SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES

IBM NALAIYATHIRAN (HX8001)
PROJECT REPORT

Submitted by

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BACHELOR OF ENGINEERING

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RAJALAKSHMI INSTITUTE OF TECHNOLOGY

ANNA UNIVERSITY: CHENNAI 600 025

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Contents

INTRODUCTION:

The amount of waste produced everyday by the industries and the households is increasing at an appalling rate, and the major reason for this is soaring use of packaged items, textiles, paper, food, plastics, metals, glass etc, thus management of this refuse becomes a crucial part in our everyday life.in most of the developed countries there are many efficient techniques which are used for the proper management of this waste, but in some countries especially the developing ones the careless attitude of people towards maintaining clean surroundings, along with this many issues such as no stringent laws for using the biodegradable materials, no proper environ policies ,no laws for sustainable development are the seed for the fatal results of waste management. Due to the increasing waste, the public bins which are used for collecting this waste are overflowing, the locality is jumbled of trash, causing not only malodorous streets but also a negative impact on the health and environment.

Waste is a crucial issue, which needs to be addressed smartly. we segregate the waste at our homes for ease at processing and recycling. We observed trash vans come irregular to homes creating a despoliation of households. Due to this many civilians empty their overloaded dustbins in open spaces. This in turn increases environmental pollution.

The waste is a great hassle for our health and the environment it has many effects which are dreadful. Trash is breeding ground for bacteria, insects, flies these flies are the same that roam around the eatable and drop the off springs. thus they increase the risk with food poisoning, typhoid, gastroentetritis, salmonella, the insects cause malaria dengue etc, beside these flies and insects other animals that prosper from the trash are the rats and the stray dogs spreading diseases , the garbage also causes various respiratory diseases the toxic contaminates such as co2 methane, nitrous oxide beside health issues adversely affect the environment causing air pollution water pollution. Disposal of hazardous waste like the electronic items, plastics in water affect the aquatic life and indirectly the human beings.

Overflowing garbage is also a public hassle and eyesore. Everyone wants to visit fresh clean cities. A malodorous city with trash all around the place does not attract tourist thus loosing the money revenue and the opportunities. As prosperity grows, 62 million tons of garbage is generated everyday by the 377 million people living in urban India, now the world's third largest garbage generator. However, it's not the amount of waste generated that's as much of an issue as the fact that more than 45 million tons, or 3 million trucks worth, of garbage is untreated and disposed of by municipal authorities every day in an unhygienic manner.

1.1.PROJECT OVERVIEW:

1.1.PROJECT REVIEW:

The Internet of Things (IoT) is a concept in which surrounding objects are connected through wired and wireless networks without user intervention. In the field of IoT, the objects communicate and exchange information to provide advanced intelligent services for users. 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 user 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.

With the increasing population and industrialization of nations throughout the globe, waste has become a great concern for all of us. Over years, researchers figured that only waste management is not enough for its proper treatment and disposal techniques to preserve our environment and keeping it clean in this era of globalization. With the help of technology researchers have, introduced IoT based Smart Waste Management solutions and initiatives that ensures reduced amount of time and energy required to provide waste management services and reduce the amount of waste generated. Unfortunately, developing countries are not being able to implement those existing solutions due to many factors like socio-economic environment. Therefore, in this research we have concentrated our thought on developing a smart IoT based waste management system for developing countries like INDIA that will ensure proper disposal, collection, transportation and recycling of household waste with the minimum amount of resources being available.

1.2.PURPOSE:

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.

2.LITERATURE SURVEY:

2.1 EXISTING PROBLEM:

1.https://www.researchgate.net/publication/349099144_IoT-Based_Smart_Solid_Waste_Management_System_A_Systematic_Literature_Review

Day by day the population is rapidly growing and the economic broadening of the country, there is a very vast growth of the waste of management also. There is no actual right way of its solution or proper chain system to track and monitor the waste and disposal system. And cities are getting smart nowadays, but waste is not. Regardless of all the cities, the dustbins and waste are not getting tracked, sometimes the garbage in the bins gets to above the point, where it blemishes outside the garbage pail and open out in whole areas and causes so many health issues to the citizens.

2.

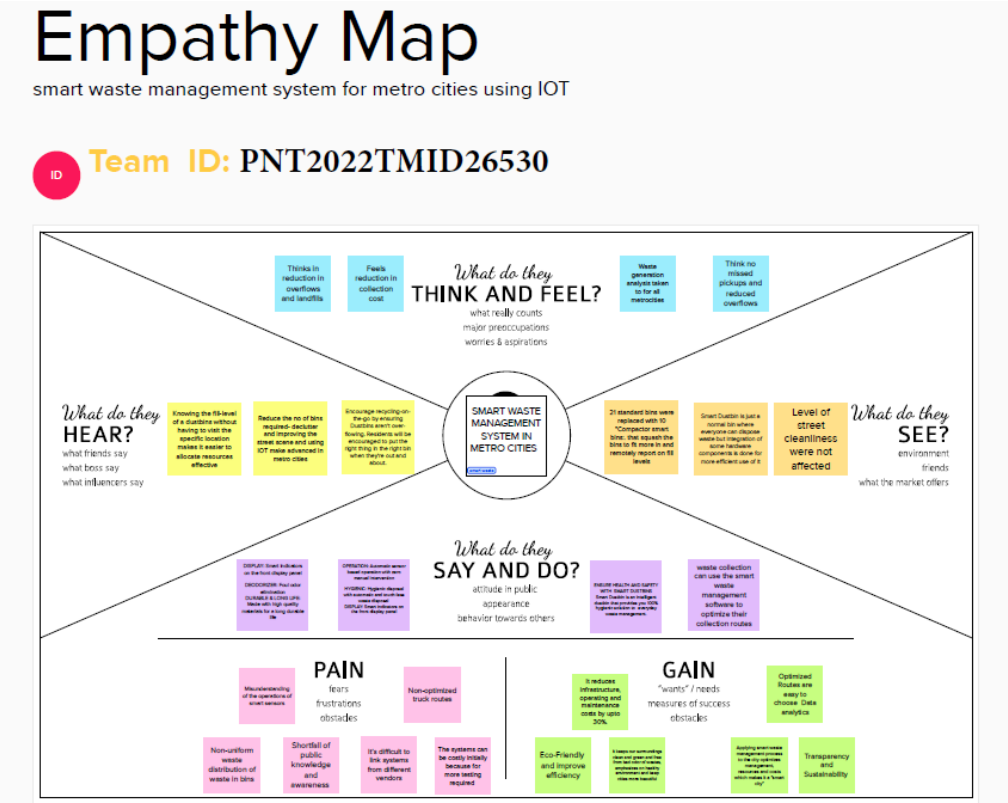
https://www.researchgate.net/publication/320252014_Smart_waste_management_using_Internet_of_Things_A_survey

This paper focuses on how to handle waste in holy sites and makah as a model .During waste management there are three key challenges we face here , small area, short period of time and the increasing of the Pilgrimages' member.The system proposed by them will use sensors inside the container to separate the waste into 4 categories (food, plastics, papers, and metal) and use actuator at a top level to inform the management system to collect the container. The main technologies used and proposed by them was Internet of Thing,Sensor, Big Data.The different sensors used for categorize the waste are Capacitive proximity sensors separate papers and plastic inside the trash can, the metal sensor is used to detect metal,the infrared sensor detects glass.Then after categorizing the waste through GSM/GPRS the Arduino IDE system sends SMS to the waste vehicle through Radio Frequency receiver when the trash can is full.

