NALAIYA THIRAN PROJECT 2022

SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES

Batch:B2-2M4E

Team ID:PNT2022TMID26648

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1. INTRODUCTION

The rate at which solid wastes are produced in most developing countries is becoming alarming. This increase may be due to recent population growth and rural-urban migration . Garbage is made up of non-renewable resources used daily to meet our needs then throw away. As increase in consumption of paper, clothing, bottles, and product packaging increases, the generation of garbage also increases significantly. The form and type of solid waste depends on a number of factors which include the living standard and life style of the inhabitants of the region and the natural resources found in the region.

The organic waste category can be further categorized into three units: non-fermentable, fermentable and putrescible . The Putrescible wastes tend to decay faster, and if not cautiously managed, decomposition can lead to an offensive odour with an unpleasant view. Fermentable waste which also tends to decompose rapidly do so without the accompanying of offensive odour. Non-fermentable waste most times do not decompose or do so at a very slow rate. Unless organic waste is managed appropriately, the stricken negative effect it has will continue until full decomposition or stabilization occurs. Decomposed products which are poorly managed or uncontrolled can and often times lead to contamination of air, water and soil resources

A typical example is the garbage bins seen around which appear overfull to the point of spilling out, leading to environmental pollution. The effect of this is increase in the number of diseases because it gives room for insects to breed. Solid waste requires systematic management the content, origin or hazard potential notwithstanding as this will ensure environmental best practices and living standard. Because solid waste management forms a very critical aspect of our environmental hygiene, it is therefore necessary to incorporate it into environmental planning.
the proposed solid waste management system, the bins are connected to the internet to relay real-time information of the status of the bin. The rapid
growth in population in recent years has led to more waste disposals, necessitating the need for a proper waste management system to avoid unhygienic living conditions.

Implementation of the system translates to the bin being interfaced with microcontroller-based system with ultrasonic sensors and a Wi-Fi module. The data which would be sent from the bins would be received, analysed and processed in the IBM cloud that displays the level of the garbage in the bin on a graph in its web page.

The Research includes

A brief survey of research is done about gathering the details of bins present at multiple locations.

The research is done about the previous studies related to the smart waste management system.

PROJECT OVERVIEW:

The main aim of the project is the help authorities to maintain and monitor the garbage bins in the cities , and provide the web application to view the level and Weight of the bins. This will help the authorities to monitor the bins and clean wisely.

PURPOSE :

Smart waste management is characterized by the usage of technology in order to be more efficient when it comes to managing waste. This makes it possible to plan more efficient routes for the trash collectors who empty the bins, but also lowers the chance of any bin being full for over a week.

2 . LITERATURE SURVEY :

EXISTING PROBLEM

Waste generation rate depends on factors such as population density, economic status, level of commercial activity, culture and city/region. provides data on MSW generation in different states, indicating high waste generation in Maharashtra (115 364–19 204 tonnes per day), Uttar Pradesh, Tamil Nadu, West Bengal (11 523–15 363 tonnes per day), Andhra Pradesh, Kerala (7683–11 522 tonnes per day) and Madhya Pradesh, Rajasthan, Gujarat, Karnataka and Mizoram (3842–7662 tonnes per day).

REFERENCE

- In sung Hong ,SunghoiPark ,BeomseokLee, Jaekeun Lee, DaebeomJeong, andSehyunPark, “IoT-Based Smart Garbage System for Efficient Food Waste Management” -Scientific World Journal-Aug 2014.

- Ala Al-Fuqaha, Mohsen Guizani, Mehdi Mohammadi, Mohammed Aledhari, Moussa Ayyash, “Internet of Things: A Survey on Enabling Technologies, Protocols and Applications” -IEEE-2015.

- The odoros Anagnost opoulos ,Arkady Zaslavsky ,Alexey Medvedev , “IRobust Waste Collection exploiting Cost Efficiency of loT potentiality in Smart Cities” -EEE-April-2015.

- Vikrant Bhor1, Pankaj Morajkar2, Maheshwar Gurav3, Dishant Pandya4, Amol Deshpande, “Smart Garbage Management System” -March 2015.

- Dario Bonion, Maria Teresa Delgado Alizo, Alexandre Alapetite, Thomas Gilbert, athais Axling,HelenUdsen, Jose Angel Carvajalsoto, Maurizio Spirito, “ALMANAC: Internet Of Things for Smart Cities” IEEE-2015.

- FachminFolianto, Yong Sheng Low,Wai Leong Yeow, ”Smart bin: Smart Waste Management System” -IEEE-April 2015.

- KristýnaRybová, Jan Slavík, “Smart cities and ageing population– Implications for

waste management in the Czech Republic " -IEEE 2016.

- Jose M. Gutierreza, Michael Jensenb, Morten Heniusa and Tahir Riazc, "Smart Waste Collection System Based on Location Intelligence" -2015.

- Álvaro Lozano Murciego, Gabriel Villarrubia González, Alberto LópezBarriuso, Daniel Hernández de La Iglesia, Jorge Revuelta Herrero and Juan Francisco De Paz Santana, "Smart Waste Collection Platform Based on WSN and Route Optimization "-2016.

- Theodoros Anagnostopoulos1, Arkady Zaslavsky2,1, Alexey Medvedev1, Sergei oruzhnicov1, "Top–k Query based Dynamic Scheduling for IoT-enabled Smart City Waste Collection" -IEEE-2016.
- Adnan Aijaz, Member, IEEE; Cognitive Machine-to Machine Communications for Internet-of-Things : A Protocol Stack Perspective.

- Hassan, S. A., Jameel, N.G.M. & Boran. S. (2016). Smart Solid Waste Monitoring and Collection System. International Journal of Advanced Research in Smart Solid Waste Monitoring and Collection System.

- Bhide, A. D and Shekdar A. V (1998), 'Solid waste management in Indian urban centers', International Solid Waste Association Times (ISWA), Volume 1, pp 26–28.

- Xu Y, Zhang L, Yeh CH, Liu Y (2018) Evaluating E-WASTE recycling innovation strategies with interacting sustainability-related criteria. J Clean Prod 190:618–629.

- Rahman MW, Islam R, Hasan A, Bithi NI, Hasan MM (2020) Intelligent waste management system using deep learning with IoT. J King Saud Univ – Comput Inf Sci-in Press 1–16.

- Ala Al-Fuqaha, Mohsen Guizani, Mehdi Mohammadi, Mohammad Aledhari and Moussa Ayyash, "Internet of Things: A survey on enabling technologies Protocols and applications", IEEE communications surveys and tutorials, pp. 1553-877, 2015.

