

SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES

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1.INTRODUCTION

1.1 Project Overview

Garbage may consists of unwanted material leftover from City, Public area, Society, College, home etc. For the smart lifestyle, cleanliness is needed, and cleanliness begins with Garbage Bin. Pollution is the spread of contaminants into an environment that causes instability, disorder, harm or discomfort to the environment. Solid waste management is one of the major environmental problems of India. Solid waste management is the collection, transport, disposal, managing and monitoring of waste material. Garbage may consist of the municipal solid waste construction waste, commercial waste, industrial waste etc... left over the city. This project is related to the “Smart City” and based on “Internet of Things” (IOT).To overcome the wate management problem, a web page is built to show the status to the user monitoring it. Once the garbage bin gets filled, the solenoid lock will be locked. Only after the user unlocks it, garbage bin can be used again. Thus we can avoid spilling of waste in public places, which in turn leads to a healthy environment.

1.2 Purpose

For healthy lifestyle cleanliness is needed and it begins with the use of trash bins. This project will help to eradicate or minimize the solid waste disposal problem. In present scenario, many times we see the garbage bins gets overloaded due to increase in solid waste

everyday. It creates unhygienic environment and bad smell in the society and because of this many disease get spread in the society, to avoid this situation we are designing “Smart Waste Management System using Internet of Things” In this proposed system the multiple trash bins are located throughout the city, these trash bins are embedded with low cost embedded device. The proposed system is cost effective because it will notify to the organization and they will get time to optimize the cost of transportation.

2.LITERATURE SURVEY

2.1 Existing Problem

We have noticed that our city is filled with garbage at every nook and corner. I am trying to prevent people from disease caused by spilling of garbage. But it is not possible to find a solution only by giving awareness to people about spillage of garbage. Because giving awareness does not reach every person which makes me feel to develop a project on waste management to prevent each and every individual from disease. Thus we can keep our environment clean and disease free.

2.2 References

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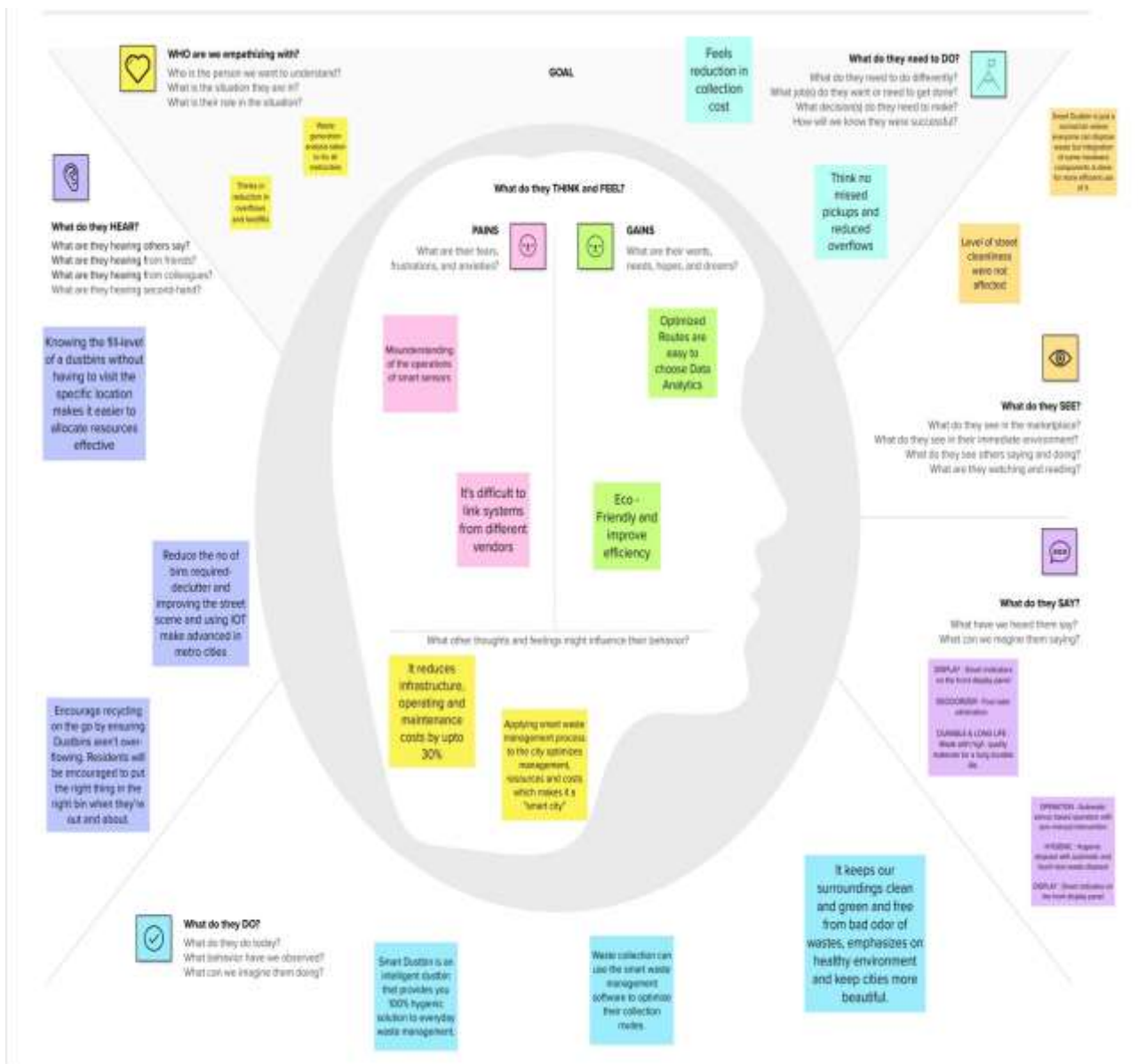
2.3 Problem Statement Definition

Due to increase in population in metropolitan cities, the disposal of waste is also increased. A big challenge in the urban cities is solid waste management. People throw garbage on that dustbin which is already overflowed. Sometimes due to unclean garbage bins bad smell arises also toxic and unhygienic gases are produced which is way to support to the air pollution and to some harmful diseases which are easily spreadable. Nowadays, there are tons of flats and apartments which have been built in the rapid urbanization area. This is due to high housing demands which have been drastically risen as a result of migration from villages to cities to find work. In order to accommodate the growing population in the urban area, the government has also constructed more apartment complexes. 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. 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 waste is one of the primary problems of the present era.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation and Brain Storming



3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	There are several issues faced by the residents of the flats. One of them is the disposal of solid waste. This is due to high housing demands which have drastically risen because of migration from villages to cities to find work.

2.	Idea / Solution description	The garbage level in dustbins is monitored continuously and lock the dustbin with help of a solenoid lock if the dustbin gets filled. Thus no one can able to open it before the disposal of waste.
3.	Novelty / Uniqueness	<p>In this project, we used an ultrasonic sensor to detect the garbage level and solenoid lock.</p> <p>Once the dustbin is filled the sensor automatically sends the notification through IoT and activates the lock, then the dustbin will get locked.</p>
4.	Social Impact / Customer Satisfaction	<p>Makes a clean and healthy environment.</p> <p>To automate the waste management process efficiently. This avoids voids infectious diseases like dengue, cholera, and parasitic diseases.</p>
5.	Business Model (Revenue Model) social and economic quality.	Waste Management incurs costs in relation to the procurement of supplies and equipment – including vehicles, the development of its website and online platform, the maintenance of its IT and communications infrastructure, the operation of its physical waste management facilities, the management of its partnerships, the implementation of marketing and advertising campaigns, and the retention of its personnel.

