.
- Monitoring the signal strength.
- Monitoring the charging status and charge level of the battery.
- Reading, writing and searching phone book entries.

Figure4:GSM MODULE

BATTERY:

The nine-volt battery format is commonly available in primary carbon-zinc and alkaline chemistry, in primary lithium iron disulfide, and in rechargeable form in nickel-cadmium, nickel-metal hydride and lithium-ion. Mercury-oxide batteries of this format, once common, have not been manufactured in many years due to their mercury content. .

Battery

Connectors:

Connectors

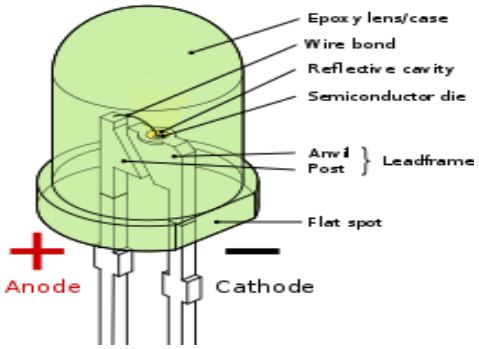
The battery has both terminals in a snap connector on one end. The smaller circular (male) terminal is positive, and the larger hexagonal or octagonal (female) terminal is the negative contact. The connectors on the battery are the same as on the

connector itself; the smaller one connects to the larger one and vice versa.

4.8 LED:

Fig 4.13: LED

Fig 4.14: LED pin diagram



A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode that emits light when activated. When a suitable current is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. LEDs are typically small (less than 1 mm2) and integrated optical components may be used to shape the radiation pattern.

Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared light. Infrared LEDs are still frequently used as transmitting elements in remote-control circuits, such as those in remote controls for a wide variety of consumer electronics. The first visible-light LEDs were of low intensity and limited to red. Modern LEDs are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

Early LEDs were often used as indicator lamps for electronic devices, replacing small incandescent

were soon packaged into numeric readouts in the form of seven-segment displays and were commonly seen in digital clocks. Recent developments have produced LEDs suitable for environmental and task lighting. LEDs have led to new displays and sensors, while their high switching rates are useful in advanced communications technology.

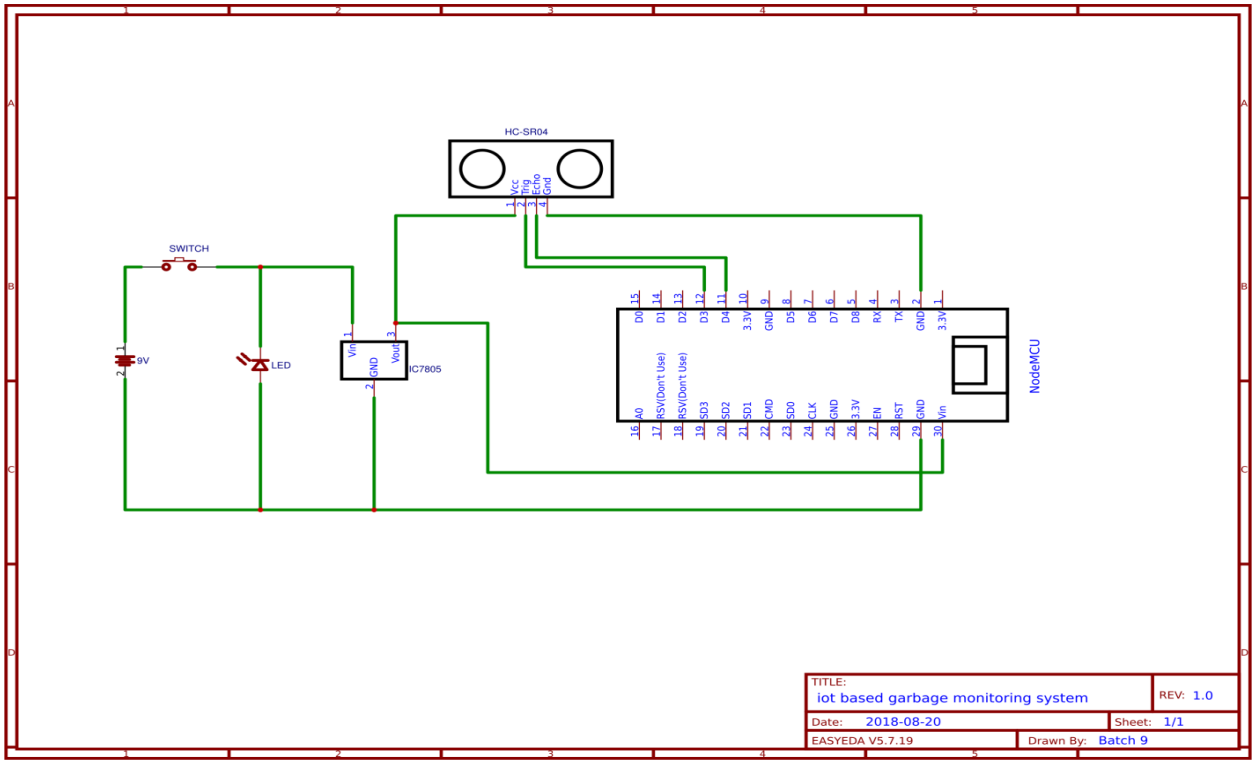
LEDs have many advantages over incandescent light sources, including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. Light-emitting diodes are used in applications as diverse as aviation lighting, automotive headlamps, advertising, general lighting, traffic signals, camera flashes, lighted wallpaper and medical devices. They are also significantly more energy efficient and, arguably, have fewer environmental concerns linked to their disposal