2.2 REFERENCES:
1.P. Suresh, Vijay. Daniel, R.H. Aswathy, Dr. V. Parthasarathy, “A State-of-the-Art review on Internet of Things” International Conference on Science Engineering and Management Research (ICSEMR), IEEE, DOI: 10.1109/ICSEMR.2014.7043637 19 February 2015.
2. Parkash, Prabu V “IoT Based Waste Management for Smart City” International Journal of Innovative Research in Computer and Communication Engineering, Vol. 4, Issue 2, DOI: 10.15680/IJIRCCE.2016. 0402029, February 2016.
3.Evaluation on the Performance of Urban Domestic Sewage Treatment Plants in China – 201 Dongmei Han; Guojun Song .
4.Teemu Nuortioa, Jari Kyto¨jokib, Harri Niskaa, Olli Bra¨ysyb “Improved route planning and scheduling of waste collection and transport”, Expert Systems with Applications 30 (2006) 223– 232, Elsevier .
5.M. Arebey, M. Hannan, H. Basri, and H. Abdullah, "Solid waste monitoring and management using RFID, GIS and GSM", The IEEE Student Conference on Research and Development (SCOReD), 16-18 November 2009, UPM Serdang, Malaysia, 2009 .

3. IDEATION & PROPOSED SOLUTION:

3.2.EMPATHY MAP:



2.3.IDEATION&BRAINSTOMING
LITERATURE SURVEY

PAPER TITLE	AUTHOR	OUTCOME
IoT Based Smart Garbage System.	1) T.Sinha 2) R.M Sahuother	IoT Based Smart Garbage System which indicates directly that the dustbin is filled to a certain level by the garbage and cleaning or emptying them is a matter of immediate concern. This prevents lumping of garbage in the roadside dustbin which ends up giving foul smell and illness to people. The design of the smart dustbin includes a single by ultrasonic sensor which configured with Arduino Uno with this research ,it is sending SMS to the Municipal Council that particular dustbin is to overflow.
Raspberry pi-based smart waste management system using Internet of Things.	1)Shaik Vaseem Akram 2)Rajesh Singh	Nowadays it is becoming a difficult task to distinguish wet and dry waste. The new waste management system covers several levels of enormous workforce. Every time labourerS must visit the garbage bins in the city area to check whether they are filled or not. The data communicates to the cloud server for real-time

		monitoring of the system. With the real-time fill level information collected via the monitoring platform, the system reduces garbage overflow by informing about such instances before they arrive.

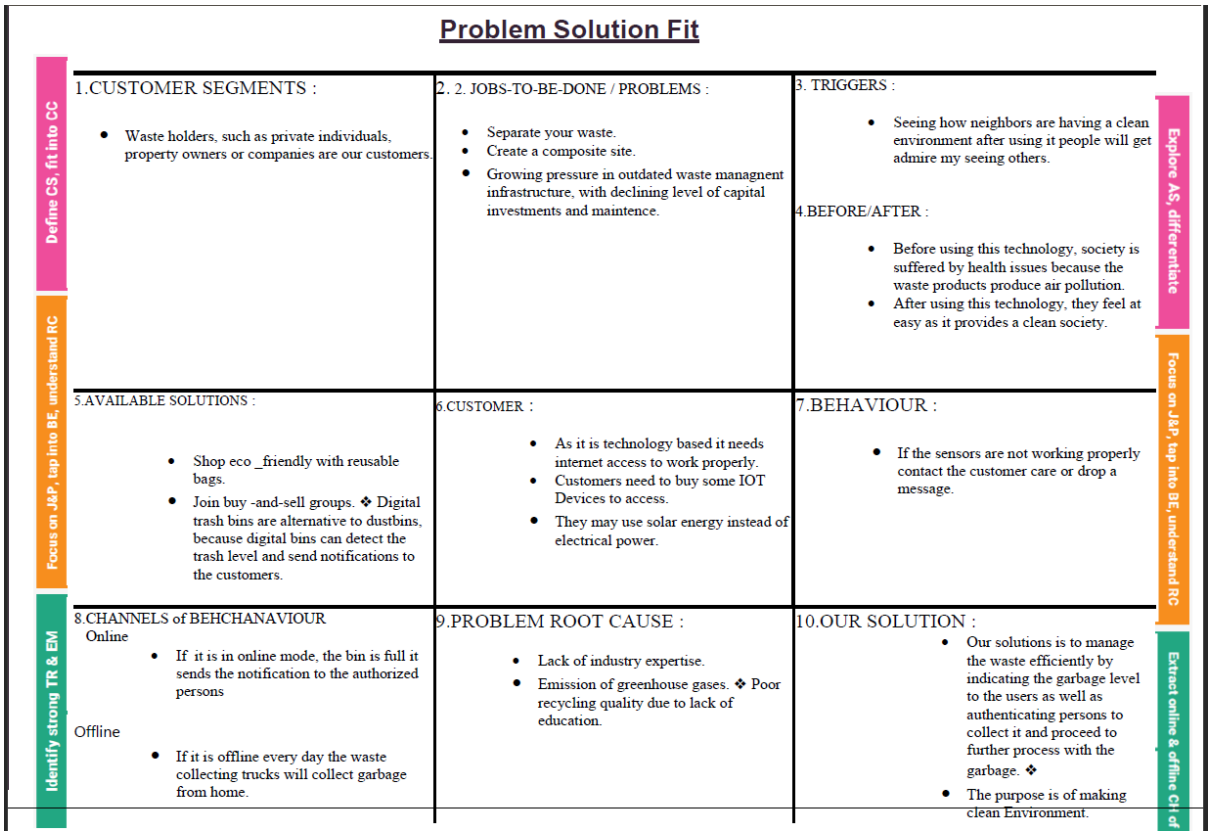
BRAINSTORMING:

3.3PROPOSED SOLUTION:

To solve this problem of wate management for disposal using a smart refuse bin built with technologies like sensors,Arduino ,uno.

S.No	Parameter	Description
1	Problem statement :	• • Rubbish and waste can cause air and water pollution. • • Rotting garbage is also known to produce harmful gases mix with the air and cause breathing problem in people. • • Due to improper waste disposal, we may face several problems like unpleasant odour and health problems.
2	Solution	• • To solve this problem of waste management for disposal using a smart refuse bin built with technologies like Sensors, Arduino Yun. • • Garbage truck Weighing Mechanisms. AI Recycling Robots
3	Uniqueness	• • Identify potential waste streams. • • Create a waste management-focused community outreach plane
4	Social impact	• • Neighbourhood of landfills to communities, breeding of pests and loss in property values. • • The IOT solution uses the data and selects optimum routes for waste collection trucks

PROBLEM SOLUTION FIT:



4.REQUIRED ANALYSIS:

4.1.FUNCTIONAL REQUIREMENT:

Functional Requirements:

Following are the functional requirements of the proposed solution. **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-bin- discharge 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.