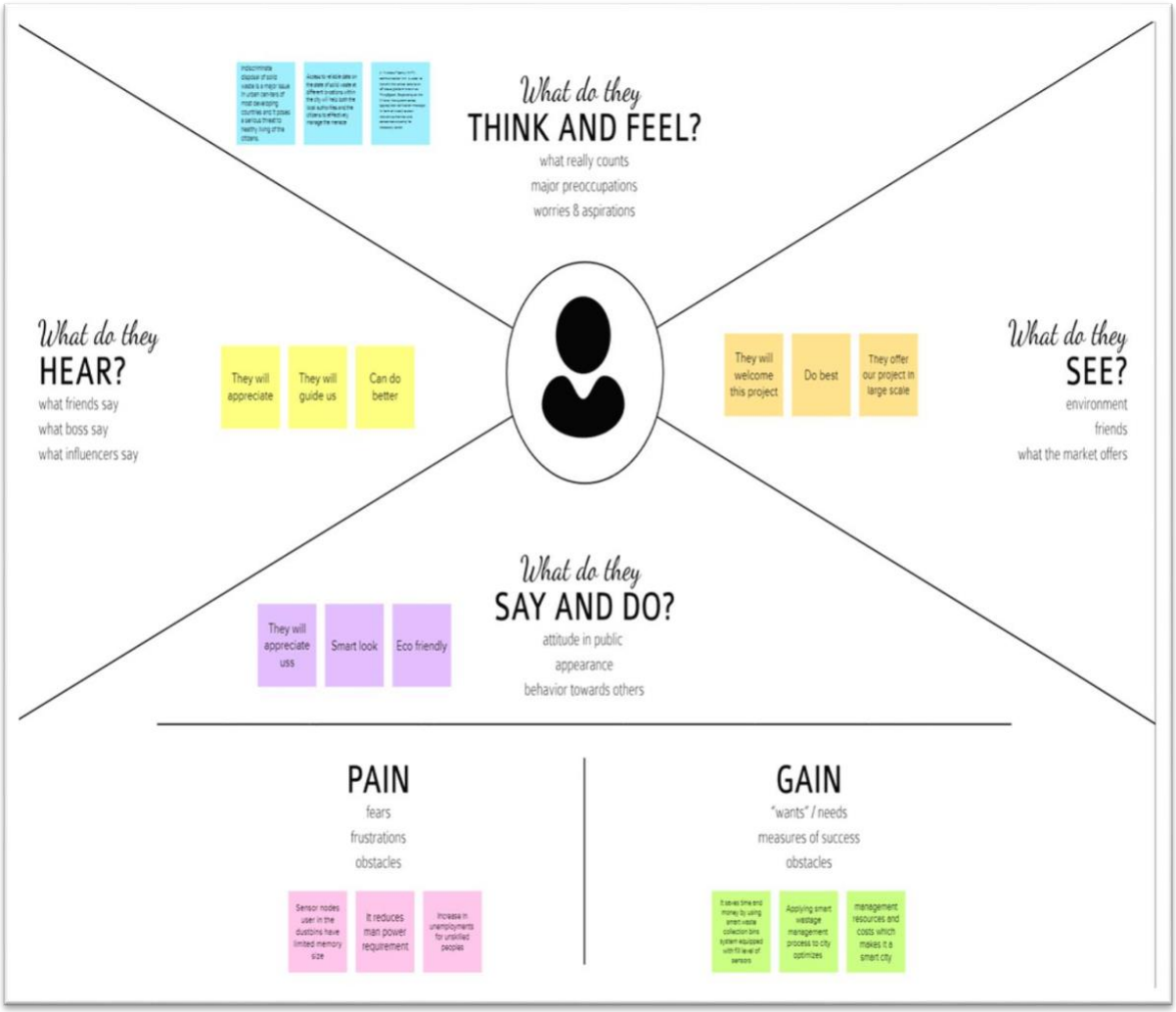
PROBLEM STATEMENT DEFINITION

In today's world there is no proper management and control system for proper garbage collection. Humans have a tendency to avoid their duty. People in the societies use to throw garbage in filled garbage containers and garbage authorities also do not collect the garbage timely. Hence it leads to various types of pollution and many serious health issues.

Poor waste management ranging from non-existing collection systems to ineffective disposal causes air pollution, water and soil contamination. Open and unsanitary landfills contribute to contamination of drinking water and can cause infection and transmit diseases.

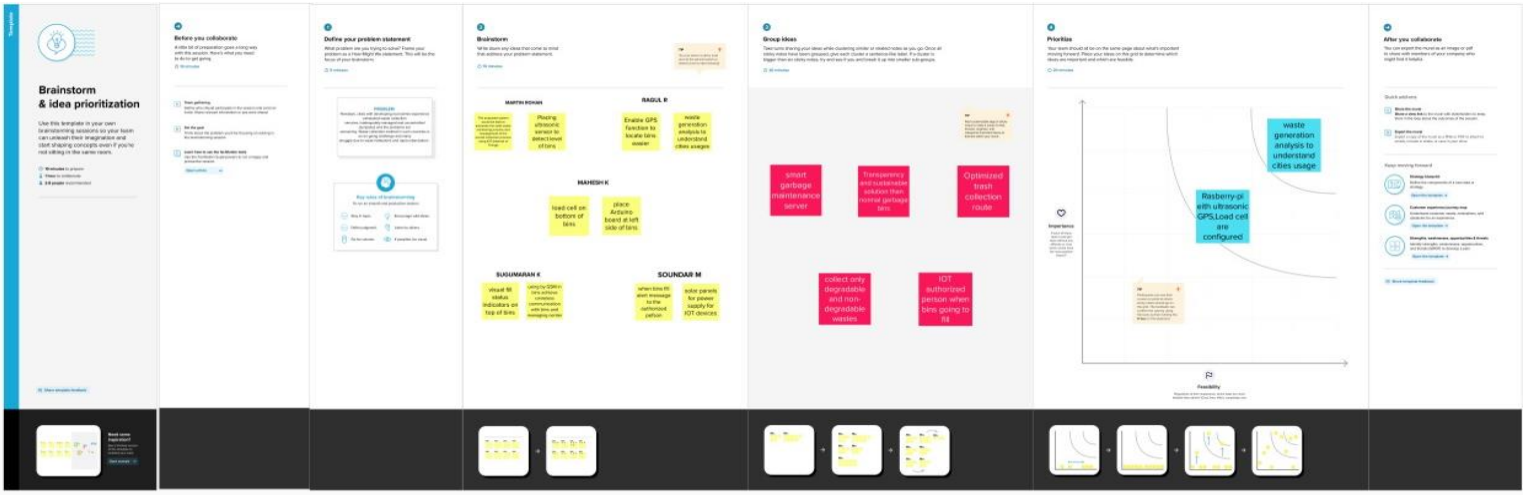
3.IDEATION & PROPOSED SOLUTION:

EMPATHY MAP CANVAS :



IDEATION & BRAINSTROMING :

https://app.mural.co/invitation/mural/smartwastemanagementclub8365/1667391047247?sender=u604384860effc6da472b2623&key=e01b46bd-55b5-4a00-b739-49be47e9ceb1