Unlike a laser, the color of light emitted from an LED is neither coherent nor monochromatic, but the spectrum is narrow with respect to human vision, and for most purposes the light from a simple diode element can be regarded as functionally monochromatic.

CHAPTER 5

CONSTRUCTION AND DESIGN

5.1 DESIGN OF THE IOT BASED GARBAGE MONITORING SYSTEM:



5.2 STEPS IN THE CONSTRUCTION OF THE SMART GARBAGE BIN:

- The Ultrasonic-sensor is connected to the Node-MCU with the help of the jumper wires.
- The trigger pin and echo pin of the ultrasonic-sensor is connected to pins D3 and D4 of Node-MCU which output and input pins.
- A 9v battery is use as a power source. This battery supplies power to the whole circuit via a switch and a IC7805 voltage regulator.
- The positive terminal for the battery is connect to the switch and the negative terminal acts as a common ground.
- From the other end of the switch a wire is connected to the IC7805 voltage regulator's input terminal. And the ground pin of the regulator is connect to the common ground where the negative terminal of the battery is connected.
- Form the output pin of the regulator a regulated voltage of 5v is drawn with the help of a jumper. Now this used for powering both the Node-MCU and ultrasonic-sensor.
- The wire which is drawn from the output pin is connect to the Vin of the Node-MCU and the ground of the Node-MCU is connect to the common ground.

- The Vcc pin of the ultrasonic sensor is connect to the output pin of the regulator. And the ground is connect to the common ground.
- After the formation of the circuit an algorithm is designed for the interfacing of Node-MCU and Ultrasonic sensor.
- From the algorithm an embedded c program is written in Node-MCU IDE and then the code is uploaded to the Node-MCU.

5.3 WORKING OF THE PROJECT:

Each bin is connected with a complete circuit of Node-MCU, Ultrasonic-sensor, IC7805 voltage regulator, 9v battery, switch and a led.

- When the circuit is powered the Node-MCU starts receiving data from the ultrasonic sensor.
- Ultrasonic sensors use sound to determine the distance between the sensor and the closest object in its path.
- The sensor sends out a sound wave at a specific frequency. It then listens for that specific sound wave to bounce off of an object and come back.
- The sensor keeps track of the time between sending the sound wave and the sound wave returning. If you know how fast something is going and how long it is traveling you can find the distance traveled with the help of the formula $d=v \times t$.
- The HCSR04 can be triggered to send out an ultrasonic burst by setting the TRIG pin to HIGH. Once the burst is sent the ECHO pin will automatically go HIGH. This pin will remain HIGH until the burst hits the sensor again.
- This whole procedure is controlled by the Node-MCU which is set by a predefined values.
- When the ultrasonic sensor is calculated the distance (the level of the bin) this data is send to the Node-MCU.
- The Node-MCU then sends this data to the database(in this case its firebase).
- This data is then updated into their particular fields.
- Then this data is send to the hosting server which shows the status of bins in a webpage.
- This webpage is automatically updated for every 20 seconds showing the status of the bins.

CHAPTER 7

RESULTS

The following are the results which are obtained from this work.