6.	Scalability of the Solution	Smart cities can create safe and sustainable environments that are centered on the well-being of their inhabitants. They can and do achieve that success by focusing on accessibility, transportation, improved healthcare, and reduced waste to improve social and economic quality.
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3.4 Problem Solution Fit

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) CS Each and every individual in the society	6. CUSTOMER CONSTRAINTS CC Since metropolitan cities covers large area, implementation of this project requires more time and each and every individual should work for it. Also we are lack of development of technology in this field is a major issue.	5. AVAILABLE SOLUTIONS AS The garbage level in dustbins is monitored continuously monitored and once if the dustbin gets filled it automatically gets locked and the message will be sent to the municipality workers. This will be the best solution for this problem.	Explore AS, differentiate
	2. JOBS-TO-BE-DONE / PROBLEMS J&P There are several issues faced by the residents of the flats. One of them is the disposal of solid waste. This is due to high housing demands which have drastically risen because of migration from villages to cities to find work.	9. PROBLEM ROOT CAUSE RC The main reason for this problem is increase in population in metropolitan cities. This is mainly due to development of the technology and people started to migrate from rural areas to urban due to unemployment.	7. BEHAVIOUR BE They should inform the municipality workers about the problem or they should voluntarily involve in waste management activities.	
Focus on J&P, tap into BE, understand RC	3. TRIGGERS TR They get triggered after seeing the people who are affected with some diseases like cholera, typhoid and some skin diseases due to the improper handling of waste. And also by seeing awareness programs about waste management.	10. YOUR SOLUTION SL Our solution for this problem is the garbage level of the dustbin is continuously monitored by the sensor and once if the dustbin get filled, it automatically gets locked. Simultaneously message will be sent to the respective municipality worker and then he can dispose the waste effectively.	8. CHANNELS of BEHAVIOUR CH Online: Advertising about the issue in internet, television, and creating some postures about the impact of the problem. Offline: Organising a campaign and awareness program in public places and schools.	Identify strong TR & EM
	4. EMOTIONS: BEFORE / AFTER EM Before: They get affected with some air borne diseases and the city is also more polluted. After: But it helps them to diagnose about the problem in early stage and they took some effective measures in waste management to avoid the problem.			

4. REQUIREMENTS

4.1 Functional Requirements

FR No.	Functional Requirement	Description
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 inefficient 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

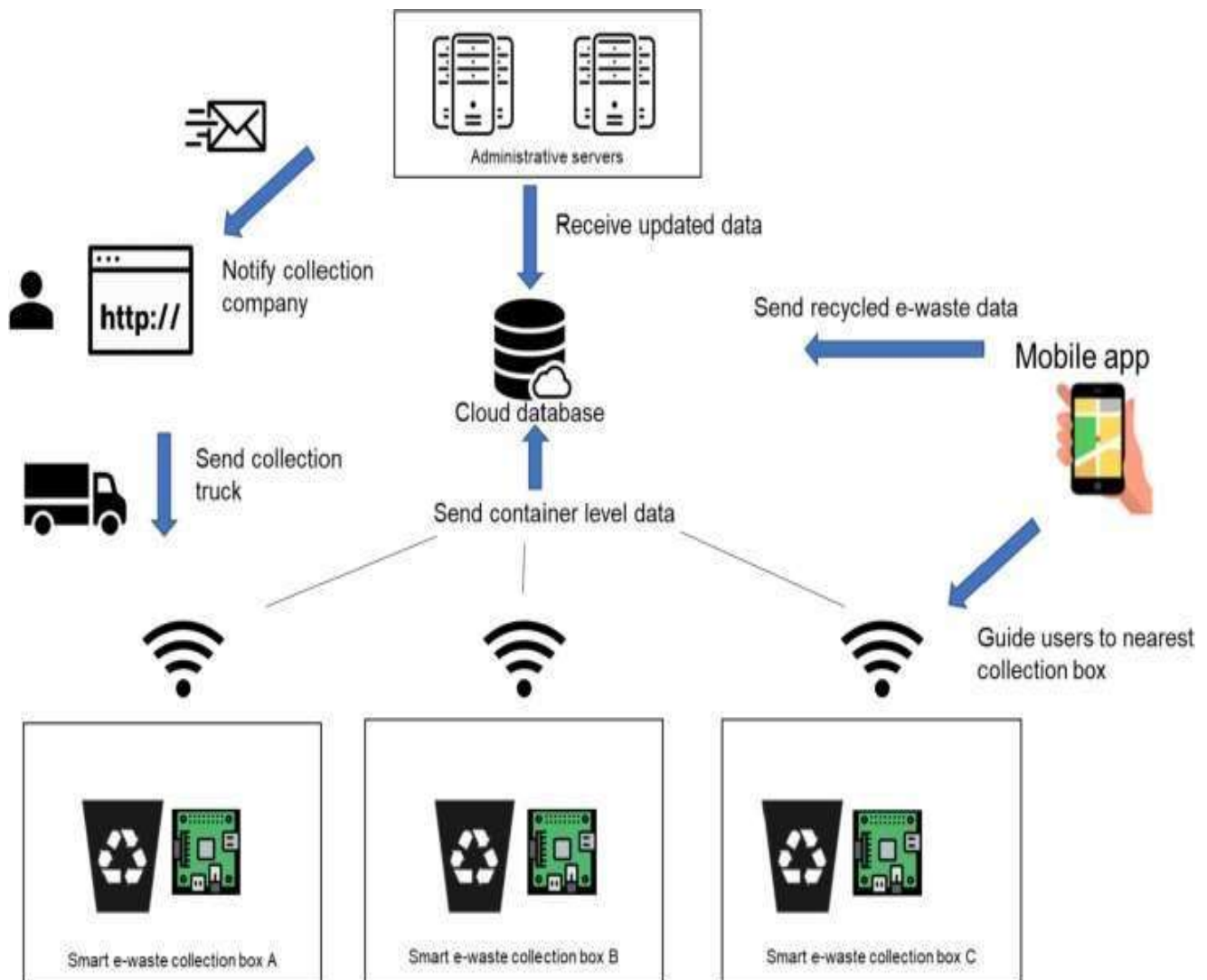
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	IoT device verifies that usability is a special and important perspective to analyze user requirements, which can further improve the design quality. In the design process with user experience as the core, the analysis of users' product usability can indeed help designers better understand

		users' potential needs in waste management, behavior and experience.
NFR-2	Security	<p>Use a reusable bottles</p> <p>Use reusable grocer bags</p> <p>Purchase wisely and recycle</p> <p>Avoid single use food and drink containers.</p>
NFR-3	Reliability	<p>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.</p>
NFR-4	Performance	<p>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.</p>
NFR-5	Availability	<p>By developing & deploying resilient hardware and beautiful software we empower cities, businesses, and countries to manage waste smarter.</p>
NFR-6	Scalability	<p>Using smart waste bins reduce the number of bins inside town , cities coz we able to monitor the garbage 24/7 more cost effect and scalability when we moves to smarter.</p>

5. PROJECT DESIGN

5.1 Dataflow Diagrams

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within the system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leave the system, what changes information, and where data is saved. A smart waste management platform uses analytics to transfer the data gather in your into actionable insights to help you improve your waste service. You can receive data on metric such as



5.2 Solution & Technical Architecture

A smart waste management platform uses analytics to transfer the data gather in your into actionable insights to help you improve your waste service. You can receive data on metric such as:

- The first test conducted is the situation where the garbage bin is empty or its garbage level is very low.
- Then, the bin is filled with more garbage until its level has surpassed the first threshold value which is aid to 80% then the first warning SMS is being sent , as depicted.
- The first notification SMS sent by the system, once the waste reaches the level of 85% full.
- The second notification SMS sent by the system, indicating that bin is at least 95% full and the garbage needs to be collected immediately.
- Locations prone to overflow
- The number of bins needed to avoid overflowing waste is reduced.
- The number of collection services that could be saved
- The amount of fuel could be saved
- The driving distance could be saved

5.3 User Stories

User Type	Functional Requirement(Epic)	User Story Number	User Story/Task	Acceptance Criteria	Priority	Release
Admin(Who Manage web Server)	Login	USN-1	As an Admin, I gave user id and password for ever workers and manage them.	I can manage web account / dashboard	Medium	Sprint-2
Co Admin	Login	USN-2	As a Co Admin, I'll manage garbage level monitor if garbage get filling alert will post location and garbage id to trash truck	I can manage garbage monitoring	High	Sprint-1
TruckDriver	Login	USN-3	As Truck Driver, I'll follow the route send by Co Admin to reach the filled garbage	I can drive to reach the garbagefilled route in shortest route given	Medium	Sprint-2
Local Garbage Collector	Login	USN-4	As a Waste Collector, I'll collectall the trash from garbage and load into garbage truck and send them to landfill	I can collect trashand pulled to truck and send off	Medium	Sprint-2
Municipality	Login	USN-5	As a Municipality, I'll check the process are happening in discipline manner without any issues	I can manage all these process are going good	High	Sprint-1