4.2.Non-functional Requirements:

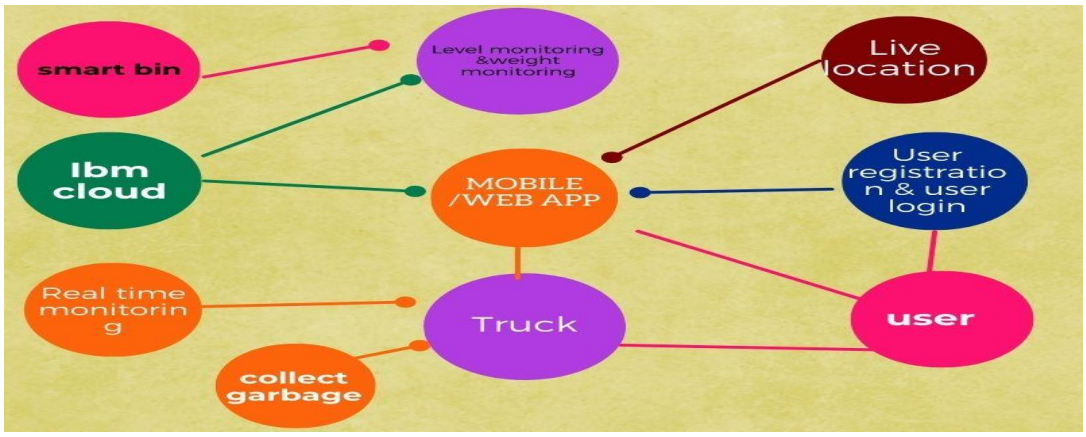
Following are the non-functional requirements of the proposed solution. **FR No.**	**Non-Functional Requirement**	**Description**
NFR-1	**Usability**	IoT device verifies that usability is a special and important perspective to analyze user requirements, which can further improve the design quality. In 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 data- driven 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%.
NFR-5	**Availability**	By developing & deploying resilient hardware and beautiful software we empower cities, businesses, and countries to manage waste smarter.
NFR-6	**Scalability**	Using smart waste bins reduce the number of bins inside town , cities coz we able to monitor the

5.PROJECT DESIGN:

5.1.DATA FLOW DIAGRAM:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the rightamount of the system requirement graphically. It shows how data enters and leaves the system, what changes theinformation, and where data is stored.



5.2.Solution &Technical Architecture:

COMPONENTS:

S.No	Component	Description	Technology
1.	User Interface	Web Portal	HTML,CSS,Node Red, Javascript.o r on
2.	Application Logic-1	To calculate the distance of dreck and show the real time level in web portal , information getting via ultra sonic sensor and the alert message activate with python script to web portal.	Ultrasonic sensor/ Python.
3.	Application Logic-2	To calculate the weight of the garbage and show the real time weight in web portal, this info getting via load cell and the alert message activate with python to web portal.	Load cell/Python.
4.	Application Logic-3	Getting location of the Garbage.	GSM / GPS.
5.	Cloud Database.	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
6.	File Storage	File storage requirements	Github,Local file system.
7.	External API1.	Firebase is a set of hosting services for any type of	Firebase.

TECHNOLOGY:

S.No	Characteristics	Description	Technology
		Ports: micro HDMI 2.0, 3.5mm analogue audiovideo jack, 2x USB 2.0, 2x USB 3.0, Ethernet Dimensions: 88mm x 58mm x 19.5mm, 46g	
4.	Availability	These smart bins use sensors like ultrasonic and load cell to send alert message about the trash level recognition technology, and artificial intelligence, enabling them to automatically sort and categorize recycling litter into one of its smaller bin.	IoT.
5.	Performance	Number of request:RPI manages to execute 129139 read requests per second. Use of Cache:512mb Use of CDN's:Real time	IoT/Web portal.

5.3.USER STORIES:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Primary admin	login	USN-1	As a primary admin , I can manage the webserver	I can access account / dashboard	Medium	Sprint-2
Secondary admin	login	USN-2	As a secondary admin, I can Monitor the trucks	I can access the location	High	Sprint-1
Truck driver	dashboard	USN-3	As a truck driver, I reach to the correct destination to collect the garbage.	I can register & access the location via dashboard	Medium	Sprint-2
Local garbage collector	dashboard	USN-4	As a local garbage collector, I collect the garbage from the bins	I can register & access the location	Medium	Sprint-2

6.PROJECT PLANNING&SCHEDULING:

SPRINT ESTIMATION SCHEDULE:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Login	USN-1	As a Administrator, I need to give user id and passcode for ever workers over there in municipality	10	High	Rithika
Sprint-1	Login	USN-2	As a Co-Admin, I'll control the waste level by monitoring them vai real time web portal. Once the filling happens, I'll notify trash truck with location of bin with bin ID	10	High	Rithika
Sprint-2	Dashboard	USN-3	As a Truck Driver, I'll follow Co-Admin's Instruction to reach the filling bin in short roots and save time	20	Low	Sai Anantha Lakshmi
Sprint-3	Dashboard	USN-4	As a Local Garbage Collector, I'll gather all the waste from the garbage, load it onto a garbage truck, and deliver it to Landfills	20	Medium	Sangamitra
Sprint-4	Dashboard	USN-5	As a Municipality officer, I'll make sure everything is proceeding as planned and without any problems	20	High	Sathish

SPRINT DELIVERY SCHEDULE:

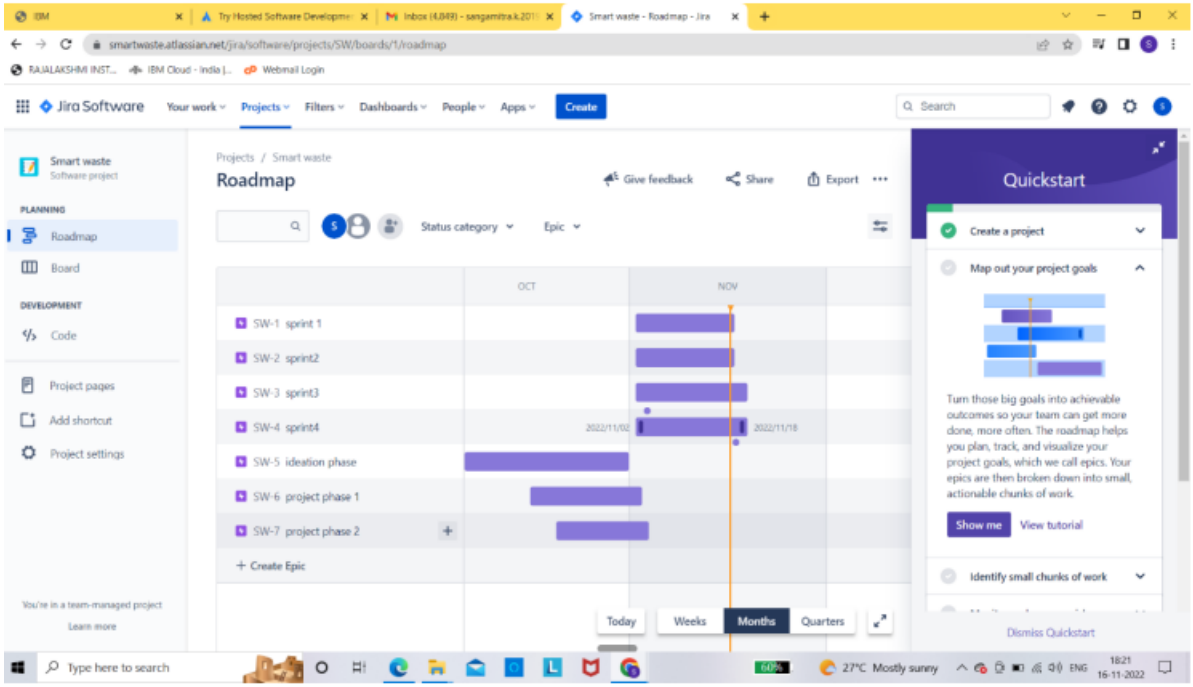
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