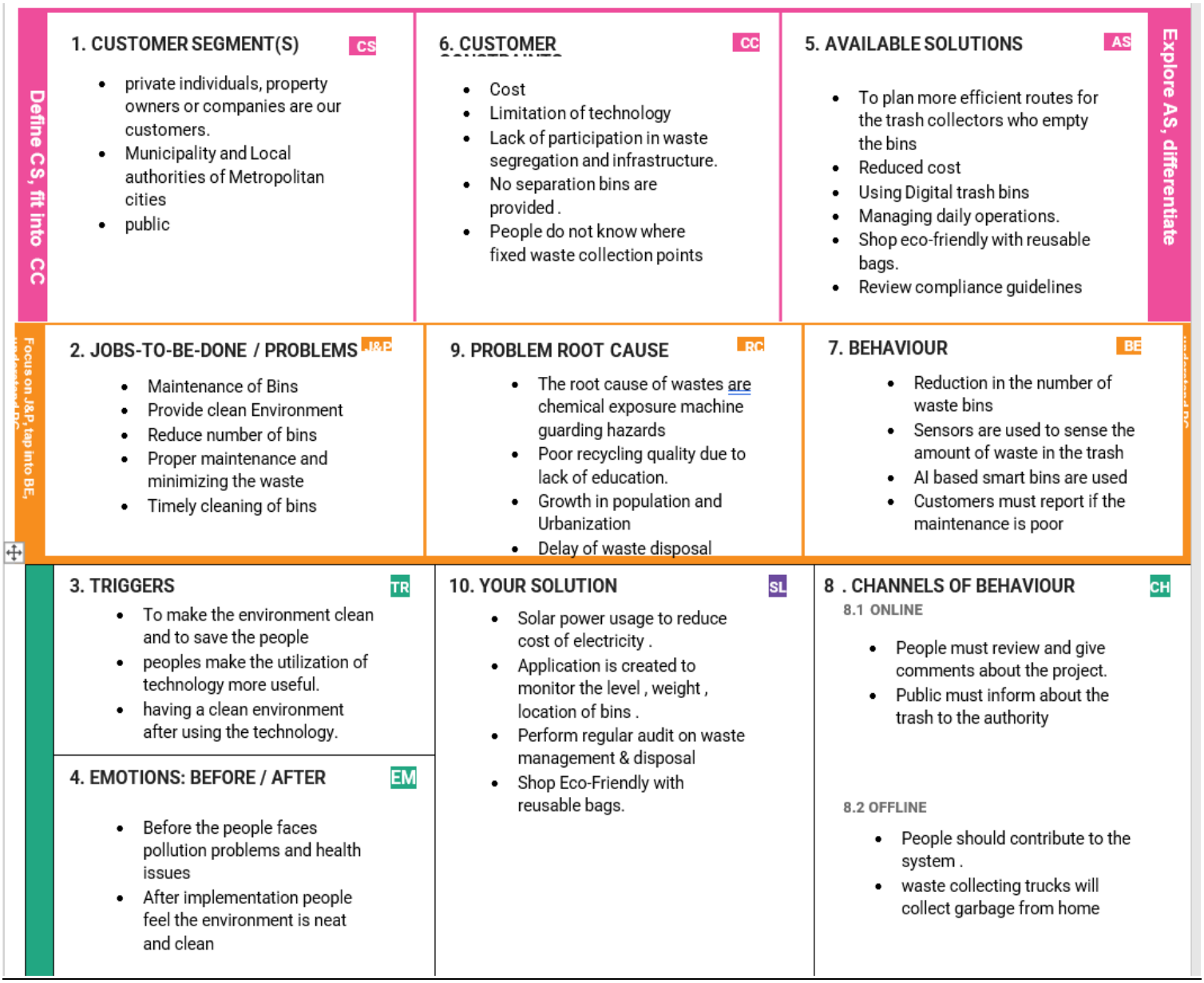


PROPOSED SOLUTION :

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	➢ The major problems are unscientific treatment , improper collection of waste, and ethical problems ➢ Cost is the big challenge ➢ Uncontrolled waste management can lead to medical and healthcare waste being mixed with household waste. ➢ if trash has been deposited unevenly in one part of the bin than the other, the sensors may read that the bin is full, when in reality it is only half full.
2.	Idea / Solution description	➢ To solve this problem of waste management for disposal using a smart refuse bin built with technologies like Sensors, Arduino ➢ Garbage truck Weighing Mechanisms and AI Recycling Robots. ➢ management of the overall collection process using IOT (Internet of Things). ➢ Recycled plastic building is a great way to solve the waste management challenges.
3.	Novelty / Uniqueness	➢ It can give correct and accurate information ➢ Create a waste management-focused Community

		➢ Fair investment in the circular waste management sector could generate a profit, both in monetary and social terms. ➢ Recycled plastic could help make buildings more solid and reduce the environmental impact
4.	Social Impact / Customer Satisfaction	➢ It has a great interactive dashboard for predicting the Wastage ➢ The IOT solution uses the data and selects optimum routes for waste collection trucks ➢ Lower-income families tend to produce less waste and thus pay lower waste collection fees.
5.	Business Model (Revenue Model)	➢ It has huge revenue when it comes to the market. ➢ Recycling solutions to residential , commercial etc.
6.	Scalability of the Solution	➢ Large-scale infrastructure, and economic activities enable innovation and efficiency. ➢ Recycling not only save energy but also prevent the material from going to landfills and incineration and provide raw material for new products.

PROPOSED SOLUTION FIT :



4.REQUIREMENT ANALYSIS

FUNCTIONAL REQUREMENT :

FR No.	Functional Requirement	Sub Requirement (Story / Sub-Task)
FR-1	**IOT Technology and sensors**	➢ IOT device is fixed to the dustbin. ➢ Sensors such as : ultrasonic sensor , IR sensor to sense the data and GPRS is used
FR-2	**Detailed bin inventory**	➢ The bins are been monitored and seen on the map via street view. ➢ Bins or stands are visible on the map as green, orange or red circles.

		➢ The details such as waste level , weight of trash , GPS location can be seen through the application
FR-3	**Bin Monitoring**	➢ The details such as waste level , weight of trash , GPS location can be seen through the Dash board in the app created. ➢ The past data of the bins are also stored to check the accuracy of system. ➢ With real-time data and predictions, you can eliminate the overflowing bins and stop collecting half-empty ones.
FR-4	**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. ➢ It also calculates the distance from depo-bin discharge
FR-5	**Predictions for bin Levels**	➢ It is a 24×7 monitoring system is designed for monitoring the dumpster. ➢ If the containers is full then an alert message is sent from the dustbin to employees and the cloud. ➢ In turn, employees can clear the corresponding dumpster. The bin has Sensors that can 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 halfempty ones.
FR-6	**Plan waste collection routes**	➢ The shortest and fastest routes is selected using the GPRS ➢ Based on current bin fill-levels and predictions of reaching full capacity, you are ready to respond and schedule waste collection. ➢ You can also compare planned vs. executed routes to identify any inconsistencies

NON-FUNCTIONAL REQUREMENT :

FR No.	**Non-Functional Requirement**	**Description**
NFR-1	**Usability**	➢ Smart solution has been proposed to make the waste by sorting more simple and accurate. ➢ It aims to optimize ease of use while offering maximum functionality. ➢ The IOT technology is used to monitor the waste easily.

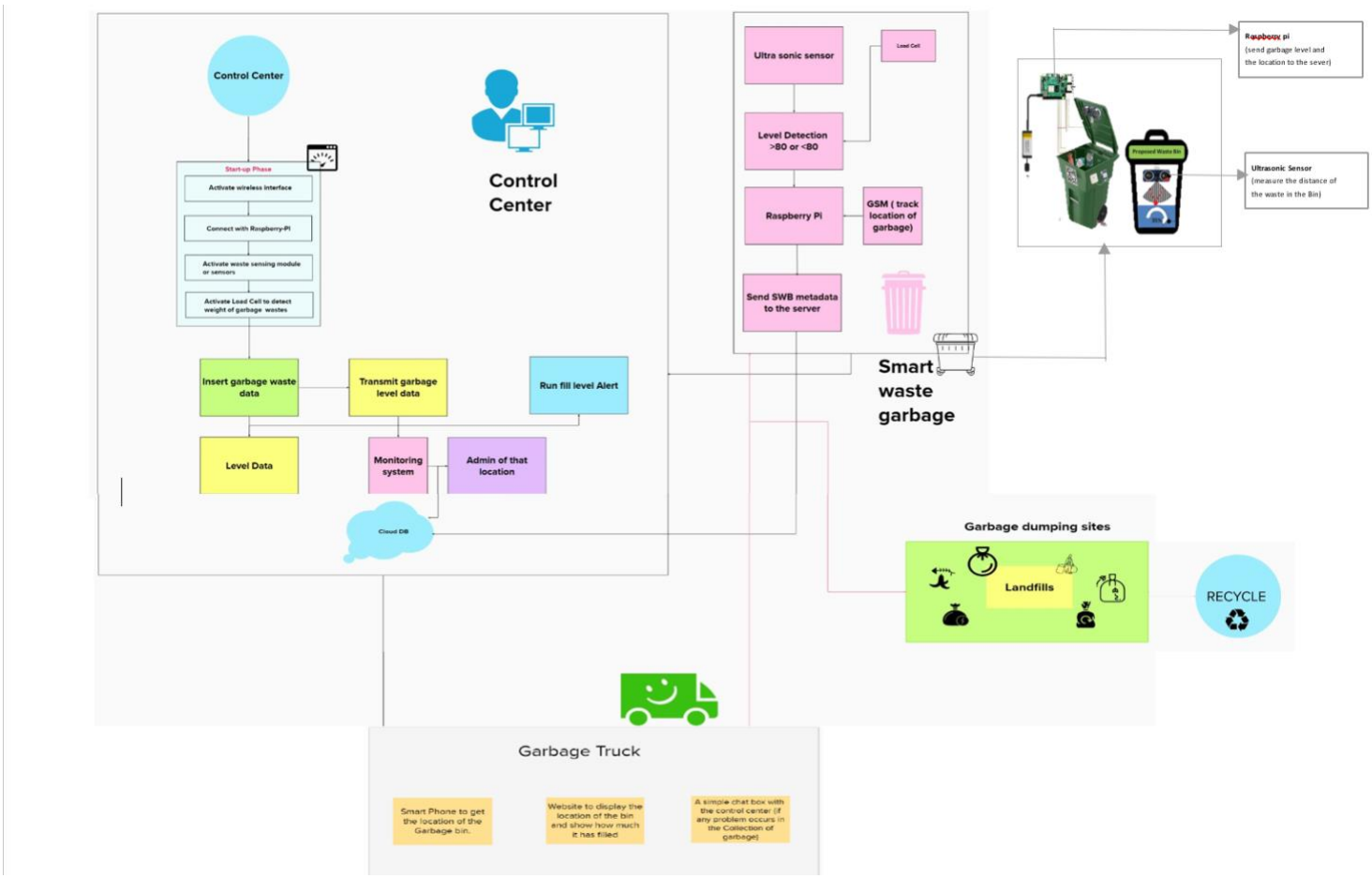
NFR-2	**Security**	➢ Building and deploying IoT-based smart waste management in cities can be a complex , time consuming and resource intensive process. ➢ Many municipal IT departments will not have the resources or in-house skills to support such a project internally.
NFR-3	**Reliability**	➢ Smart waste management is also about creating better working conditions for waste collectors and drivers. ➢ works without failure resulting in less manpower, emissions, fuel use and traffic congestion.
NFR-4	**Performance**	➢ There will be an accurate monitoring of garbage. ➢ It also Communicates with the authorities to keep environment clean. ➢ With the help of sensors and wireless communication will reduce the total number of trips required of Garbage collecting truck. ➢ It increases the efficiency
NFR-5	**Availability**	➢ Purpose of this project is to make the proposed waste management system as cheap as possible. ➢ By this we empower cities, businesses, and countries to manage waste smarter.
NFR-6	**Scalability**	➢ Using smart waste bins reduce the number of bins inside town and cities because we able to monitor the garbage more cost effective and scalability when we move to smarter systems. ➢ Also prevent the material from going to landfills and incineration and provide raw material for new products