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	Task	Story Points	Priority	Team Members
Sprint-1	Registration	As a team lead , I can enrolled for the project by entering my email, password and within that I can enter my team members name and their email.	2	High	TL
Sprint-1		As a team lead , I will receive confirmation email once , I have enrolled for the projectwith team id and along with team members name.	2	High	TL
Sprint-2	Login	As a team member, I can login to the IBM portal by entering email & password	1	Medium	TM-1
Sprint-2		As a team member, I can login to the IBM portal by entering email & password	1	Medium	TM-2
Sprint-2		As a team member, I can login to the IBM portal by entering email & password	1	Medium	TM-3
Sprint-2		As a team member, I can login to the IBM portal by entering email & password	1	Medium	TM-4

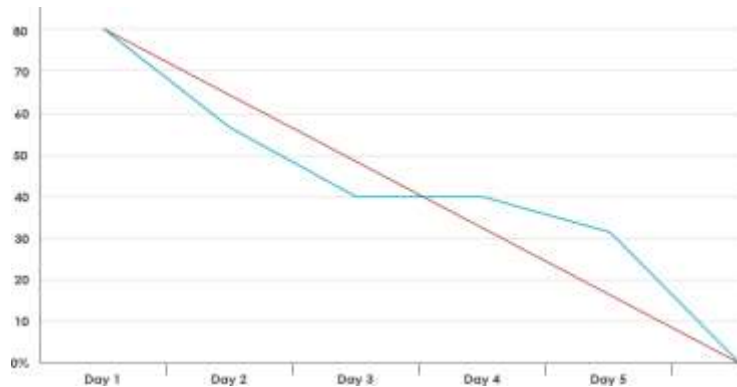
6.2 Sprint delivery Schedule

Project Tracker, Velocity & Burndown Chart:

Sprint	Total Story Points	Duration	Sprint StartDate	Sprint End Date (Planned)	Story Points Completed (Planned EndDate)	Sprint ReleaseDate (Actual)
Sprint-1	20	6 Days	22 Oct 2022	27 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	30	30 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	49	06 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	50	07 Nov 2022

Velocity:

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



DELIVERY OF SPRINT – 1
Functional Requirement – Sign in / Sign up

User story : USN – 1

HTML CODE :

```
<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="UTF-8" />
<meta name="viewport" content="width=device-width, initial-scale=1.0" />
<title>Smart Waste Management System</title>
<!-- Bootstrap 4 CSS CDN -->
<link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/twitter-
bootstrap/4.5.2/css/bootstrap.min.css" />
<!-- Fontawesome CSS CDN -->
<link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/5.14.0/css/all.min.css" />
<link rel="stylesheet" href="css/style.css" />
</head>
<body class="bg-info">
<div class="container">
<!-- Login Form Start -->
<div class="row justify-content-center wrapper" id="login-box">
```



```

<div class="col-lg-10 my-auto myShadow">

<div class="row">

<div class="col-lg-7 bg-white p-4">
<h1 class="text-center font-weight-bold text-primary">Sign in</h1>
<hr class="my-3" />

<form action="#" method="post" class="px-3" id="login-form">

<div class="input-group input-group-lg form-group">

<div class="input-group-prepend">
<span class="input-group-text rounded-0"><i class="far fa-envelope fa-lg
fa-fw"></i></span>

</div>

<input type="email" id="email" name="email" class="form-control rounded-0"
placeholder="E-Mail" required />
</div>

<div class="input-group input-group-lg form-group">
<div class="input-group-prepend">
<span class="input-group-text rounded-0"><i class="fas fa-key fa-lg fa-fw"></i></span>

</div>

    <input type="password" id="password" name="password" class="form-control
rounded-0" minlength="5" placeholder="Password" required autocomplete="off" />
</div>

<div class="form-group clearfix">

```

```

<div class="custom-control custom-checkbox float-left">

<input type="checkbox" class="custom-control-input" id="customCheck" name="rem" />

<label class="custom-control-label" for="customCheck">Remember me</label>

</div>

<div class="forgot float-right">

<a href="#" id="forgot-link">Forgot Password?</a>

</div>

</div>

<div class="form-group">

<input type="submit" id="login-btn" value="Sign In" class="btn btn-primary btn-lg btn-
block myBtn" />

</div>

</form>

</div>

<div class="col-lg-5 d-flex flex-column justify-content-center myColor p-4">

<h1 class="text-center font-weight-bold text-white">Welcome Friend!</h1>

<hr class="my-3 bg-light myHr" />

<p class="text-center font-weight-bolder text-light lead">Start your initiative to make your
environment clean</p>

<button class="btn btn-outline-light btn-lg align-self-center font-weight-bolder mt-4
myLinkBtn" id="register-link">Sign Up</button>

</div>

</div>

</div>

```

</div>

<!-- Login Form End -->

<!-- Registration Form Start -->

<div class="row justify-content-center wrapper" id="register-box" style="display: none;">

<div class="col-lg-10 my-auto myShadow">

<div class="row">

<div class="col-lg-5 d-flex flex-column justify-content-center myColor p-4">

<h1 class="text-center font-weight-bold text-white">Welcome Back!</h1>

<hr class="my-4 bg-light myHr" />

<p class="text-center font-weight-bolder text-light lead">To stay connected Please login with your personal info.</p>

<button class="btn btn-outline-light btn-lg font-weight-bolder mt-4 align-self-center myLinkBtn" id="login-link">Sign In</button>

</div>

<div class="col-lg-7 bg-white p-4">

<h1 class="text-center font-weight-bold text-primary">Create Account</h1>

<hr class="my-3" />

</div>

<input type="password" id="password" name="password" class="form-control rounded-0" minlength="5" placeholder="Password" required autocomplete="off" />

</div>

<div class="form-group clearfix">

<div class="custom-control custom-checkbox float-left">

```

<input type="checkbox" class="custom-control-input" id="customCheck" name="rem" />
<label class="custom-control-label" for="customCheck">Remember me</label>
</div>
<div class="forgot float-right">
<a href="#" id="forgot-link">Forgot Password?</a>
</div>
</div>
<div class="form-group">
<input type="submit" id="login-btn" value="Sign In" class="btn btn-primary btn-lg btn-
block myBtn" />
</div>
</form>
</div>
<div class="col-lg-5 d-flex flex-column justify-content-center myColor p-4">
<h1 class="text-center font-weight-bold text-white">Welcome Friend!</h1>
<hr class="my-3 bg-light myHr" />
<p class="text-center font-weight-bolder text-light lead">Start your initiative to make your
environment clean</p>
<button class="btn btn-outline-light btn-lg align-self-center font-weight-bolder mt-4
myLinkBtn" id="register-link">Sign Up</button>
</div>
</div>
</div>
</div>

```

<!-- Login Form End -->

<!-- Registration Form Start -->

`<div class="row justify-content-center wrapper" id="register-box" style="display: none;">`

`<div class="col-lg-10 my-auto myShadow">`

`<div class="row">`

`<div class="col-lg-5 d-flex flex-column justify-content-center myColor p-4">`

`<h1 class="text-center font-weight-bold text-white">Welcome Back!</h1>`

`<hr class="my-4 bg-light myHr" />`

`<p class="text-center font-weight-bolder text-light lead">To stay connected Please login with your personal info.</p>`

`<button class="btn btn-outline-light btn-lg font-weight-bolder mt-4 align-self-center myLinkBtn" id="login-link">Sign In</button>`

`</div>`

`<div class="col-lg-7 bg-white p-4">`

`<h1 class="text-center font-weight-bold text-primary">Create Account</h1>`

`<hr class="my-3" />`

`<div class="col-lg-10 my-auto myShadow">`

`<div class="row">`

`<div class="col-lg-7 bg-white p-4">`

`<h1 class="text-center font-weight-bold text-primary">Forgot Your Password?</h1>`