- Waste level detection inside the dustbin.
- Transmit the information wirelessly to concern.
- The data can be accessed any time and from anywhere.
- The real time data transmission and access.
- Avoids the overflow of the dustbin.

This waste management system using IoT is very useful for smart cities in diverse aspects. In the cities there are dissimilar dustbins located in different areas and dustbins become over flown many times and the concerned people do not get info about this. This system is designed to crack this issue and will offer complete details of the dustbins located in different areas throughout the city. The allocated authority can access the information from anywhere and anytime to get the details. Accordingly they can renew the decision on this immediately.

CHAPTER 8

CODING&SOLUTIONING

Code

```
#include<WiFi.h>                                  // library for wifi
#include<PubSubClient.h>                           // library for MQTT
#include<LiquidCrystal_I2C.h>
#include<mjson.h>
LiquidCrystal_I2C lcd(0x27, 20, 4);

//---------------------- credentials of IBM Accounts ------------------------------

#define ORG "9gbe4w"
#define DEVICE_TYPE "SWMSMC"                  // Device type mentioned in ibm watson
iot platform
#define DEVICE_ID "ibmproject"                // Device ID mentioned in ibm watson iot
platform
#define TOKEN "sUNA41tG6-Pq)0rk5X"            // Token

//---------------------- customise above values ----------------------------------
-----------------

char server[] = ORG ".messaging.internetofthings.ibmcloud.com";                //
server name
char publishTopic[] = "iot-2/evt/data/fmt/json";                               //
topic name and type of event perform and format in which data to be send
char topic[] = "iot-2/cmd/led/fmt/String";                                     // cmd
Represent type and command is test format of strings
char authMethod[] = "use-token-auth";                                          //
authentication method
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;                     //Client
id

//-------------------------------------------------------------------------------
--------------------------------

WiFiClient wifiClient;                                                        //
creating instance for wificlient
```

```
PubSubClient client(server, 1883, wifiClient);

#define ECHO_PIN 12
#define TRIG_PIN 13
float dist;
String data3;
voidsetup()
{
  Serial.begin(115200);
  pinMode(LED_BUILTIN, OUTPUT);
  pinMode(TRIG_PIN, OUTPUT);
  pinMode(ECHO_PIN, INPUT);
  //pir pin
  pinMode(34, INPUT);

  //ledpins
  pinMode(23, OUTPUT);
  pinMode(2, OUTPUT);
  pinMode(4, OUTPUT);
  pinMode(15, OUTPUT);


  lcd.init();
  lcd.backlight();
  lcd.setCursor(1, 0);
  lcd.print("");
  wifiConnect();
  mqttConnect();
}

float readcmCM()
{
  digitalWrite(TRIG_PIN, LOW);
  delayMicroseconds(2);
  digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG_PIN, LOW);
  int duration = pulseIn(ECHO_PIN, HIGH);
  return duration * 0.034 / 2;
}

voidloop()
 {

  lcd.clear();
```

```
  publishData();
  delay(500);
  if (!client.loop())
    {
      mqttConnect();                                    // function call to connect
to IBM
    }
}


/* ------------------------------retrieving to cloud----------------------------
----------------------*/

void wifiConnect()
{
  Serial.print("Connecting to ");
  Serial.print("Wifi");
  WiFi.begin("Wokwi-GUEST", "", 6);
  while (WiFi.status() != WL_CONNECTED)
    {
      delay(500);
      Serial.print(".");
    }
  Serial.print("WiFi connected, IP address: ");
  Serial.println(WiFi.localIP());
}
void mqttConnect()
  {
    if (!client.connected())
      {
        Serial.print("Reconnecting MQTT client to ");
        Serial.println(server);