5.PROJECT DESIGN

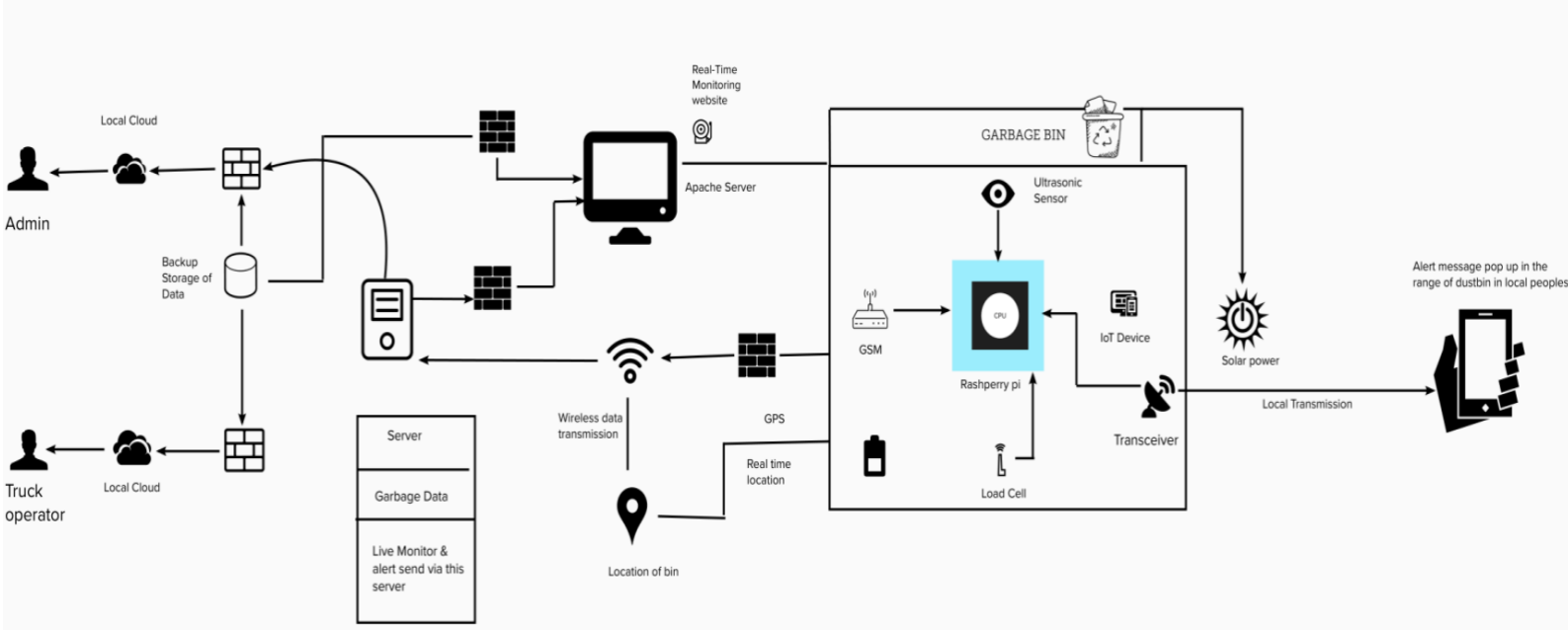
Project design is an early phase of the project lifecycle where ideas, processes, resources, and deliverables are planned out. A project design comes before a project plan as it's a broad overview whereas a project plan includes more detailed information.

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 right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



SOLUTION & TECHNICAL ARCHITECTURE :



User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Admin (who Manage web server)	Login	USN-1	As a admin, I have my user name and Password for every worker and co-workers to manage them.	I can manage web Account and direct workers.	High	Sprint-1
Co-admin	Login	USN-2	As a co-admin , I'll manage other monitoring activities like garbage level monitoring, location accuracy, garbage separation and removal of waste within a scheduled time.	I can monitor garbage bins activities.	High	Sprint-1
Municipality officer	Login	USN-3	As a Municipality officer, I'll make sure everything is sticked to plan and without any issues	All of these processes are under my control.	High	Sprint-2
Customer (Web user)	User	USN-4	Here comes the customer , he/she will have access to mobile apps or login web pages to view progress of bins and to report if any query found.	He/ she has the right to make a query if any	Moderate	Sprint-2
Customer Care Executive	Worker	USN-5	The customer care executive , will try to rectify the queries from customers by contacting co-admin . If case of any critical/ emergency situation query can be conveyed to higher authority.	I can attend the calls and respond people by rectifying the problem	High	Sprint-2
Local Garbage Collector	Worker	USN-6	As a Local Garbage Collector, I'II gather all the waste collected from the garbage and house and load it onto a garbage truck	I can collect the trach, pull it to the truck, and send it out.	Moderate	Sprint-3
Truck Driver	Worker	USN-7	Here, truck driver is a worker who has particular assignments that he has to report when and where the garbage has been picked according to the daily schedule. And should update the happenings in the given website	I can update my activities on site when the given Task has been completed.	Moderate	Sprint-4

6.PROJECT PLANNING & SCHEDULING

The definition of a sprint is a dedicated period in which a set amount of work will be completed on a project. It's part of the agile methodology, and an Agile project will be broken down into a number of sprints, each sprint taking the project closer to completion

SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	IBM cloud platform	USN-1	To create the IBM cloud used in the process of project And configure the IBM cloud	10	Medium	MartinRohan C Mahesh K Ragul R Sugumaran K Soundar M
Sprint-1		USN-2	Create and configure the IBM Watson IOT platform for the processing of sensor data and create a system for waste management	10	High	MartinRohan C Mahesh K Ragul R Sugumaran K Soundar M
Sprint-2		USN-3	Create a Node-RED service. Connect the Node-RED service to IBM Watson With the API keys from IBM IOT platform	5	High	MartinRohan C Mahesh K Ragul R Sugumaran K Soundar M
Sprint-2	Python IDLE IBM Watson Node Red services	USN-4	Develop the python code to find the GPS location using Latitude and Longitude (random values) and send it to Node red using IBM Watson platform and view location of bins on map	15	High	MartinRohan C Mahesh K Ragul R Sugumaran K Soundar M
Sprint-3	IBM Watson Node Red services	USN-5	Create a IOT device to sense the level of bins and do code for device	20	High	MartinRohan C Mahesh K Ragul R