`<hr class="my-3" />`

`<p class="lead text-center text-secondary">To reset your password, enter the registered e-mail address and we will send you password reset instructions on your e-mail!</p>`

```

<form action="#" method="post" class="px-3" id="forgot-form">

<div id="forgotAlert"></div>

<div class="input-group input-group-lg form-group">

<div class="input-group-prepend">
<span class="input-group-text rounded-0"><i class="far fa-envelope fa-lg"></i></span>
</div>

<input type="email" id="femail" name="email" class="form-control rounded-0"
placeholder="E-Mail" required />

</div>

<div class="form-group">
<input type="submit" id="forgot-btn" value="Reset Password" class="btn btn-primary btn-
lg btn-block myBtn" />

</div>

</form>

</div>

<div class="col-lg-5 d-flex flex-column justify-content-center myColor p-4">

<h1 class="text-center font-weight-bold text-white">Reset Password!</h1>
<hr class="my-4 bg-light myHr" />

<button class="btn btn-outline-light btn-lg font-weight-bolder myLinkBtn align-self-
center" id="back link">Back</button>

</div>

</div>

</div>

</div>

```

<!-- Forgot Password Form End -->

</div>

<!-- jQuery CDN -->

<script src="https://cdnjs.cloudflare.com/ajax/libs/jquery/3.5.1/jquery.min.js"></script>

<script src="js/script.js"></script>

</body>

</html>

CSS CODE :

@import

url("https://fonts.googleapis.com/css?family=Maven+Pro:400,500,600,700,800,900&display=swap");

*** {**

margin: 0; padding: 0; box-sizing:

border-box; font-family: "Maven Pro", sans-serif;

}

.wrapper

{ height: 100vh;}

.myColor

{

background-image: linear-gradient(to right, #324bf3 50%, #f9d423 150%);

}

.myShadow {

box-shadow: 0 10px 10px rgba(0, 0, 0, 0.5);

```

}
.myBtn { border-radius: 50px; font-weight: bold; font-size: 20px; background-image:
linear-gradient(to right, #0acffe 0%, #495aff 100%); border: none;
}
.myBtn:hover { background-image: linear-gradient(to right, #495aff 0%, #0acffe 100%);
}
.myHr { height: 2px; border-radius: 100px;
}
.myLinkBtn { border-radius: 100px; width: 50%; border: 2px solid #fff;
}
@media (max-width: 720px) {
.wrapper { margin: 2px;
}
}
}

```

JS CODE:

```

$(function () {

$("#register-link").click(function () {

$("#login-box").hide();

$("#register-box").show();

});

$("#login-link").click(function () {

$("#login-box").show();

```



```
$("#register-box").hide();

});

$("#forgot-link").click(function () {

$("#login-box").hide();

$("#forgot-box").show();

});

$("#back-link").click(function () {

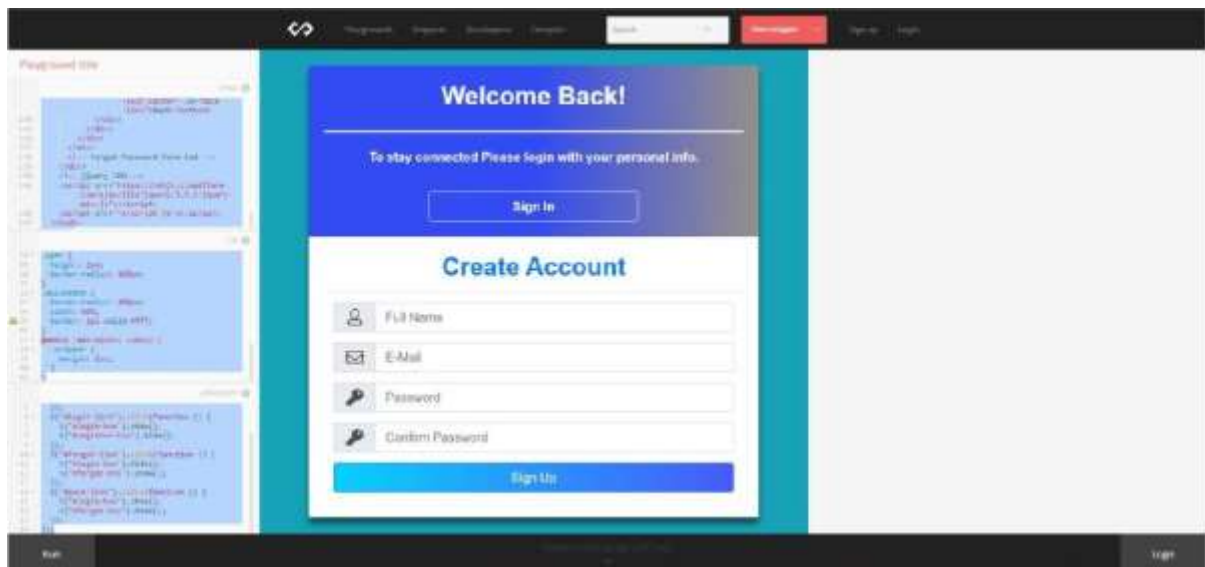
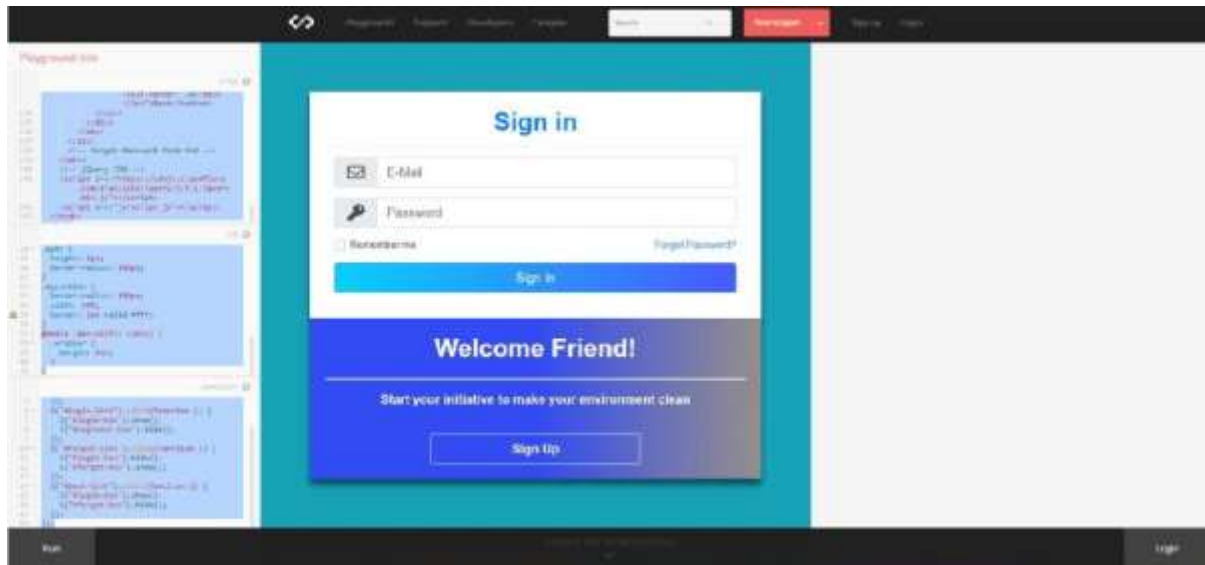
$("#login-box").show();

$("#forgot-box").hide();

});

});
```

OUTPUT



SPRINT 2

CODE :

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

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

#define ORG "cbseji" // IBM organisation id

#define DEVICE_TYPE "abcd"          // Device type mentioned in ibm watson
iot platform#define DEVICE_ID "1234"      // Device ID mentioned in ibm watson
iot platform #define TOKEN "12345678" // 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 wificlientPubSubClient
client(server, 1883, wifiClient);
```

```

#define ECHO_PIN 12

#define TRIG_PIN 13 float dist;

void setup()

{

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;

}

void loop()

{

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)