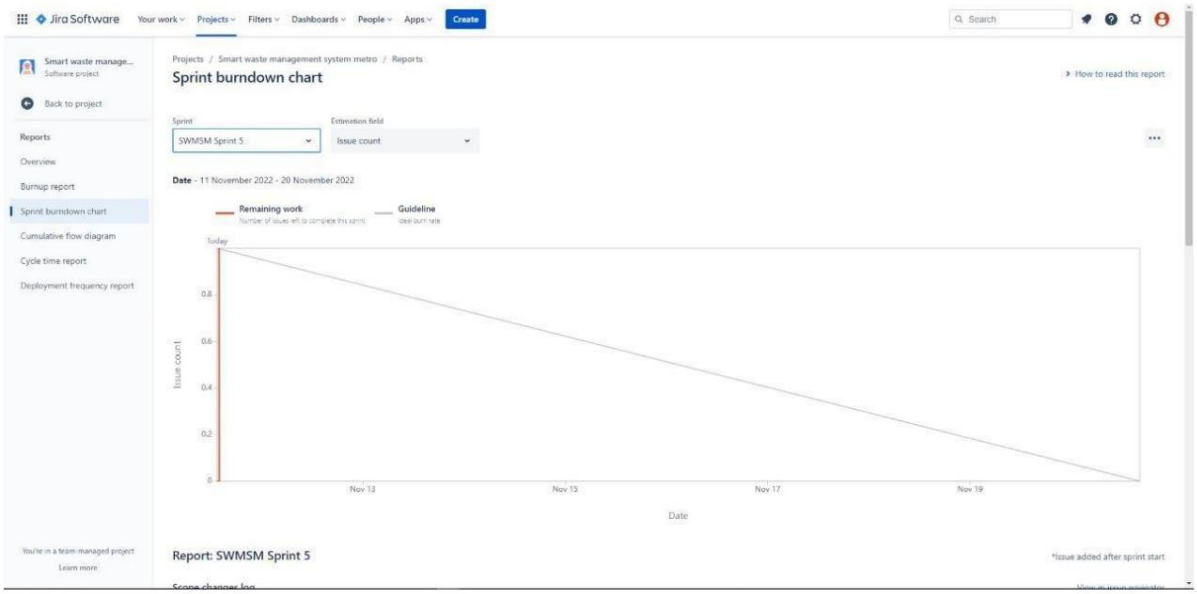
Velocity:

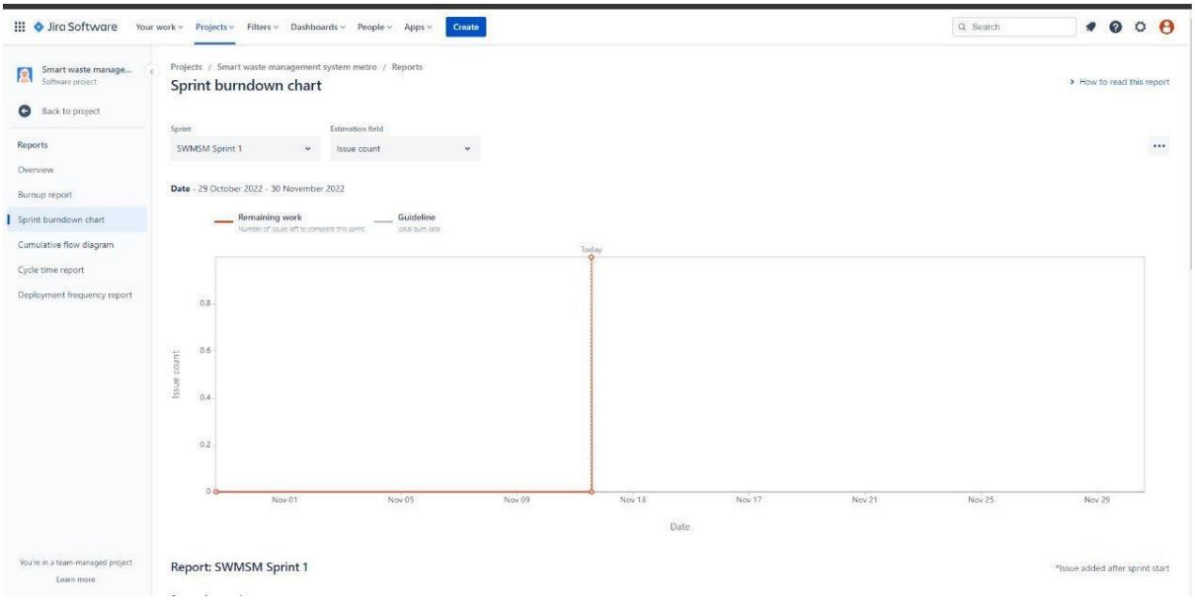
Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day).

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

6.3.REPORTS FROM JIRA:







7.CODING AND SOLUTION:

FEATURE 1:

```
#include
<ESP32Se
rvo.h>
#include
<LiquidC
rystal_I
2C.h>
LiquidCrystal_I2C LCD =
LiquidCrystal_I2C(0x27, 16, 2);
Servo servo;
i
n
t

t
r
i
g
P
i
n
1

=

2
;
```

```
  digitalWrite(trigPin2, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin2, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin2, LOW);
  duration2 = pulseIn(echoPin2, HIGH);
  distance2= duration2*0.034/2;
  Serial.println("The lid is closed");

  }
  LCD.setCursor(0,1);
  LCD.print("Fill Status: ");

  if(distance2>300 && distance2<=400){
    LCD.setCursor(12,1);
    LCD.print("25% ");
    Serial.println("Bin status:25%");
  }
  else if(distance2 > 200 && distance2<= 299){
    LCD.setCursor(12,1);
    LCD.print("50%");
    Serial.println("Bin status:50%");
  }
  else if(distance2 >50 && distance2<=199){
    LCD.setCursor(12,1);
    LCD.print("75%");
    Serial.println("Bin status:75%");
  }
  else{
    LCD.setCursor(12,1);
    LCD.print("100%");
```

```
    LCD.setCursor(12,1);
    LCD.print("100%");
    Serial.println("Bin status:100%");
  }
  if(distance1<=50){
    servo.write(90);
  }
  else{
    servo.write(0);
  }
}
```