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
			and send to Node Red using the API keys from Watson platform			Sugumaran K Soundar M
Sprint-4	Python IDLE IBM Watson Node Red services	USN-6	Develop an application using Node Red to monitor the Bin values	10	Medium	MartinRohan C Mahesh K Ragul R Sugumaran K Soundar M
Sprint-4		USN-7	Test the created web UI using the random values to sensors	10	High	MartinRohan C Mahesh K Ragul R Sugumaran K Soundar M

SPRINT DELIVERY SCHEDULE :

Project Tracker, Velocity & Burndown Chart:

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)

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

MILESTONE & ACTIVITY LIST

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers , research publications etc	19 SEPTEMBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem Statements	19 SEPTEMBER 2022
Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	19 SEPTEMBER 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	23 SEPTEMBER 2022
Problem Solution Fit	Prepare problem –solution fit document	30 SEPTEMBER 2022
Solution Architecture	Prepare solution architecture document.	28 SEPTEMBER 2022
Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit).	20 OCTOBER 2022
Functional Requirement	Prepare the functional requirement document.	8 OCTOBER 2022
Data Flow Diagrams	Draw the data flow diagrams and submit for review.	9 OCTOBER 2022
Technology Architecture	Prepare the technology architecture diagram.	10 OCTOBER 2022
Prepare Milestone & Activity List	Prepare the milestones & activity list of the project.	22 OCTOBER 2022
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developed code by testing it.	15 NOVEMBER 2022

7.CODING & SOLUTIONING

FEATURE 1 - WOKWI CODE :

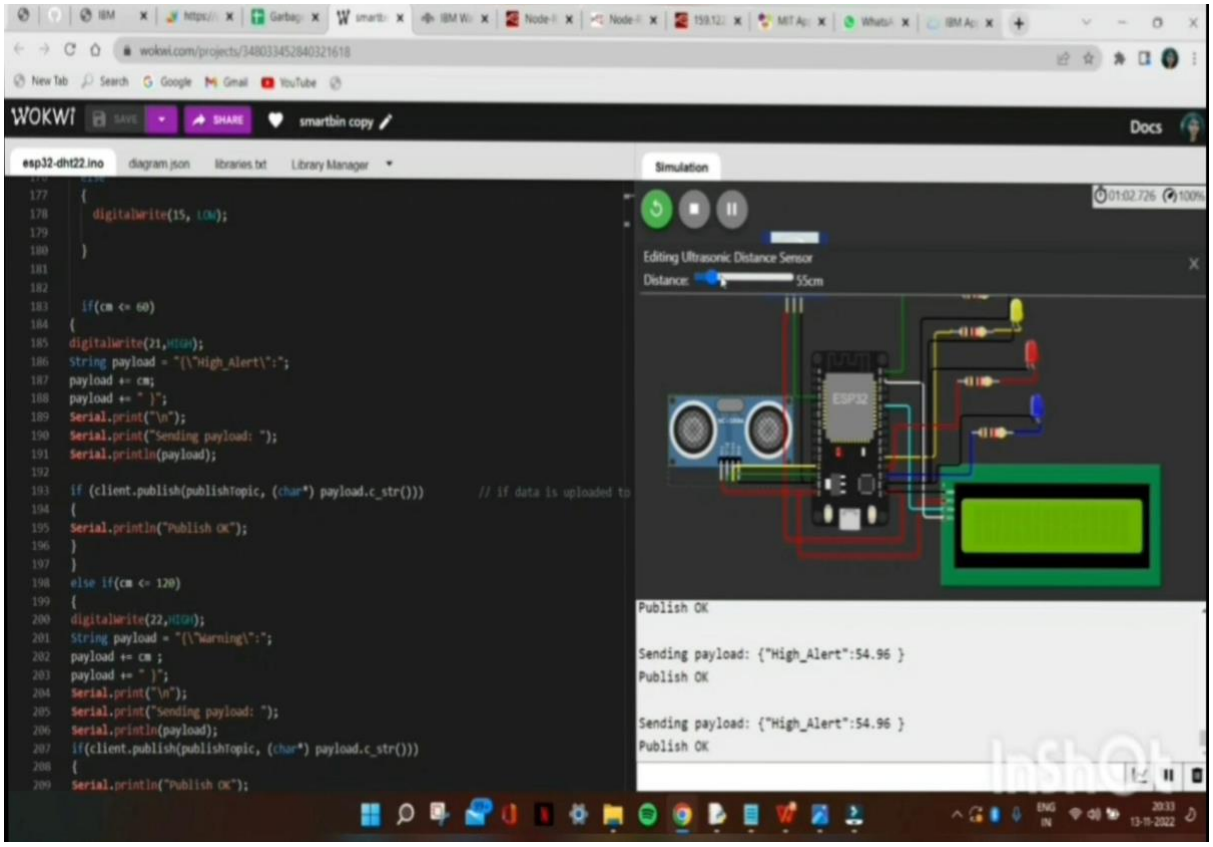
```
#include <WiFi.h>
#include <PubSubClient.h>
void callback(char* subscribetopic, byte* payload, unsigned int
payloadLength);
//-------credentials of IBM Accounts------
#define ORG "fzv53v"//IBM ORGANITION ID
#define DEVICE_TYPE "Bin"//Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "Bin_1"//Device ID mentioned in ibm watson IOT Platform
#define TOKEN "1234567890" //Token
String data3;
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";
char publishTopic[] = "iot-2/evt/Data/fmt/json";
char subscribetopic[] = "iot-2/cmd/test/fmt/String";
char authMethod[] = "use-token-auth";
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;
WiFiClient wifiClient;
PubSubClient client(server, 1883, callback ,wifiClient);
const int trigPin = 5;
const int echoPin = 18;
#define SOUND_SPEED 0.034
long duration;
float distance;
float level;
void setup() {
Serial.begin(115200);
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
wificonnect();
mqttconnect();
}
void loop()
{
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
```

```
distance = duration * SOUND_SPEED/2;
level = (400 - distance)/40;
Serial.print("Distance (cm): ");
Serial.println(level);
if(level>8)
{
Serial.println("ALERT!!");
delay(1000);
PublishData(level);
delay(1000);
if (!client.loop()) {
mqttconnect();
}
}
else
{
Publishdata2(level);
delay(1000);
if (!client.loop()) {
mqttconnect();
}
}
delay(1000);
}


void PublishData(float dist) {
mqttconnect();
String payload = "{\"Level\":";
payload += dist;
payload += ",\"ALERT!!\":""\"Bin is to be FULL \"";
payload += "}";
Serial.print("Sending payload: ");
Serial.println(payload);

if (client.publish(publishTopic, (char*) payload.c_str())) {
Serial.println("Publish ok");
} else {
Serial.println("Publish failed");
}
}
void Publishdata2(float dist) {
mqttconnect();
String payload = "{\"Level\":";
payload += dist;
payload += "}";
Serial.print("Sending payload: ");
Serial.println(payload);
```

```
if (client.publish(publishTopic, (char*) payload.c_str())) {
Serial.println("Publish ok");
} else {
Serial.println("Publish failed");
}
}

void mqttconnect() {
if (!client.connected()) {
Serial.print("Reconnecting client to ");
Serial.println(server);
while (!!!client.connect(clientId, authMethod, token)) {
Serial.print(".");
delay(500);
}
initManagedDevice();
Serial.println();
}
}

void wificonnect()
{
Serial.println();
Serial.print("Connecting to ");
WiFi.begin("Wokwi-GUEST", "", 6);
while (WiFi.status() != WL_CONNECTED) {
delay(500);
Serial.print(".");
}
Serial.println("");
Serial.println("WiFi connected");
Serial.println("IP address: ");
Serial.println(WiFi.localIP());
}
void initManagedDevice() {
if (client.subscribe(subscribetopic)) {
Serial.println((subscribetopic));
Serial.println("subscribe to cmd OK");
} else {
Serial.println("subscribe to cmd FAILED");
}
}

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength)
{
Serial.print("callback invoked for topic: ");
Serial.println(subscribetopic);
for (int i = 0; i < payloadLength; i++) {
```

```
//Serial.print((char)payload[i]);
data3 += (char)payload[i];
}

Serial.println("data: "+ data3);
data3="";
}
```