        while (!client.connect(clientId, authMethod, token))
          {
            Serial.print(".");
            delay(500);
          }
        initManagedDevice();
        Serial.println();
      }
  }
void initManagedDevice()
  {
    if (client.subscribe(topic))
      {
        Serial.println("IBM subscribe to cmd OK");
      }
```

```
    else
      {
        Serial.println("subscribe to cmd FAILED");
      }
  }
void publishData()
{
  float cm = readcmCM();

  if(digitalRead(34))                                    //pir motion detection
  {
    Serial.println("Motion Detected");
    Serial.println("Lid Opened");
    digitalWrite(15, HIGH);



 if(digitalRead(34)== true)
 {
  if(cm <= 60)                                                  //Bin level detection
  {
    digitalWrite(2, HIGH);
    Serial.println("High Alert!!!,Trash bin is about to be full");
    Serial.println("Lid Closed");
    lcd.print("Full! Don't use");
    delay(2000);
    lcd.clear();
    digitalWrite(4, LOW);
    digitalWrite(23, LOW);
  }
  elseif(cm >60&& cm <120)
  {
    digitalWrite(4, HIGH);
    Serial.println("Warning!!,Trash is about to cross 50% of bin level");
    digitalWrite(2, LOW);
    digitalWrite(23, LOW);

  }
  elseif(cm >120)
  {
    digitalWrite(23, HIGH);
    Serial.println("Bin is available");
    digitalWrite(2,LOW);
    digitalWrite(4, LOW);

  }
```

```
    delay(10000);
    Serial.println("Lid Closed");
 }
 else
 {
   Serial.println("No motion detected");
    digitalWrite(2, LOW);
    digitalWrite(15, LOW);
    digitalWrite(4, LOW);
    digitalWrite(23, LOW);
 }


}
  else
  {
    digitalWrite(15, LOW);

  }


  if(cm <= 60)
{
digitalWrite(21,HIGH);
String payload = "{\"High_Alert\":";
payload += cm;
payload += " }";
Serial.print("\n");
Serial.print("Sending payload: ");
Serial.println(payload);

if (client.publish(publishTopic, (char*) payload.c_str()))         // if data is
uploaded to cloud successfully,prints publish ok else prints publish failed
{
Serial.println("Publish OK");
}
}
elseif(cm <= 120)
{
digitalWrite(22,HIGH);
String payload = "{\"Warning\":";
payload += cm ;
payload += " }";
Serial.print("\n");
Serial.print("Sending payload: ");
Serial.println(payload);
if(client.publish(publishTopic, (char*) payload.c_str()))
```

```
{
Serial.println("Publish OK");
}
else
{
Serial.println("Publish FAILED");
}
}
else
{
digitalWrite(23,HIGH);
String payload = "{\"Safe\":";
payload += cm;
payload += " }";
Serial.print("\n");
Serial.print("Sending payload: ");
Serial.println(payload);

if (client.publish(publishTopic, (char*) payload.c_str()))         // if data is
uploaded to cloud successfully,prints publish ok else prints publish failed
{
Serial.println("Publish OK");
}

}

  float inches = (cm / 2.54);                                      //print on lcd
  lcd.setCursor(0,0);
  lcd.print("Inches");
  lcd.setCursor(4,0);
  lcd.setCursor(12,0);
  lcd.print("cm");
  lcd.setCursor(1,1);
  lcd.print(inches, 1);
  lcd.setCursor(11,1);
  lcd.print(cm, 1);
  lcd.setCursor(14,1);
  delay(1000);
  lcd.clear();
}

//handles commands from user side
void callback(char* subscribetopic, byte* payload, unsignedint payloadLength)
{

  Serial.print("callback invoked for topic: ");
```

```
  Serial.println(subscribetopic);
  for (int i = 0; i < payloadLength; i++) {

    data3 += (char)payload[i];
  }
  Serial.println("data: "+ data3);

  constchar *s =(char*) data3.c_str();
  double pincode = 0;


        constchar *buf;
        int len;

        if (mjson_find(s, strlen(s), "$.command", &buf, &len))  // And print it
        {

          String command(buf,len);
          if(command=="\"Seal Bin\"")
          {
            Serial.println("Sealed");

          }


          }









  data3="";
 }
```