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);
}

else if(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)
}

else if(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");
}

}

else if(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

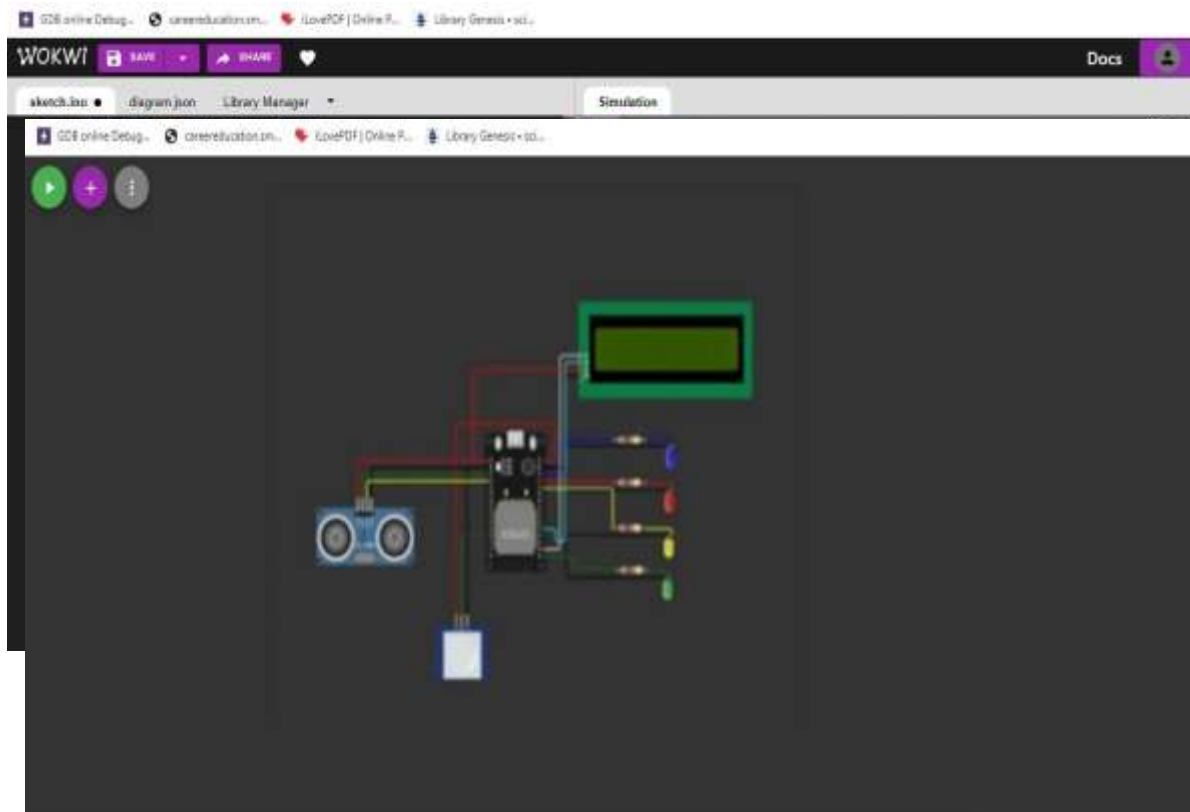
Serial.println();