Output:

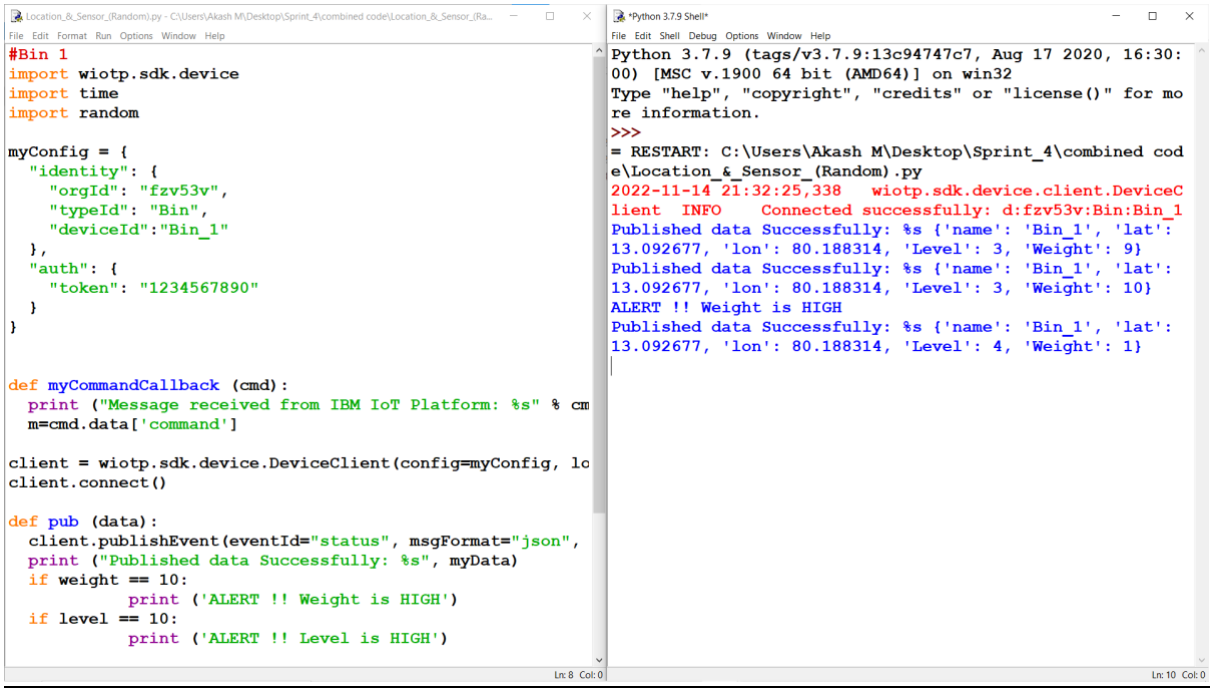


FEATURE 2 - PYTHON CODE :

```
        #Bin 1
import wiotp.sdk.device
import time
import random

myConfig = {
  "identity": {
    "orgId": "fzv53v",
    "typeId": "Bin",
    "deviceId":"Bin_1"
  },
  "auth": {
    "token": "1234567890"
  }
}



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()

def pub (data):
  client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None)
  print ("Published data Successfully: %s", myData)
  if weight == 10:
          print ('ALERT !! Weight is HIGH')
  if level == 10:
```

```
        print ('ALERT !! Level is HIGH')


while True:
        level=random.randint(0,10)
        weight=random.randint(0,10)
        myData={'name': 'Bin_1', 'lat': 13.092677, 'lon': 80.188314
,'Level':level,'Weight':weight}
        pub (myData)
        time.sleep (5)
        client.commandCallback = myCommandCallback
client.disconnect ()
```

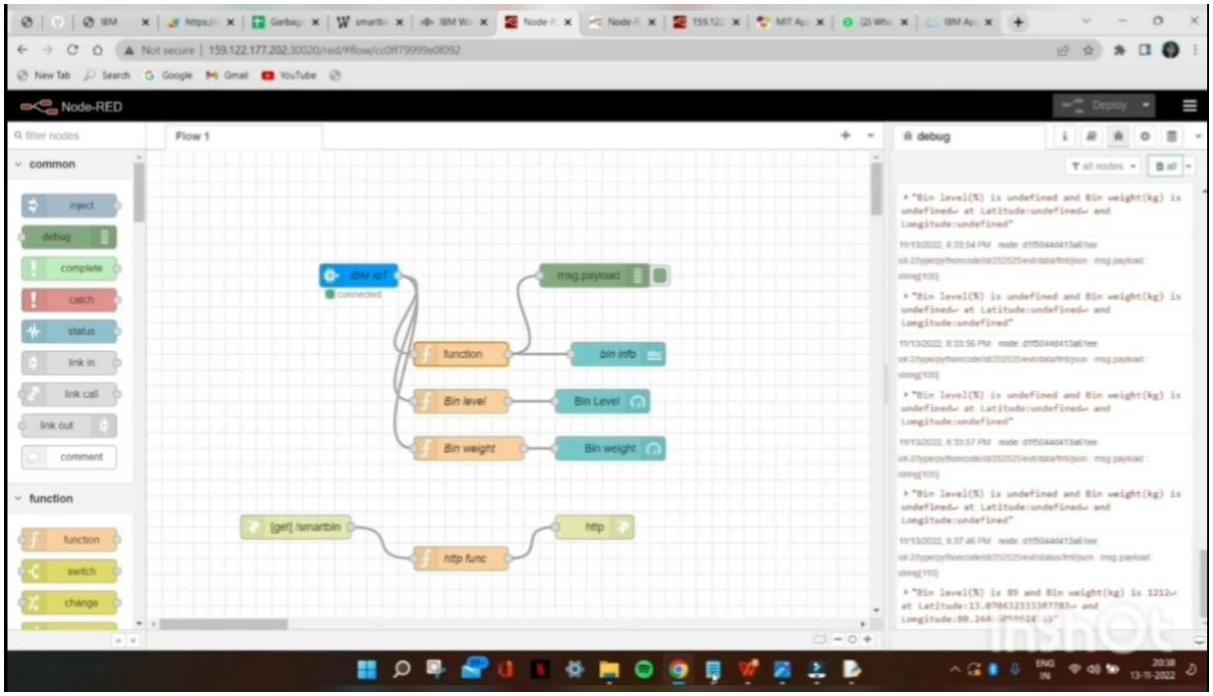
Output :



```
#Bin 1
import wiotp.sdk.device
import time
import random

myConfig = {
  "identity": {
    "orgId": "fzv53v",
    "typeId": "Bin",
    "deviceId":"Bin_1"
  },
  "auth": {
    "token": "1234567890"
  }
}


def myCommandCallback (cmd):
  print ("Message received from IBM IoT Platform: %s" % cm
  m=cmd.data['command']

client = wiotp.sdk.device.DeviceClient(config=myConfig, lo
client.connect()

def pub (data):
  client.publishEvent(eventId="status", msgFormat="json",
  print ("Published data Successfully: %s", myData)
  if weight == 10:
            print ('ALERT !! Weight is HIGH')
  if level == 10:
            print ('ALERT !! Level is HIGH')
```

```
Python 3.7.9 (tags/v3.7.9:13c94747c7, Aug 17 2020, 16:30:
00) [MSC v.1900 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for mo
re information.
>>>
= RESTART: C:\Users\Akash M\Desktop\Sprint_4\combined cod
e\Location_&_Sensor_(Random).py
2022-11-14 21:32:25,338   wiotp.sdk.device.client.DeviceC
lient  INFO    Connected successfully: d:fzv53v:Bin:Bin_1
Published data Successfully: %s {'name': 'Bin_1', 'lat':
13.092677, 'lon': 80.188314, 'Level': 3, 'Weight': 9}
Published data Successfully: %s {'name': 'Bin_1', 'lat':
13.092677, 'lon': 80.188314, 'Level': 3, 'Weight': 10}
ALERT !! Weight is HIGH
Published data Successfully: %s {'name': 'Bin_1', 'lat':
13.092677, 'lon': 80.188314, 'Level': 4, 'Weight': 1}
```