7.2.FEATURE 2:

```
#include <WiFi.h>                 //Library for WiFi
#include <PubSubClient.h>         //Library for MQTT
#include <ArduinoJson.h>          //Library for ArduinoJson

WiFiClient wifiClient;



//------------------------------Customise above values---------------------------------------


char server[] = ORG ".messaging.internetofthings.ibmcloud.com";          //Server Name
char publishTopic[] = "iot-2/evt/Data/fmt/json";
char topic[] = "iot-2/cmd/home/fmt/String";
char authMethod[] = "use-token-auth";                                    //Authentication Method
```

```
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;              //Client id

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

PubSubClient client(server, 1883, wifiClient);
void publishData();

const int trigpin=5;
const int echopin=18;
String command;
String data="";
String lat="13.167558";
String lon="80.244510";
String name="point2";
String icon="fa-trash-o";
String color="green";
long duration;
int dist;

void setup()

 void setup()
 {
   Serial.begin(115200);
   pinMode(trigpin, OUTPUT);
   pinMode(echopin, INPUT);
   wifiConnect();
   mqttConnect();
 }

 void loop() {
```

```
 publishData();
 delay(500);

 if (!client.loop()) {
  mqttConnect();
 }
}

//.....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(1000);
  }
  initManagedDevice();
  Serial.println();
 }
```

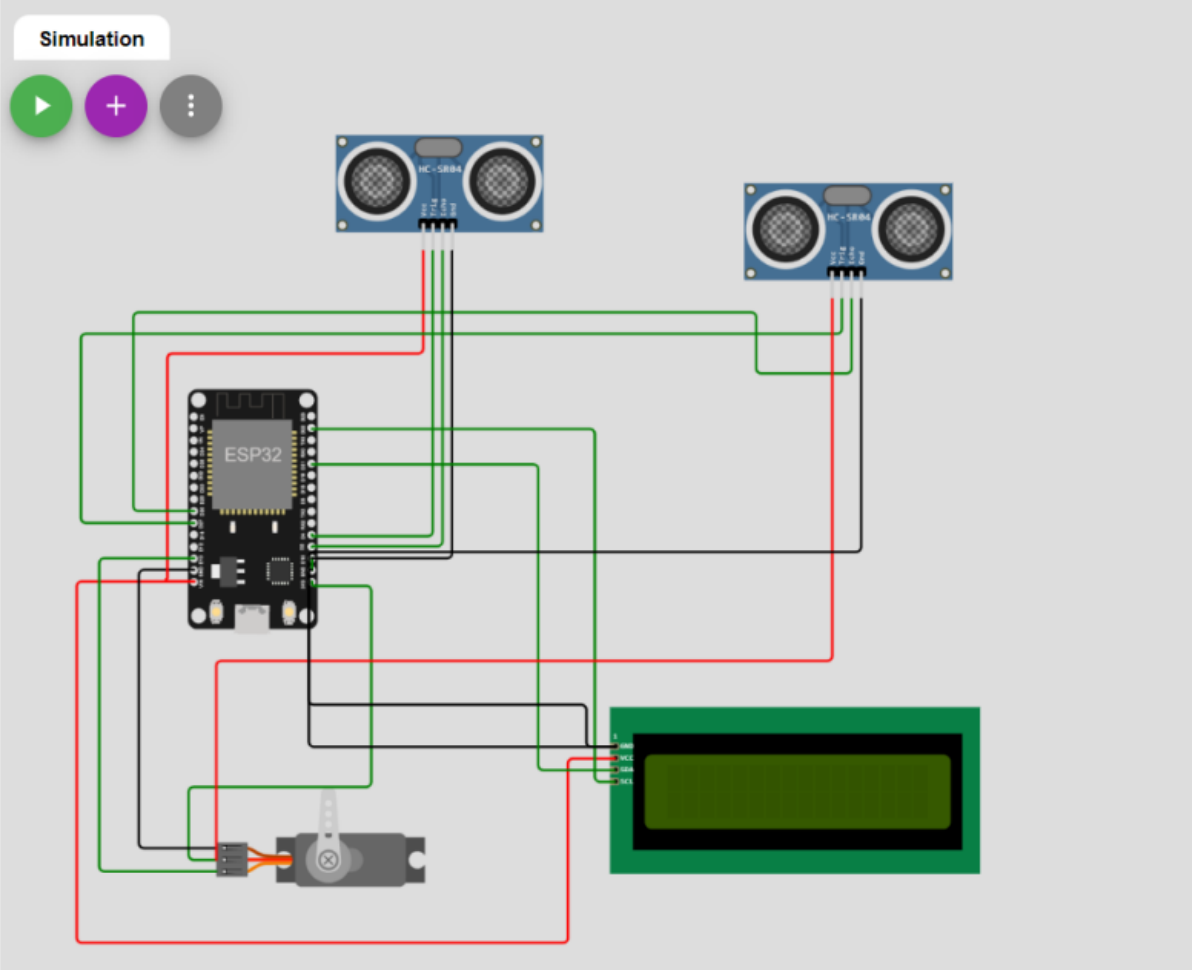
```
}

void initManagedDevice() {
 if (client.subscribe(topic)) {
    Serial.println(client.subscribe(topic));
   Serial.println("subscribe to cmd OK");
 } else {
   Serial.println("subscribe to cmd FAILED");
 }
}

//-------------------------------------------Publish Smart Bin level-------------------------------------------


void publishData()
{
 digitalWrite(trigpin,LOW);
 digitalWrite(trigpin,HIGH);
 delayMicroseconds(10);
 digitalWrite(trigpin,LOW);
```

```
delayMicroseconds(10);
digitalWrite(trigpin,LOW);
duration=pulseIn(echopin,HIGH);
dist=duration*speed/2;
dist=dist/4;
dist=100-dist;
if(dist>80){
icon="fa-trash";
color="red";
}else{
 icon="fa-trash-o";
 color="green";
}
```

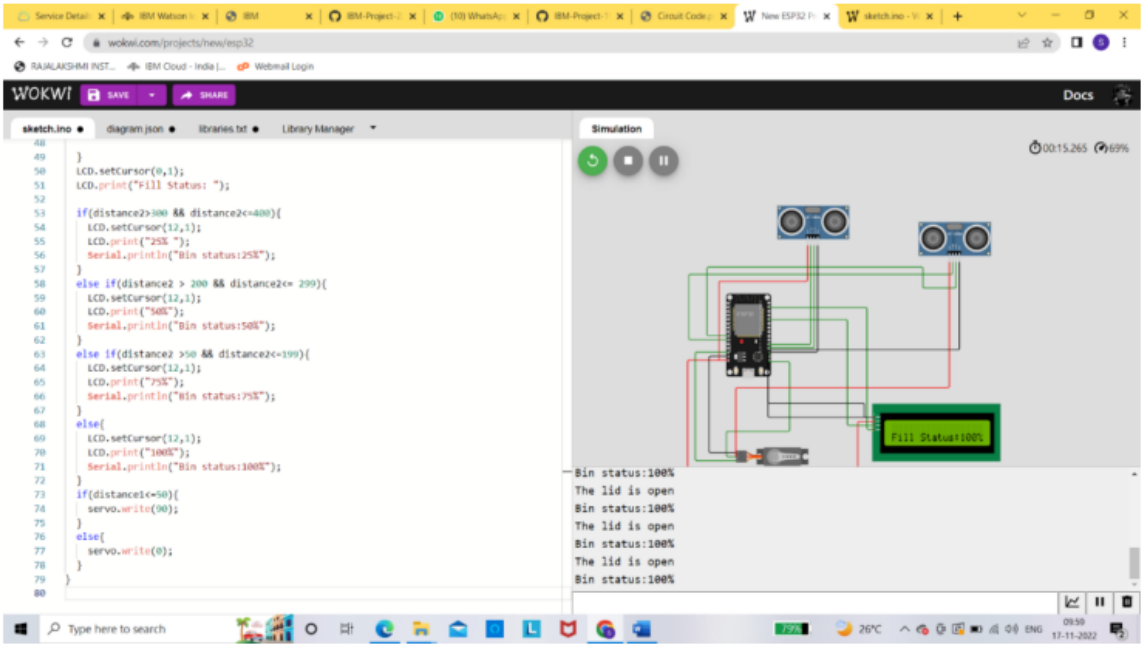
```
DynamicJsonDocument doc(1024);
String payload;
doc["Name"]=name;
doc["Latitude"]=lat;
doc["Longitude"]=lon;
doc["Icon"]=icon;
doc["FillPercent"]=dist;
doc["Color"]=color;
serializeJson(doc, payload);
delay(3000);

//.....Print on LCD.....


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");
}
```