Diagram.json

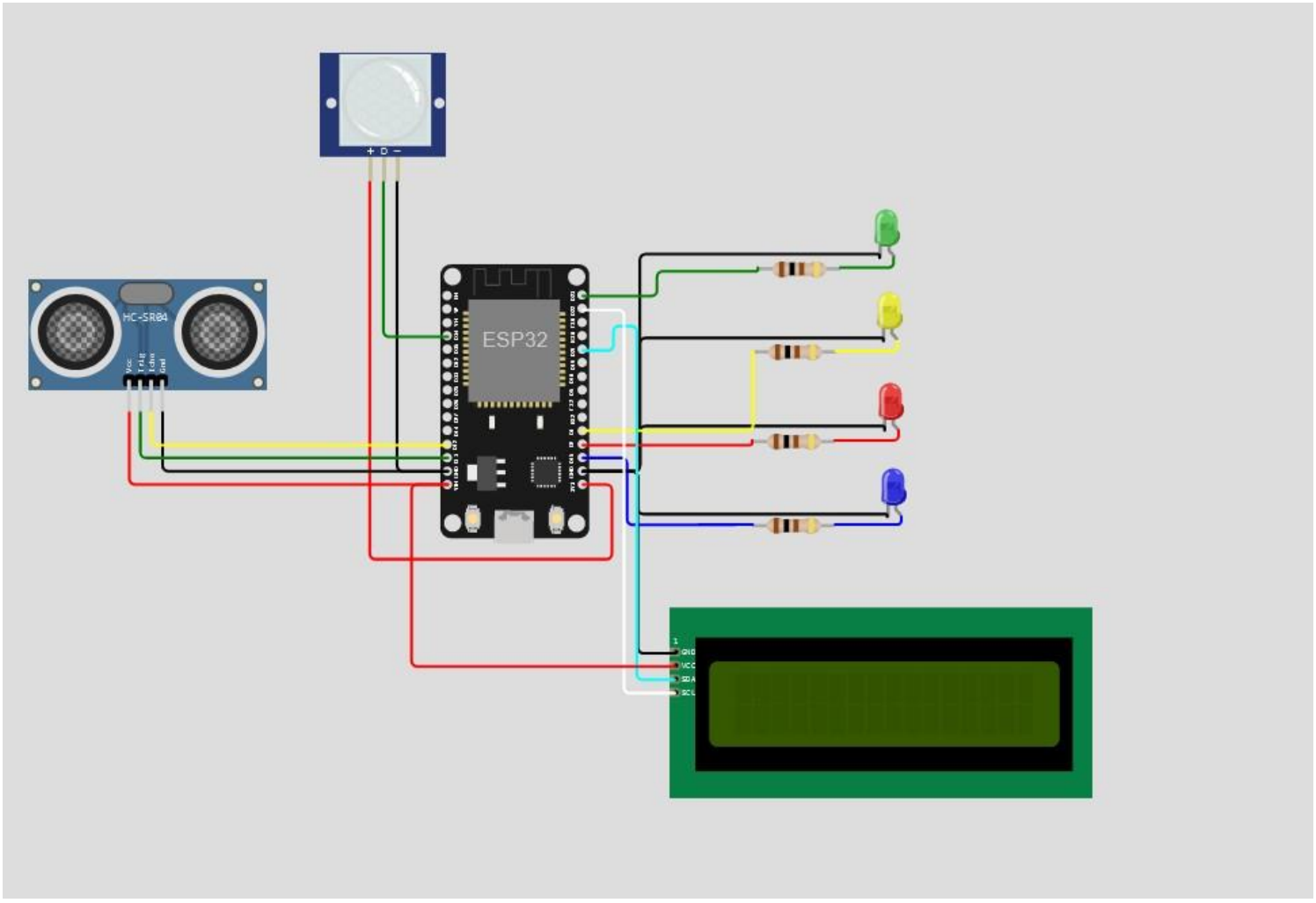
```
{
  "version":  1,
  "author": "Uri Shaked",
  "editor": "wokwi",
  "parts": [
    { "type": "wokwi-esp32-devkit-v1", "id": "esp", "top": 1.29, "left": -1.29, "attrs": {} },
```