}

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"); 1
  cd.setCursor(1,1);
  lcd.print(inches, 1);1
  cd.setCursor(11,1);
  lcd.print(cm, 1);
  lcd.setCursor(14,1);
  delay(1000); lcd.clear();
}

```

OUTPUT



SPRINT – 3

PYTHON CODE : [To connect IBM WATSON]

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

# Provide your IBM Watson Device Credentials
organization = "znsc13"
deviceType = "SENSOR"
deviceId = "SENSOR-23"
authMethod = "use-token-auth"
authToken = "12345678"

# Initialize GPIO

def myCommandCallback(cmd):
```

```

    print("Command received: %s" % cmd.data['command'])status=cmd.data['command']
if status=="lighton":print("led is on")
    else :
    print ("led is off")

    #print(cmd)

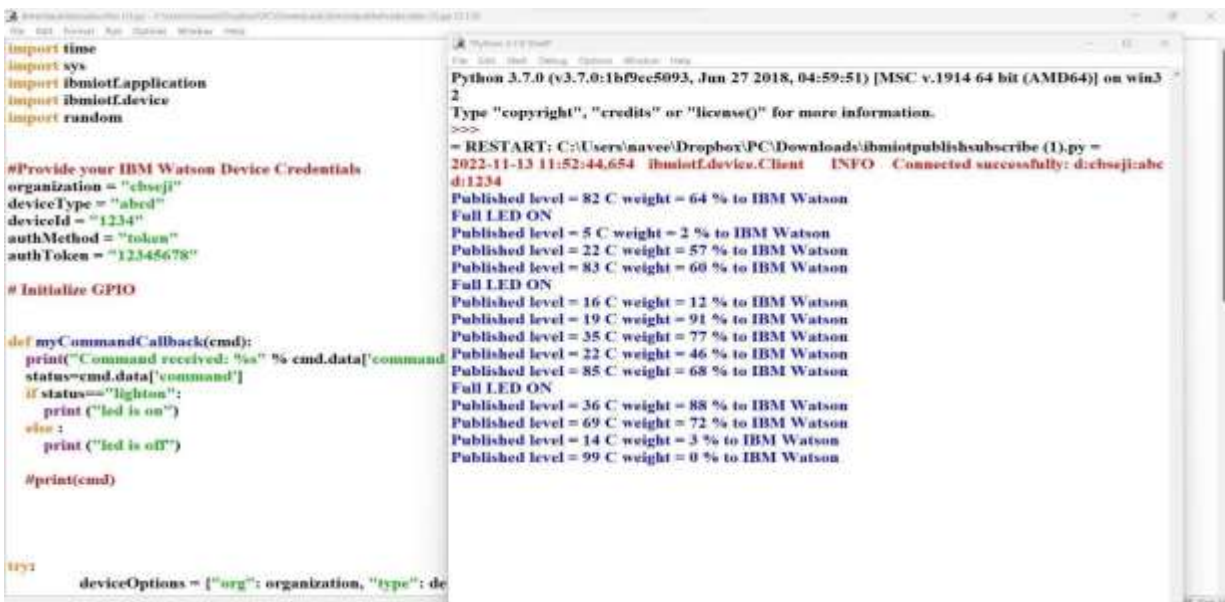
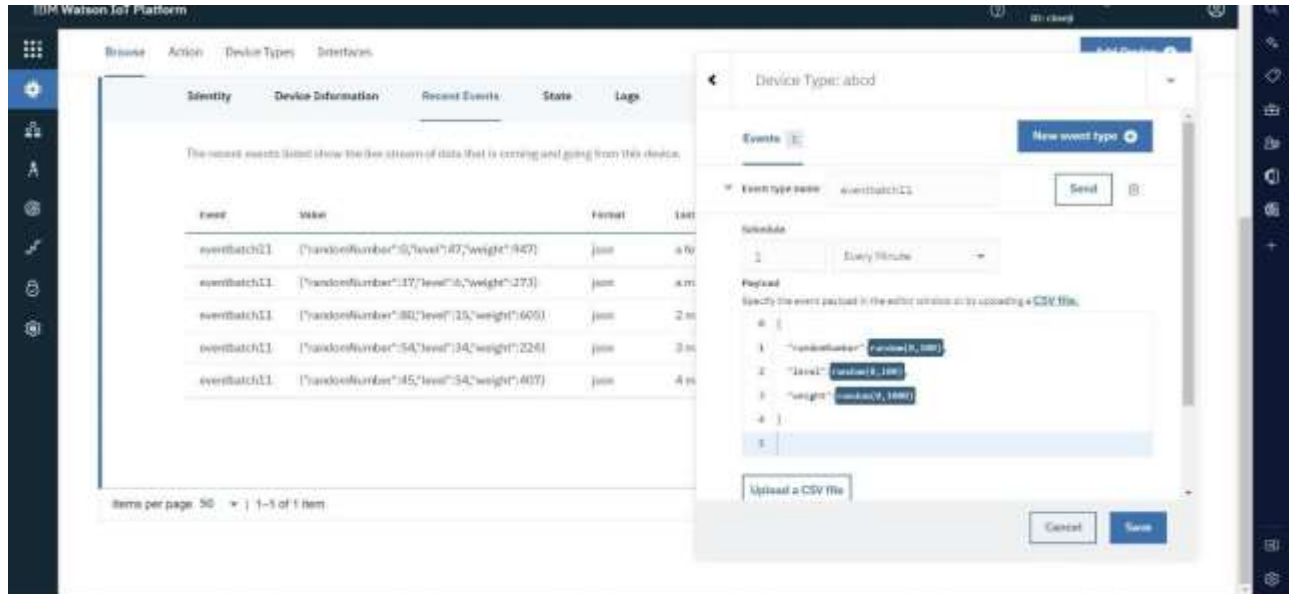
    try:
        deviceOptions = {"org": organization, "type": deviceType, "id":
deviceId, "auth-method": authMethod, "auth-token": authToken}deviceCli =
ibmiotf.device.Client(deviceOptions) #.....
        except Exception as e:
            print("Caught exception connecting device: %s" % str(e))sys.exit()
            # Connect and send a datapoint "hello" with value "world" into thecloud as anevent of type
            "greeting" 10 times
            deviceCli.connect()
            while True:
                #Get Sensor Data from DHT11
                level=random.randint(0,100)weight=random.randint(0,100)
                data = { 'level' : level, 'weight': weight }#print data
                def myOnPublishCallback():
                    print ("Published level = %s C" % level, "weight = %s %% "
                    % weight, "to IBM Watson")
                    success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,on_publish=myOnPubli
                    shCallback)
                    if not success:
                        print("Not connected to IoTF")time.sleep(1)
                        deviceCli.commandCallback = myCommandCallbackif(level>=75):

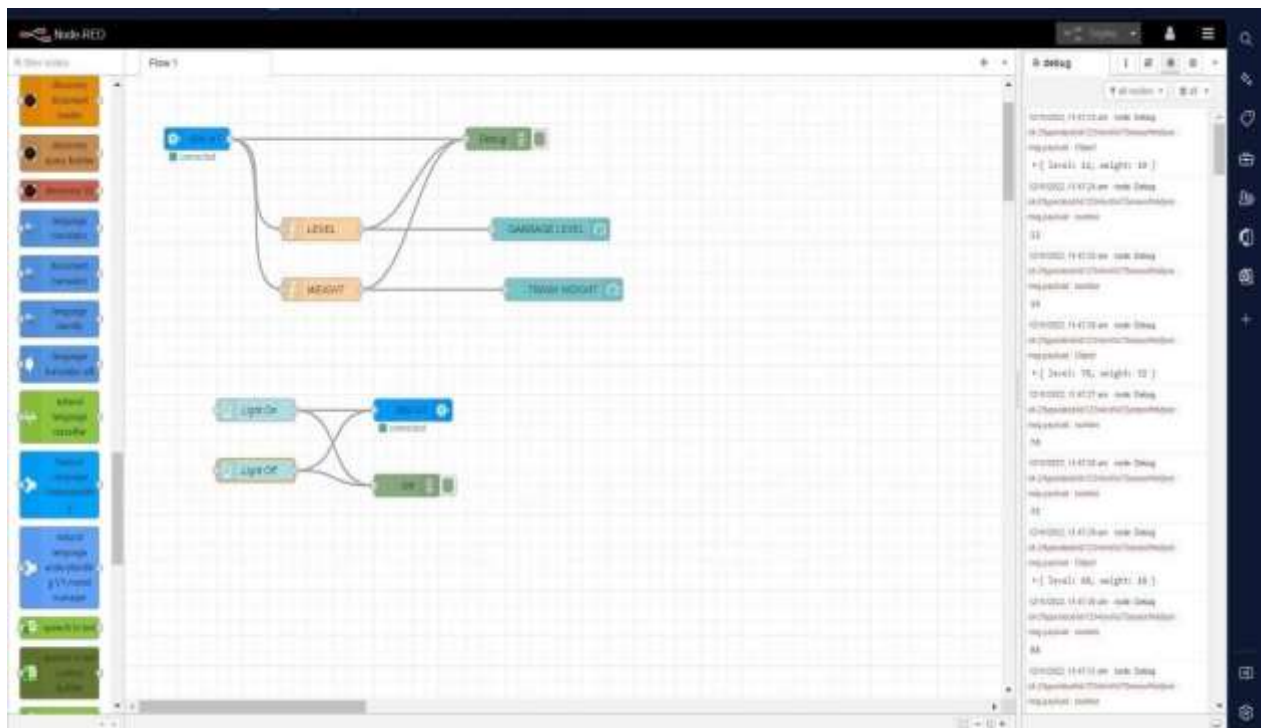
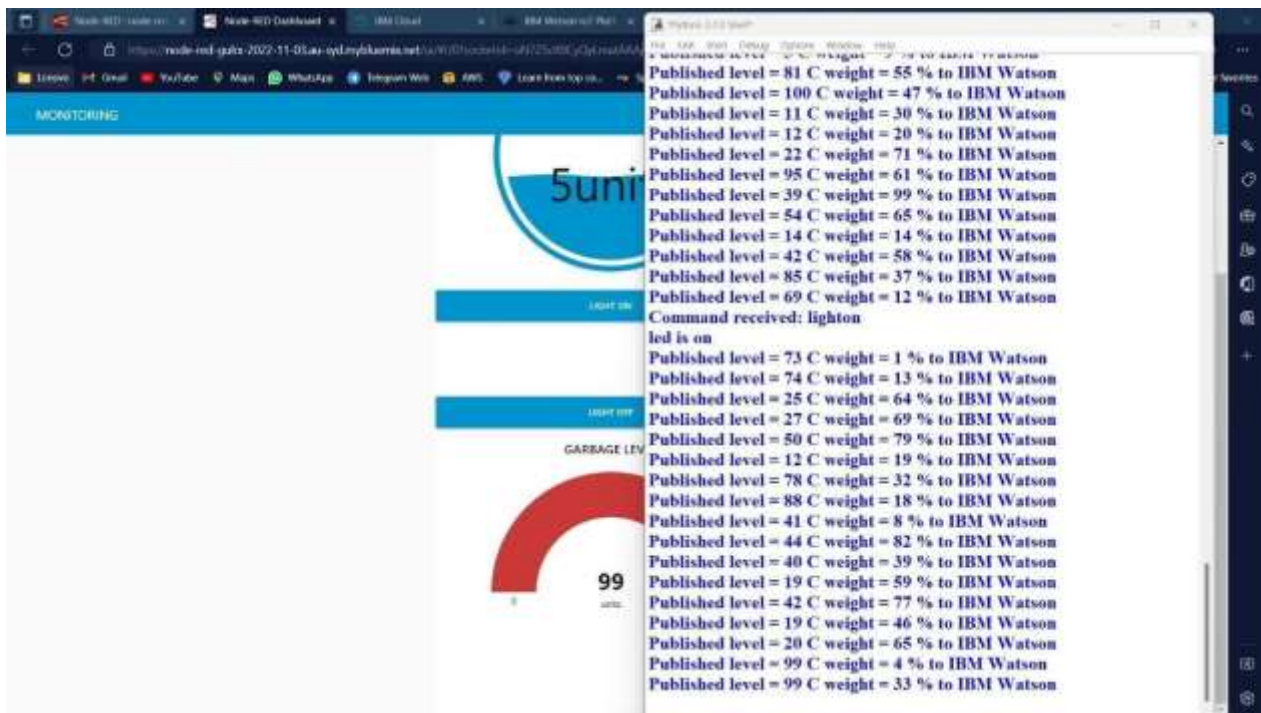
```

```
print("Full LED ON")
```