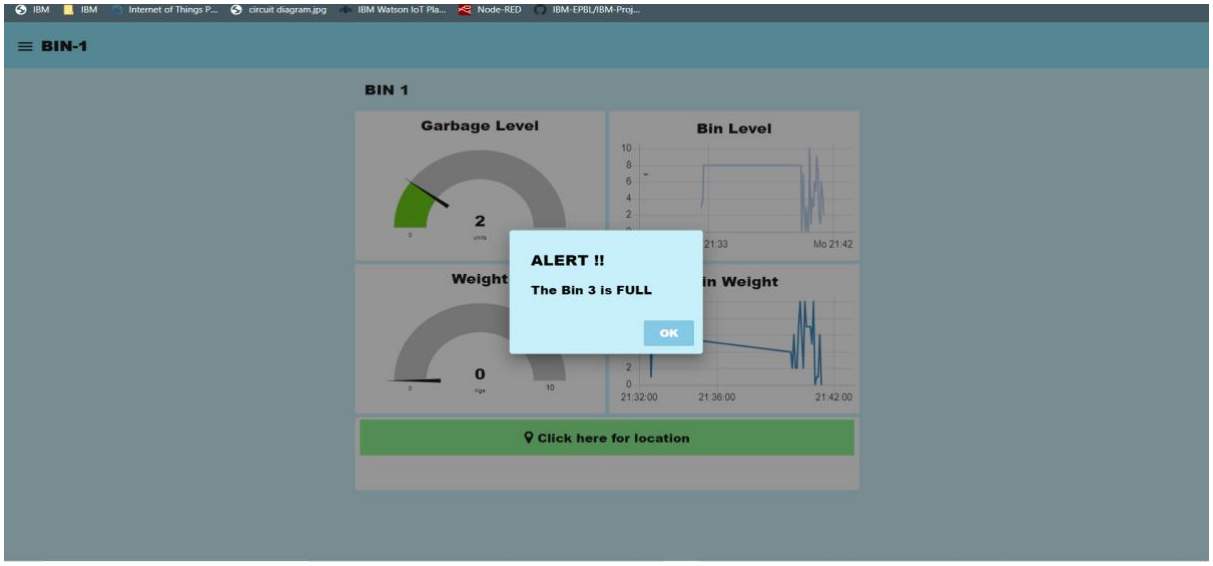
FEATURE 3 – Node RED

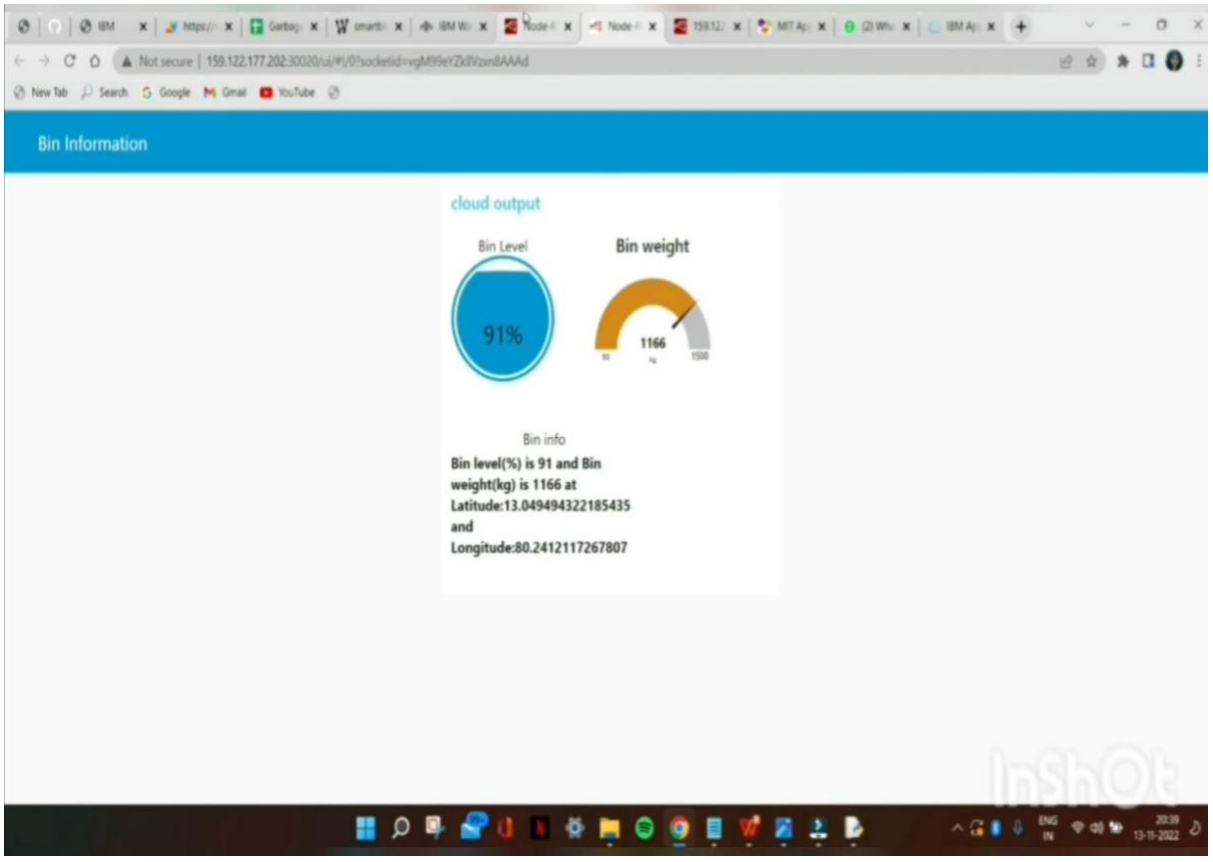


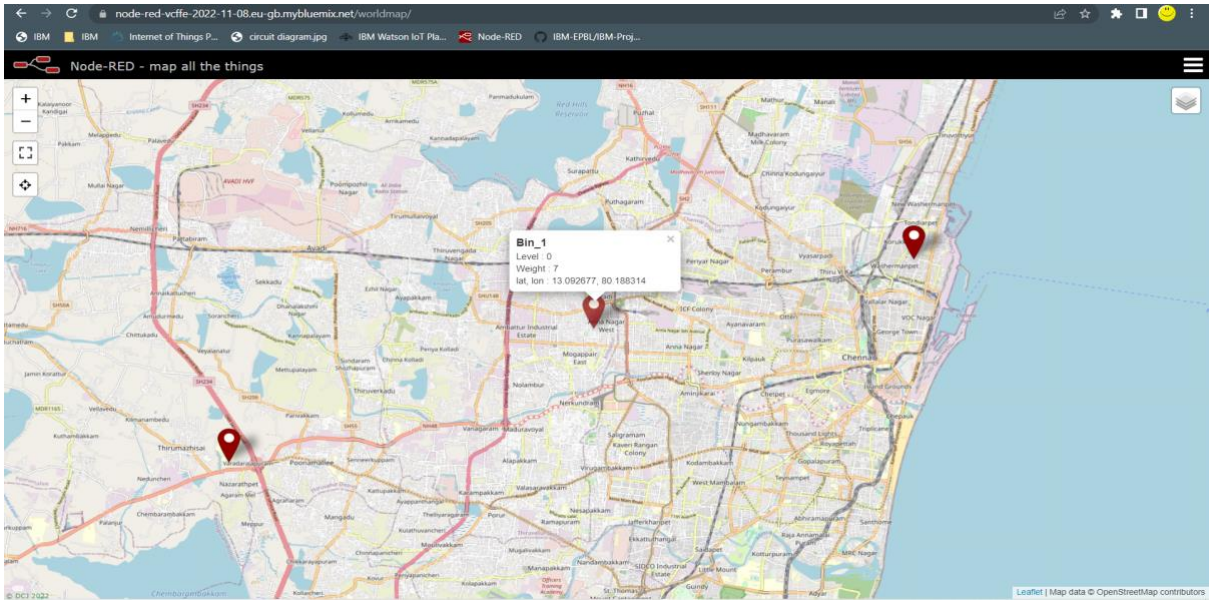
8.TESTING

Test cases help guide the tester through a sequence of steps to validate whether a software application is free of bugs, and working as required by the end-user.