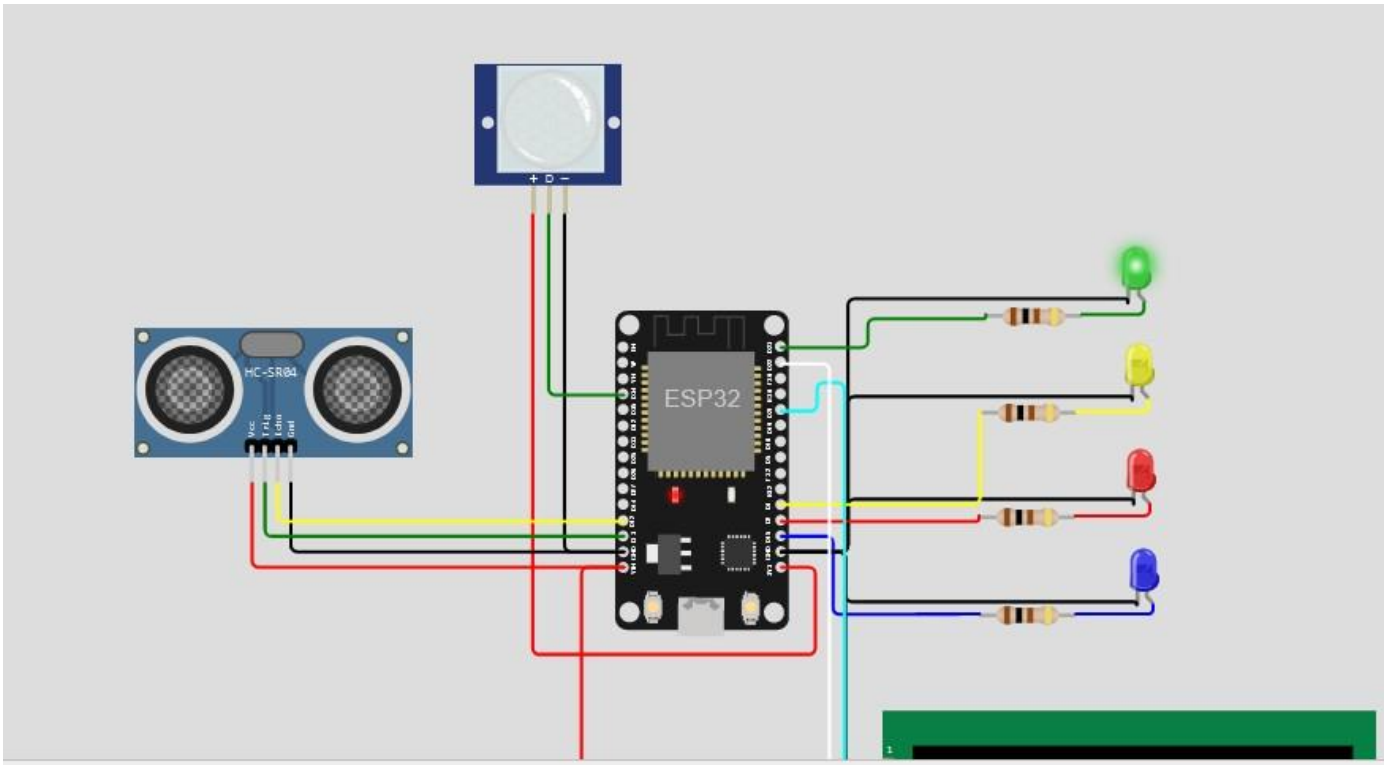
```
{
  "type": "wokwi-led",
  "id": "led1",
  "top": -43.97,
  "left": 296.62,
  "attrs": { "color": "limegreen" }
},
{
  "type": "wokwi-led",
  "id": "led2",
  "top": 15.48,
  "left": 299.36,
  "attrs": { "color": "yellow" }
},
{
  "type": "wokwi-led",
  "id": "led3",
  "top": 140.83,
  "left": 302.1,
  "attrs": { "color": "blue" }
},
{
  "type": "wokwi-led",
  "id": "led4",
  "top": 79.19,
  "left": 300.24,
  "attrs": { "color": "red" }
},
{
  "type": "wokwi-resistor",
  "id": "r1",
  "top": -3.9,
  "left": 224.81,
  "attrs": { "value": "100" }
},
{
  "type": "wokwi-resistor",
  "id": "r2",
  "top": 55.55,
  "left": 221.42,
  "attrs": { "value": "100" }
},
{
  "type": "wokwi-resistor",
  "id": "r3",
  "top": 179.36,
```

```
    "left": 221.1,
    "attrs": { "value": "100" }
  },
  {
    "type": "wokwi-resistor",
    "id": "r4",
    "top": 119.28,
    "left": 220.77,
    "attrs": { "value": "100" }
  },
  {
    "type": "wokwi-lcd1602",
    "id": "lcd1",
    "top": 248.08,
    "left": 161.61,
    "attrs": { "pins": "i2c" }
  },
  {
    "type": "wokwi-hc-sr04",
    "id": "ultrasonic1",
    "top": 13.99,
    "left": -295.33,
    "attrs": { "distance": "170" }
  },
  {
    "type": "wokwi-pir-motion-sensor",
    "id": "pir1",
    "top": -147.86,
    "left": -88.23,
    "attrs": {}
  }
],
"connections": [
  [ "esp:TX0", "$serialMonitor:RX", "", [] ],
  [ "esp:RX0", "$serialMonitor:TX", "", [] ],
  [ "led1:A", "r1:2", "green", [ "v0" ] ],
  [ "led2:A", "r2:2", "yellow", [ "v0" ] ],
  [ "led4:A", "r4:2", "red", [ "v0" ] ],
  [ "led3:A", "r3:2", "blue", [ "v0" ] ],
  [ "led1:C", "esp:GND.1", "black", [ "v-2.56", "h-170.98", "v116.48" ] ],
  [ "led2:C", "esp:GND.1", "black", [ "v-2.24", "h-173.72", "v91.96" ] ],
  [ "led4:C", "esp:GND.1", "black", [ "v-3.11", "h-174.6", "v27.59" ] ],
  [ "led3:C", "esp:GND.1", "black", [ "v-1.92", "h-177.99", "v-32.18" ] ],
  [ "r1:1", "esp:D23", "green", [ "v2.63", "h-71.91", "v19.92" ] ],
  [ "r3:1", "esp:D15", "blue", [ "v0.22", "h-89.65", "v-53.64" ] ],
  [ "lcd1:GND", "esp:GND.1", "black", [ "h-26.5", "v-129.82" ] ],
```

```
    [ "pir1:VCC", "esp:3V3", "red", [ "v268.96", "h172.77", "v-55.17" ] ],
    [ "pir1:GND", "esp:GND.2", "black", [ "v0" ] ],
    [ "pir1:OUT", "esp:D34", "green", [ "v0" ] ],
    [ "ultrasonic1:GND", "esp:GND.2", "black", [ "v0" ] ],
    [ "ultrasonic1:ECHO", "esp:D12", "yellow", [ "v0" ] ],
    [ "ultrasonic1:TRIG", "esp:D13", "green", [ "v0" ] ],
    [ "ultrasonic1:VCC", "esp:VIN", "red", [ "v0" ] ],
    [ "r4:1", "esp:D2", "red", [ "v0" ] ],
    [ "r2:1", "esp:D4", "yellow", [ "v0" ] ],
    [ "lcd1:SDA", "esp:D21", "cyan", [ "h-27.12", "v-252.33", "h-16.71", "v17.15" ] ],
    [ "lcd1:SCL", "esp:D22", "white", [ "h-36.27", "v-3.67" ] ],
    [ "lcd1:VCC", "esp:VIN", "red", [ "h-187.87", "v-129.69" ] ]
  ]
}
```