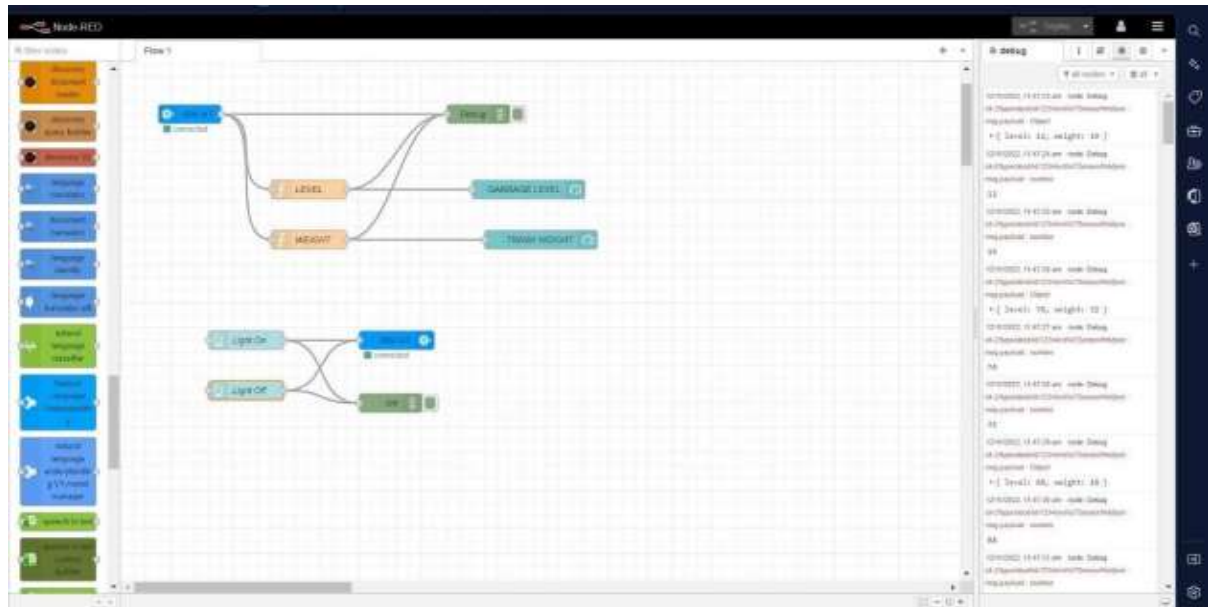
```
# Disconnect the device and application from the clouddeviceCli.disconnect()
```

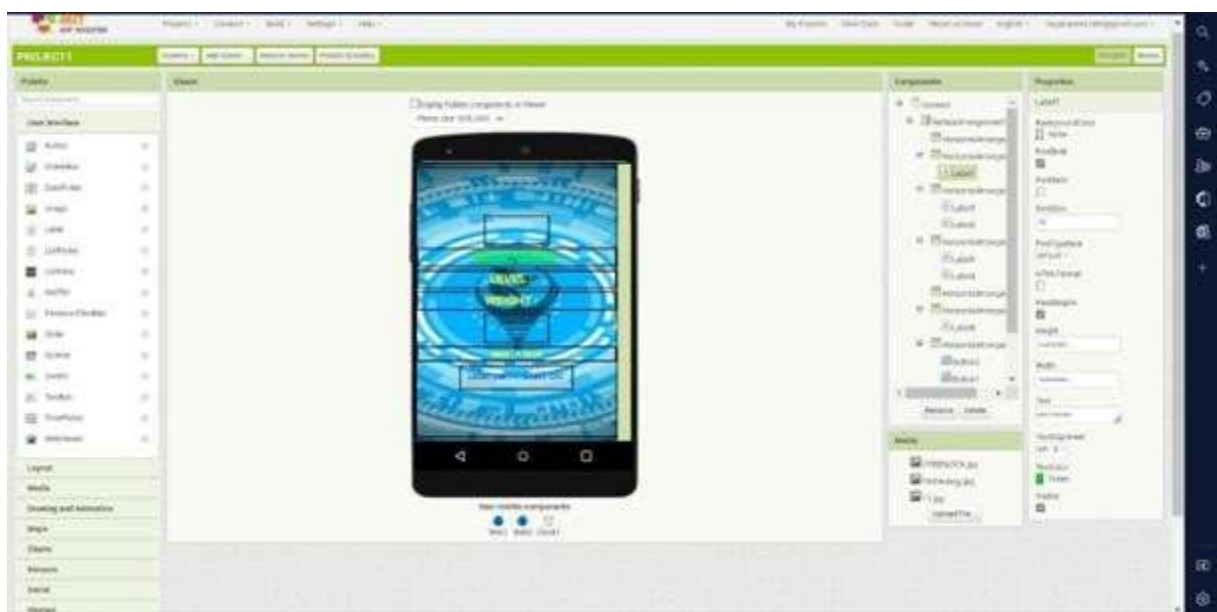
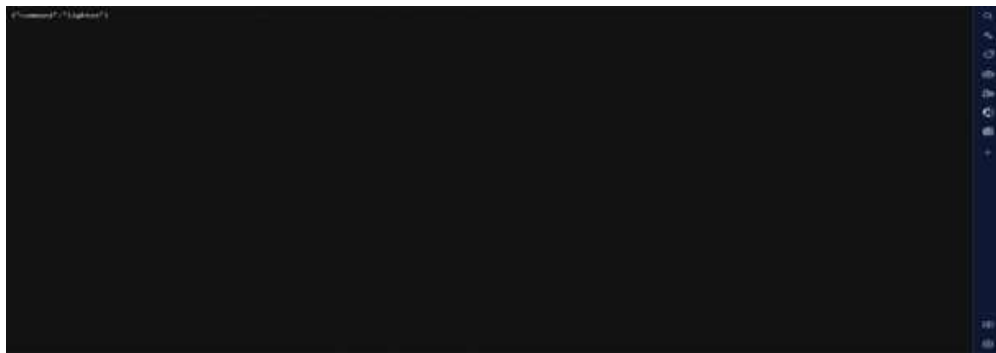
OUTPUT





SPRINT 4





OUTPUT BY PHONE :



SCREEN 1



SCREEN 2



7.CODING AND SOLUTION

7.1 Feature 1

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = "znsc13"
deviceType = "SENSOR"
deviceId = "SENSOR-23"
authMethod = "use-token-
auth"
authToken = "12345678"

# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="lighton":
        print ("led is on")
    else :
        print ("led is off")
    #print(cmd)
```

7.2 Feature 2

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```
try:

deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-
method":

authMethod, "auth-token": authToken}

deviceCli = ibmiotf.device.Client(deviceOptions)

#.....

except Exception as e:

print("Caught exception connecting device: %s" % str(e))

sys.exit()

# Connect and send a datapoint "hello" with value "world" into the cloud as an event
of type

"greeting" 10 times

deviceCli.connect()

while True:

#Get Sensor Data from DHT11

temp=random.randint(0,100)

Humid=random.randint(0,100)

data = { 'temp' : temp, 'Humid': Humid }

#print data

def myOnPublishCallback():

print ("Published Temperature = %s C" % temp, "Humidity = %s %" % Humid,

"to IBM

Watson")

success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,

on_publish=myOnPublishCallback)

if not success:
```

```
print("Not connected to IoTF")
```

```
time.sleep(1)
```

```
deviceCli.commandCallback = myCommandCallback
```

```
# Disconnect the device and application from the clouddeviceCli.disconnect()
```

8. TESTING

8.1 Test Cases:

a. Login testing

We are creating login page for the users and deployed into the testing environment. This login page is tested using credentials.

b. Storage testing

We are testing whether the information from the user is stored as database using cloud login credentials and verifying it for the user.