Learning how to write test cases for software requires basic writing skills, attention to detail, and a good understanding of the application under test (AUT).

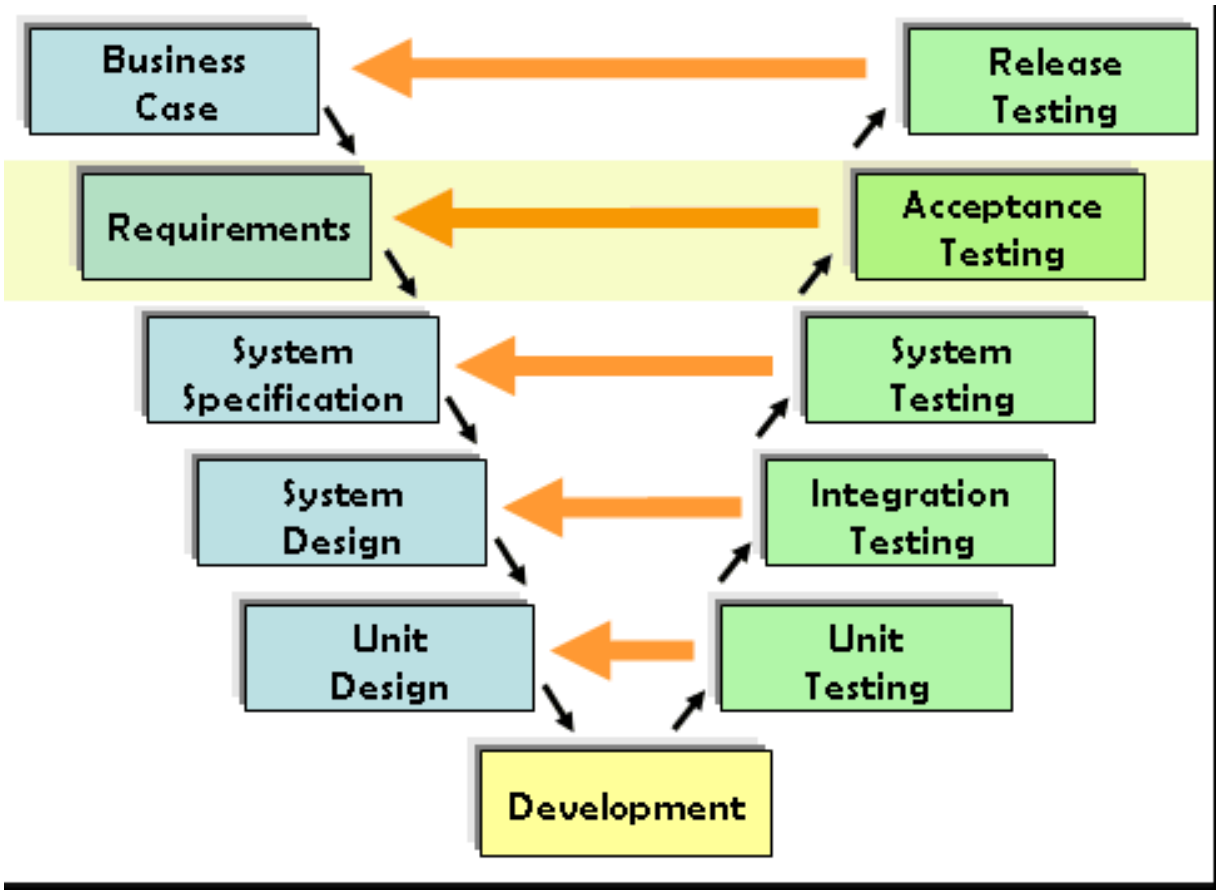

BIN-1
BIN 1
Garbage Level
2
Bin Level
ALERT !!
The Bin 3 is FULL
OK
Weight
0
in Weight
Click here for location


Not secure | 159.122.177.202:30020/ui/#!/0?socketid=vgM99eYZkIVzxn8AAAd
Bin Information
cloud output
Bin Level
91%
Bin weight
1166
Bin info
Bin level(%) is 91 and Bin weight(kg) is 1166 at Latitude:13.049494322185435 and Longitude:80.2412117267807



User Acceptance Testing:

UAT consists, in practice, of people from the target audience using the application. The defects they find are then reported and fixed. This scenario is what most closely resembles "the real world." The process allows users to "get their hands dirty" with the application. They can see if things work as intended



User Acceptance Testing is carried out in a separate testing environment with a production-like data setup. It is a kind of black box testing where two or more end-users will be involved.

10. ADVANTAGES AND DISADVANTAGES

ADVANTAGES :

- By having a more convenient route garbage trucks spend less time on the road, therefore, congestion in smart cities can be decreased.
- With the huge increase in waste, more resources are allocated to waste collection and handling
- his frees up resources for municipalities to allocate to other initiatives. Moreover, waste is properly handled and sorted and turned into recyclable assets, this provides a further potential income stream.
- Overflowing bins will pollute the environment potentially contaminating areas and harming the general health of the public.
- An optimized route and system for waste collection will eliminate this risk as well as improving air quality and minimizing CO2 emissions. Smart cities can reduce their overall carbon footprint, bringing them closer to achieving the SDG goals.
- action can be taken before having an overflow of containers. Smart cities can remain highly responsive and challenge the current waste hierarchy, breaking patterns of inefficiency and high costs.
- By routes being monitored, the opportunity of the misuse of owned assets is eliminated.
- Smart cities infrastructure and intelligent waste solutions have the potential to lead the shift towards a more sustainable future.

DISADVANTAGES:

- 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.
- Malfunctioning of sensors lead to an error
- Sensor nodes used in the dustbins have limited memory size.
- The Training has to be provided to the people involved in the smart waste management system.
- It reduces man power requirements which results into increase in unemployment for unskilled people.

CONCLUSION :

Due to the absence of sustainable waste management technology, the current waste disposal situation is likely to worsen . This work presents an enhanced solution to the problem of waste management by the littering of the garbage bins once they are full . Littering of the environment and the health hazards are minimized as timely disposal of the wastes is ensured as the system automatically sends a message alert to the garbage collector or the management authority once the bin is full thereby ensuring that the bin is made empty to avoid dumping of refuse on the floor.

11. FUTURE SCOPE

We can add GPS to this project. This will help to track the position in case there are more dustbins and It will stop overflowing of dustbins along roadsides and localities as smart Dustbins are managed in real time . In our system, the Smart dustbins are connected to the internet to get the real time information of the smart dustbins . In the recent years, there was a rapid growth in population which leads to more waste disposal. So a proper waste management system is necessary to avoid spreading some deadly diseases

12. APPENDIX

SOURCE CODE

```
#Bin 1
import wiotp.sdk.device
import time
import random

myConfig = {
  "identity": {
    "orgId": "fzv53v",
    "typeId": "Bin",
    "deviceId":"Bin_1"
  },
  "auth": {
    "token": "1234567890"
  }
}



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()

def pub (data):
  client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0, onPublish=None)
  print ("Published data Successfully: %s", myData)
  if weight == 10:
        print ('ALERT !! Weight is HIGH')
  if level == 10:
        print ('ALERT !! Level is HIGH')



while True:
      level=random.randint(0,10)

      myData={'name': 'Bin_1', 'lat': 13.092677, 'lon': 80.188314 ,'Level':level,'Weight':weight}
      pub (myData)
      time.sleep (5)
      client.commandCallback = myCommandCallback
client.disconnect ()
```

DEMONSTRATION LINK

GitHub link: https://github.com/IBM-EPBL/IBM-Project-29216-1664540371

Project demo link : https://youtu.be/iYan4L3aJq8