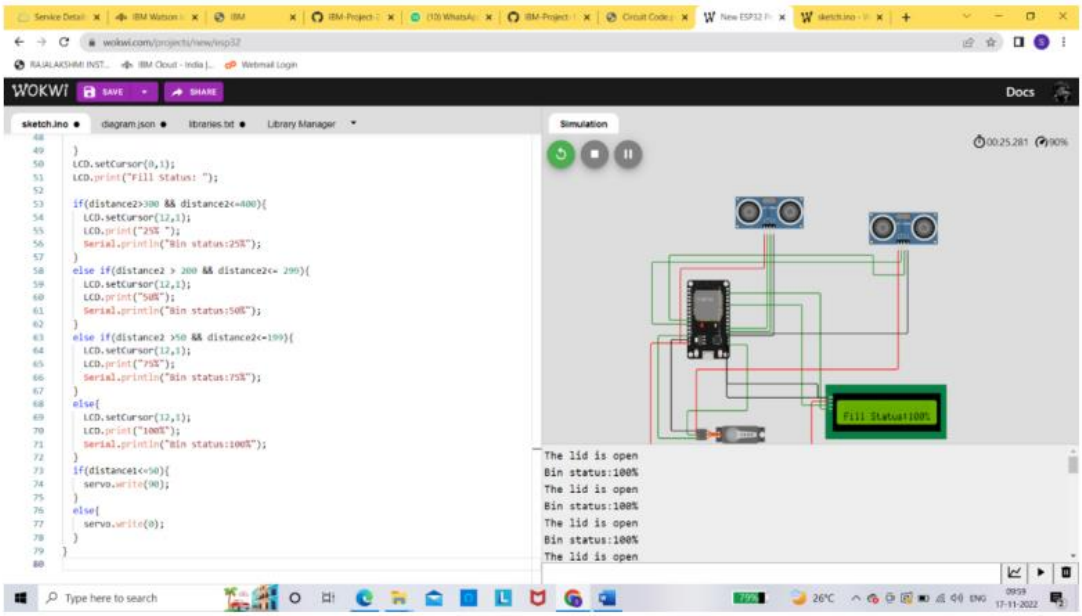
8.TESTING:

8.1.TEST CASES 1:


Simulation
HC-SR04
HC-SR04
ESP32

OUTPUT:


WOKWI
SAVE
SHARE
Docs
sketch.ino
diagram.json
libraries.txt
Library Manager
Simulation
00:15.265
69%
Fill Status:100%
Bin status:100%
The lid is open
Bin status:100%
The lid is open
Bin status:100%
The lid is open
Bin status:100%
Type here to search
26°C
ENG
17-11-2022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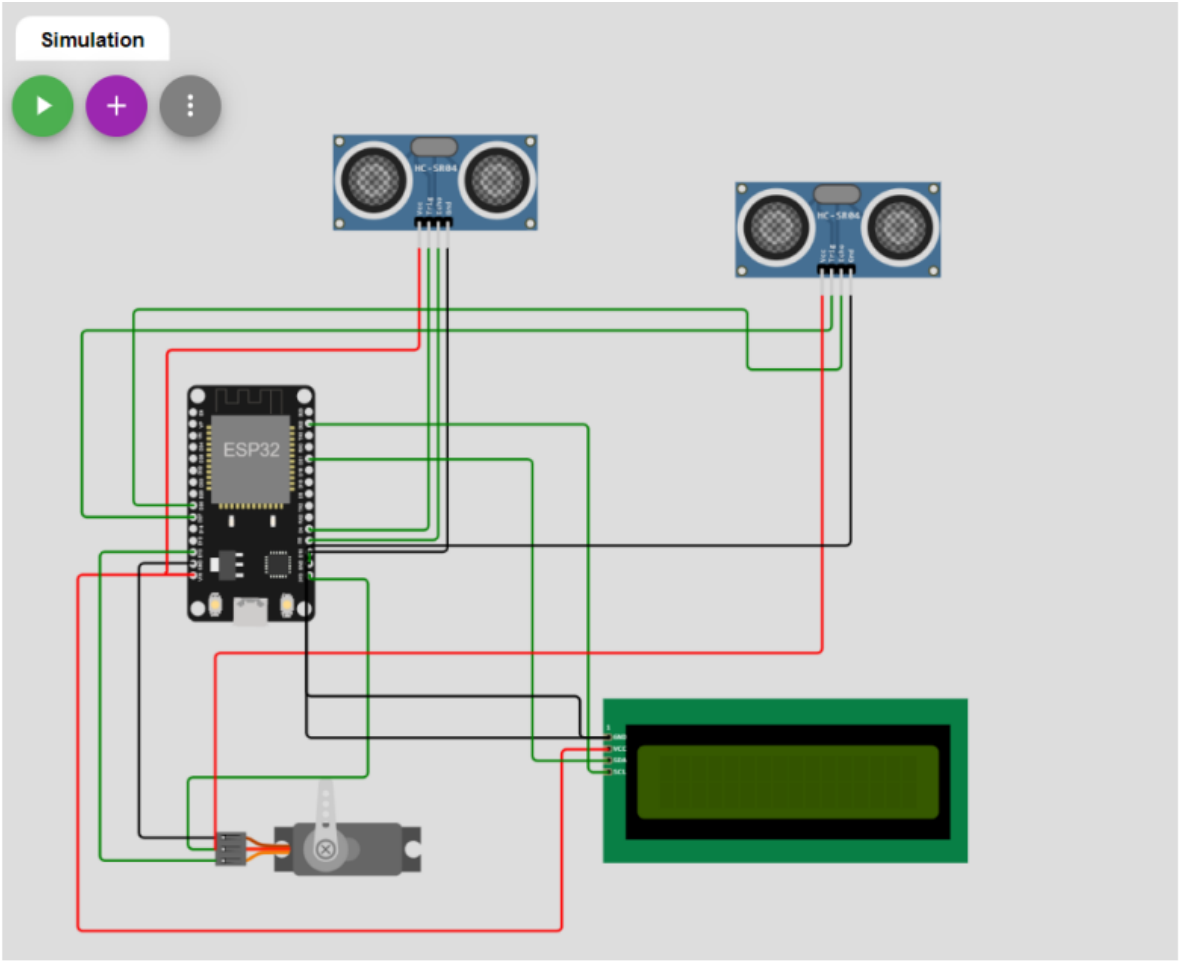
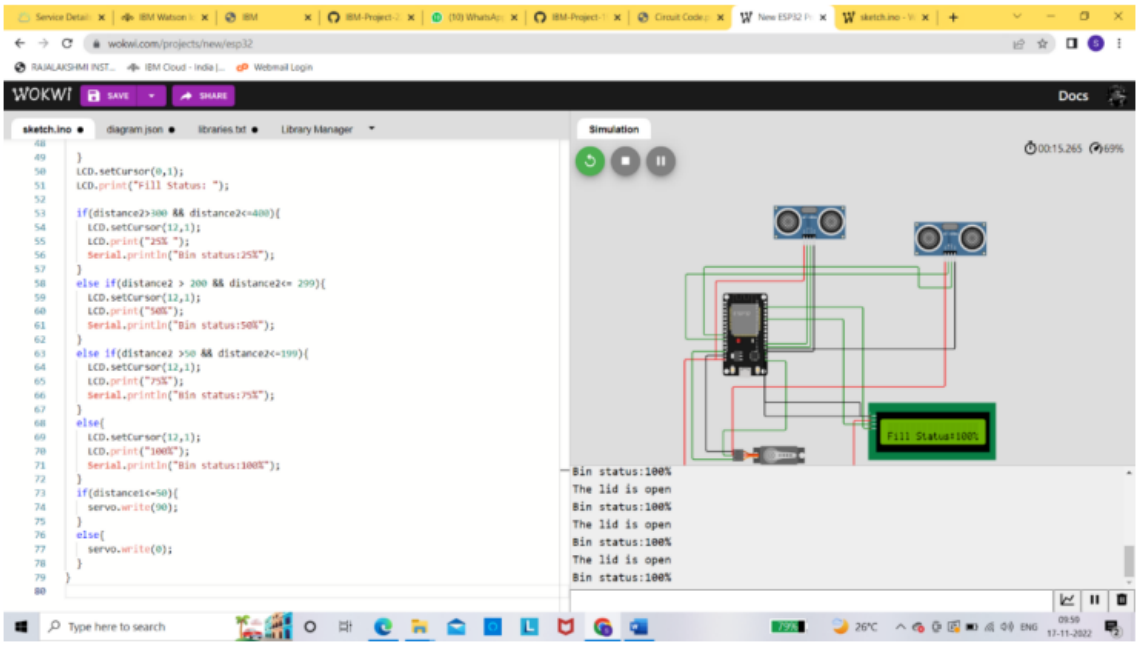
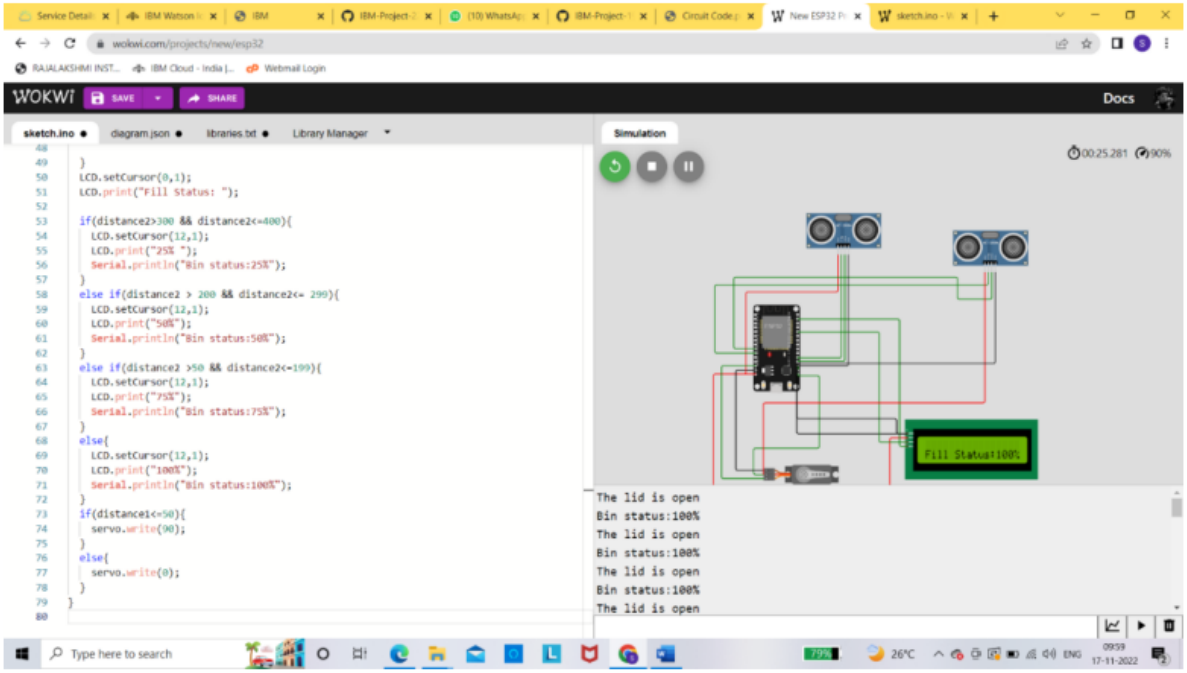
LCD.print("50%");
Serial.println("Bin status:50%");
}
else if(distance2 >50 && distance2<=199){
LCD.setCursor(12,1);
LCD.print("75%");
Serial.println("Bin status:75%");
}
else{
LCD.setCursor(12,1);
LCD.print("100%");
Serial.println("Bin status:100%");
}
if(distance1<=50){
servo.write(90);
}
else{
servo.write(0);
}
}
Fill Status:100%
The lid is open
Bin status:100%
The lid is open
Bin status:100%
The lid is open
Bin status:100%
The lid is open
Type here to search

TEST CASES 2:


Simulation
HC-SR04
HC-SR04
ESP32

OUTPUT:





9.RESULT:

FINAL CODE:

```
#pip install wiotp-sdk
import wiotp.sdk
import time
import random
```

```
myConfig = {
"identity": {
"orgId": "nhpwjc",
"typeId": "NodeMCU",
"deviceId":"2001"
},
"auth": {
"token": "123456789"
}
}
lat="13.167589"
lon="80.248510"
name="point1"
icon="fa-trash-o"
color="green"
def myCommandCallback(cmd):
print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
m=cmd.data['command']

client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()

while True:
temp=random.randint(0,100)
if temp>60:
icon="fa-trash"
color = "red"
else:
icon = "fa-trash-o"
color = "green"
myData={"Name":name,"Latitude":lat,"Longitude":lon,"Icon":icon,"FillPercent":temp,"Color"
:color}
client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None)
print("Published data Successfully: %s", myData)
client.commandCallback = myCommandCallback
time.sleep(10)
client.disconnect()
```

10.ADVANTAGES:

It saves time and money by using smart waste collection bins and systems equipped with fill level sensors. As smart transport vehicles go only to the filled containers or bins. It reduces infrastructure, operating and maintenance costs by upto 30%.