c. Device testing

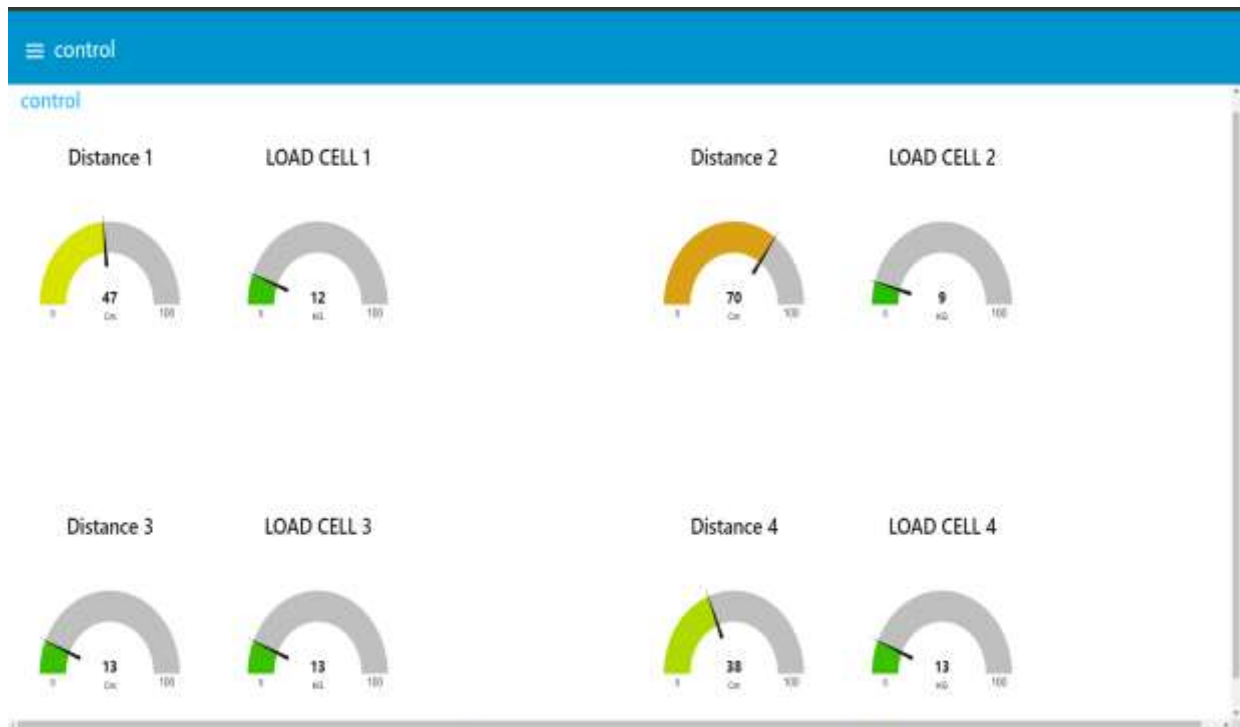
Here the IOT device is created using the cloud login credentials, the sample test case is deployed in the device and code is uploaded and tested in the testing environment.

8.2 User Acceptance Testing

Feature ID	Feature Type	Component	Test Scenario	Pre-Conditions	Steps to Execute	Test Data	Expected Results	Actual Results	Status	Comments	Run As (Automated?)	Run ID	Executed By
ExpPage_7_302	UI	Home Page	Verify whether user is able to access the UI	AMP (UI)	https://www.mcafee.com/usa/#/tools-and-services/endpoint-protection/endpoint-protection	UI	After login user is access the UI	After login user is access the UI	Pass		YES	302A	QA001
ExpPage_7_303	Functional	Home page	User can access the data in signification	AMP (UI)	Is there a scenario where either user capabilities	UI	when a data is specified (user's role)	when the request is not received	Pass	Specify the User Name	YES	303	QA001
ExpPage_7_304	Functional	Home page	User can access the data using mobile	AMP (UI)	After accessing the data, is required to be	UI	User can access the data in specified for the user	when a request is not received	Pass	Functionality	YES	304	QA001
3050_703642_7_305	Functional	Event	Verify if the input is stored in the cloud	1.0.0	After login to access the UI, with the given role, After login to view the development user role and add on the UI button, User role added in the cloud	AMP (UI) AMP (DB) AMP (API) AMP (API) AMP (DB)	After login, user is not stored in the cloud	After login, user is not stored in the cloud	Pass	Specify the development user	YES	305	QA001
	Functional	Event	Verify if the input is stored in the cloud	1.0.0	After login to access the UI, with the given role, After login to access the development user role and add on the UI button, User role added in the cloud	AMP (UI) AMP (DB) AMP (API) AMP (API) AMP (DB)	After login, user is not stored in the cloud	After login, user is not stored in the cloud	Pass	Specify the development user	YES	305	QA001
3061_7_307	Functional	Set access	Verify if it controls the medication intake by the user	1.0.0 device	Considering the UIC, time slot, medication intake time	After time and medication intake time	Given that when both time slots	Null	Fail	Check the time	YES	307	QA001
3061_7_308	Functional	Set access	Verify if it controls the medication intake by the user	1.0.0 device	Considering the UIC, time slot, medication intake time	After time and medication intake time	Given that when both time slots	Null	Fail	Check the time	YES	308	QA001
715_7_309	Functional	Set device	Verify if it gives user notifications	1.0.0 device and TB	After User log in a user notifications	Device notifications	When notifications	When notifications	Pass	Notifications are not added in the cloud	YES	309	QA001
715_7_310	Functional	Set device	Verify if it gives user notifications	1.0.0 device and TB	After User log in a user notifications	Device notifications	When notifications	When notifications	Pass	When notifications are not added	YES	310	QA001
803_7_311	Functional	UI	Verify whether the patient has taken the medication or not	1.0.0 device	The medication has been received	The status of the medication intake	The user status the health status is shown the medication has been taken	Butter in notification	Pass	When the user is taken the medication	YES	311	QA001
803_7_312	Functional	UI	Verify whether the patient has taken the medication or not	1.0.0 device	The medication has been received	The status of the medication intake	The user status the health status is shown the medication has been taken	The user status is shown in the cloud	Pass	The user status is shown in the cloud	YES	312	QA001

9.RESULTS

9.1 Performance Metrics



10. ADVANTAGES

- Practice is highly lucrative
- Keeps the environment clean and fresh
- Saves the Earth and conserves energy
- Reduces environmental pollution
- Saves people from diseases
- Reduces man power
- Seeing real time data, 24/7

DISADVANTAGES

- Process is always not cost-effective
- The resultant product has short life
- Practices are not done uniformly

11. CONCLUSION

In this project we have successfully shown how we will monitor garbage system. Earlier, we saw that it was a night mare for the people as garbage collecting worker didn't aware about the condition of the garbage bin. Moreover, it was really hard for them to monitor thousands of bins in this mega town. Waste management involves the processes of waste collection, transportation, processing, as well as waste recycling or disposal. Sustainable waste management systems include advanced management strategies to minimize environmental challenges and protect resources.

This system will help the monitoring officer about the current situation of the bin. As result he can take necessary steps very easily and fast. Along with this, as we are adding notification system, it will be very easy for them to get notification about the reason condition of the bin. Through this project garbage collecting system will find a smart

12. FUTURE SCOPE

Waste management's future includes turning waste into energy, IoT-enabled practices, improvement in monitoring systems, data collection, and much more technology-based advancements. By implementing this project we can avoid the overflowing of trash bins in residential areas which will prevent many diseases and hence we can maintain a clean environment. This system will automatically send the notification to the municipal corporation. The proposed system is more efficient and practical then the existing scenario of processing solid waste collection in which everything is manually done. Every smart dustbins will be given a specific ID number which will be send in the notification by using

that we will get to know the location of dustbins. This system will reduce the wastage of fuel by reducing number of trips of garbage collection vehicle.

13. APPENDIX

Source Code

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = "znsc13"
deviceType = "SENSOR"
deviceId = "SENSOR-23"
authMethod = "use-token-
auth"
authToken = "12345678"

# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="lighton":
        print ("led is on")
    else :
        print ("led is off")
```

```
#print(cmd)
```

```
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```

```
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Metropolitan Cities
```

```
try:
```

```
deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method":  
authMethod, "auth-token": authToken}
```

```
deviceCli = ibmiotf.device.Client(deviceOptions)
```

```
#.....
```

```
except Exception as e:
```

```
print("Caught exception connecting device: %s" % str(e))
```

```
sys.exit()
```

```
# Connect and send a datapoint "hello" with value "world" into the cloud as an event of type  
"greeting" 10 times
```

```
deviceCli.connect()
```

```
while True:
```

```
#Get Sensor Data from DHT11
```

```
temp=random.randint(0,100)
```

```
Humid=random.randint(0,100)
```

```
data = { 'temp' : temp, 'Humid': Humid }
```

```
#print data
```

```
def myOnPublishCallback():
```

```
print ("Published Temperature = %s C" % temp, "Humidity = %s %" % Humid, "to IBM  
Watson")
```

```
success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
```



```
on_publish=myOnPublishCallback)
if not success:
    print("Not connected to IoTF")
    time.sleep(1)
deviceCli.commandCallback = myCommandCallback
# Disconnect the device and application from the clouddeviceCli.disconnect()
```

GITHUB LINK

<https://github.com/IBM-EPBL/IBM-Project-14606-1659587790>

PROJECT DEMO LINK

<https://drive.google.com/drive/folders/1UzedchqpzFZ-OKikCkICa7sEx7U9SEq9>