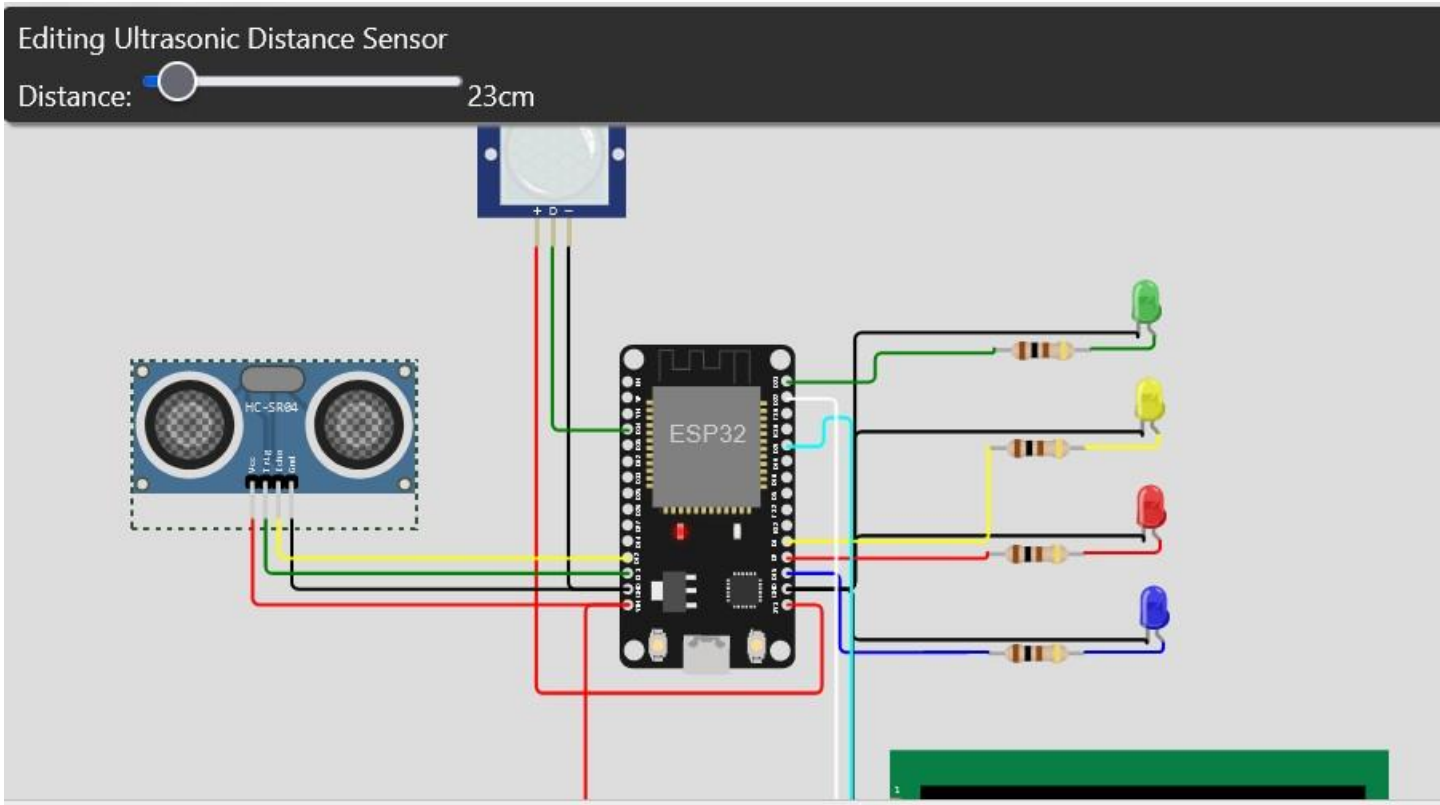
SOLUTION






```
Connecting to Wifi...WiFi connected, IP address: 10.10.0.2
Reconnecting MQTT client to 9gbe4w.messaging.internetofthings.ibmcloud.com
IBM subscribe to cmd OK


Sending payload: {"Safe":169.95 }
Publish OK
```




```
Publish OK

Sending payload: {"High_Alert":22.95 }
Publish OK

Sending payload: {"High_Alert":22.95 }
Publish OK
```