➡It decreases traffic flow and consecutively noise due to less air pollution as result of less waste collection vehicles on the roads. This has become possible due to two way communication between smart dustbins and service operators.

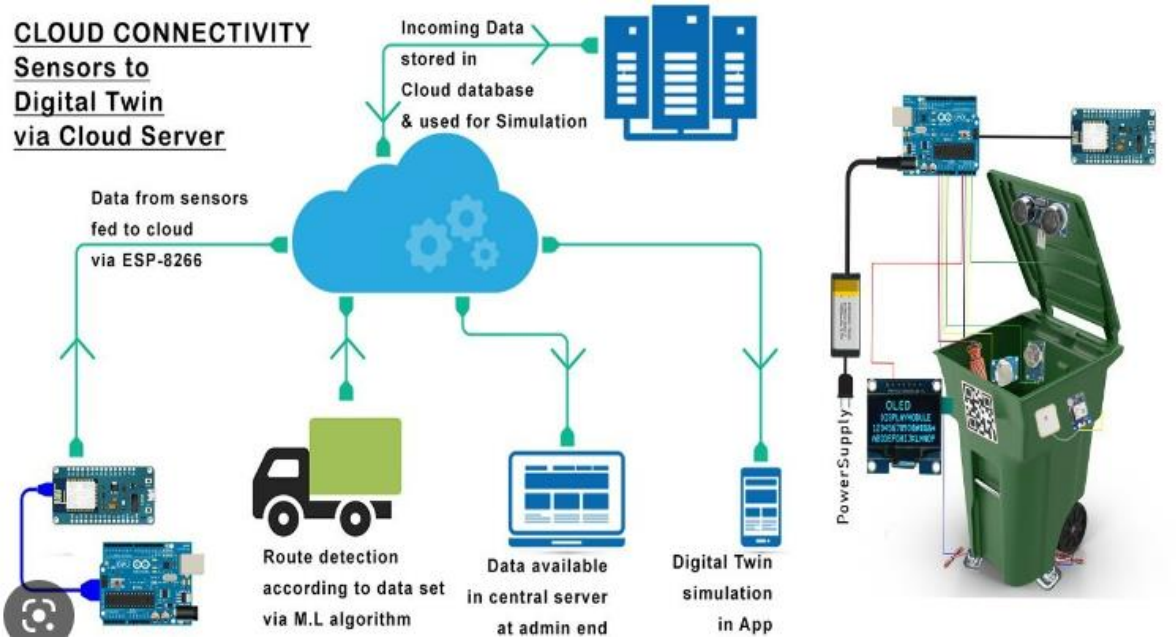
➡It keeps our surroundings clean and green and free from bad odour of wastes, emphasizes on

healthy environment and keep cities more beautiful.

➡It further reduces manpower requirements to handle the garbage collection process.

➡Applying smart waste management process to the city optimizes management, resources and costs which makes it a "smart city".

➡It helps administration to generate extra revenue by advertisements on smart devices.



DISADVANTAGES:

Following are the drawbacks or **disadvantages of Smart Waste Management**:

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

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

➡Wireless technologies used in the system such as zigbee and wifi have shorter range and lower data speed. In RFID based systems, RFID tags are affected by surrounding metal objects (if any).

➡It reduces man power requirements which results into increase in unemployments for unskilled people.

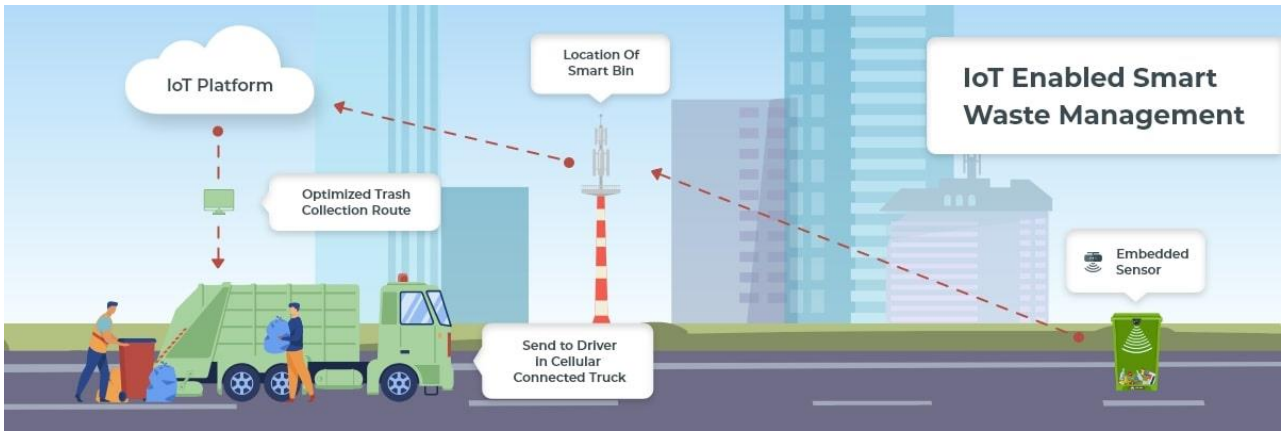
➡The trainining has to be provided to the people involved in the smart waste management system.

11.CONCLUSION:

Monitoring the fullness of bins through the use of sensors, it is possible to achieve a more efficient system than the current existing. Our idea of “Smart waste management system”, mainly concentrates on Monitoring the waste management, providing a smart technology for waste system, avoiding human intervention, reducing human time and effort and which results in healthy and waste ridden environment. The proposed idea can be implemented for smart cities where the residents would be busy enough with their hectic schedule and wouldn’t have enough time for managing waste. The bins can be implemented in a city if desired where there would be a large bin that can have the capacity to accumulate the waste of solid type for a single apartment. The cost could be distributed among the residents leading to cheaper service provision.

12.FUTURE SCOPE:

The ultimate goal of IoT applications in waste management is producing leaner operations and delivering higher quality services to citizens. A growing collection of interlinked autonomous systems are managing everyday urban operations and improving both citizen experiences and our carbon footprint. Ultimately, however, we need deeper coordination between public sectors—through a mix of regulation and incentives—and private sectors—through a willingness to engage with regional, state, and federal agencies to use IoT applications in waste management to build a better and more sustainable future.



13.Appendix:

I) Data Description a. Describing and documenting data is essential in ensuring that the researcher,and others who may need to use the data, can make sense of the data and understand the processes that have been followed in the collection, b. processing, and analysis of the data. c. Research data are any physical and/or digital materials that are collected, observed, or created in research activity for purposes of analysis to produce original research results or creative works. II) Data objects and Relationships a. A data object is a part of the repository whose content can be addressed and interpreted by the program. All data objects must be declared in the ABAP program and are not persistent, meaning that they only exist b. While the program is being executed. Before you can process persistent data (such as data from a database table or from a sequential file), you must read it into data objects first. Conversely, if you want to retain the c. Contents of a data object beyond the end of the program, you must save it in a persistent form.

14.GITHUB LINK:

https://github.com/IBM-EPBL/IBM-Project-22765-1659857712

https://github.com/IBM-EPBL/IBM-Project-22765-1659857712/tree/main/IBM