CHAPTER10
ADVANTAGES&DISADVANTAGES

ADVANTAGES

- Very simple circuit.
- Helps monitor the garbage levels.
- Uses very small amount of electricity.
- Ultimately help in better planning of garbage pickups.
- Can help in reducing over flowing bins. Reduce strips to areas where the bins still have alot of capacity.

DISADVANTAGES

- Cannot detect liquid waste.
- Only detects the top of the garbage level .It wouldn’t realize if there is space left.

CHAPTER 11
CONCLUSION

We built an efficient garbage monitoring system which can be used to monitor the level of garbage in the dump.This data can be further used to plan garbage collection trips more efficiently,ultimately reducing over flowing bins and helping have better public sanitation.

CHAPTER 12
FUTURE SCOPE

CONCLUSION AND FUTURE SCOPE

The ultimate objective of this study was to use the results obtained from understanding the existing procedures in waste management in a reflective manner, in order to improve the current scenario of waste management not only in the urban areas but to be able to spread it to the rural areas. This has to be built more along the lines of making it a habit that is required. It is said that the necessity is the mother of invention. Hence in the deep crisis of waste management that the country faces today, this is a viable and a much needed requirement to be able to cope with the rising waste in this nation. There are many campaigns that have taken shape such as the Swachh Bharat campaign.

This system caters to automate the most basic and very important service in buildingwaste management system using IoT which monitors garbage levels continuously. Therefore this system needs to be very efficient and perform seamlessly without much delay also smoothly without many deviations. For this it is important to keep the logical part of the system as simple as possible and also consider all cases while designing and testing.

The IoT Garbage monitoring system pays a lot towards clean and disinfected pollution less environment in building a smart city. As these technology is new in India there should be appropriate consciousness and alertness among the public before the operation of this technology.

Otherwise, sensitive devices like sensors might be spoiled due to rough action of the users. It is an automatic dust bin monitoring system in order to sense the full condition of the garbage bins. This provides the authorized users appropriate updates of

the location of the garbage bins and thus eliminates the need of intermittent manual checks and overflowing garbage bins. This method finally helps in keeping the environment clean. Thus, the garbage collection is made more efficient, effective and operative.