

# **SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES**

**TECHNOLOGY : IOT**

**TEAM ID : PNT2022TMID15872**

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# **CONTENTS**

## **1.INTRODUCTION**

1.1 Project Overview

1.2 Purpose

## **2. LITERATURE SURVEY**

2.1 Existing problem

2.2 References

2.3 Problem Statement Definition

## **3. IDEATION & PROPOSED SOLUTION**

3.1 Empathy Map Canvas

3.2 Ideation & Brainstorming

3.3 Proposed Solution

3.4 Problem Solution fit

## **4. REQUIREMENT ANALYSIS**

4.1 Functional requirement

4.2 Non-Functional requirements

## **5. PROJECT DESIGN**

5.1 Data Flow Diagrams

5.2 Solution & Technical Architecture

5.3 User Stories

## **6. PROJECT PLANNING & SCHEDULING**

6.1 Sprint Planning & Estimation

6.2 Sprint Delivery Schedule

6.3 Reports from JIRA

**7. CODING & SOLUTIONING** (Explain the features added in the project along with code)

7.1 Feature 1

7.2 Feature 2

7.3 Database Schema (if Applicable)

**8. TESTING**

8.1 Test Cases

8.2 User Acceptance Testing

**9. RESULTS**

9.1 Performance Metrics

**10. ADVANTAGES & DISADVANTAGES**

**11. CONCLUSION**

**12. FUTURE SCOPE**

**13. APPENDIX**

Source Code GitHub & Project Demo Link

# **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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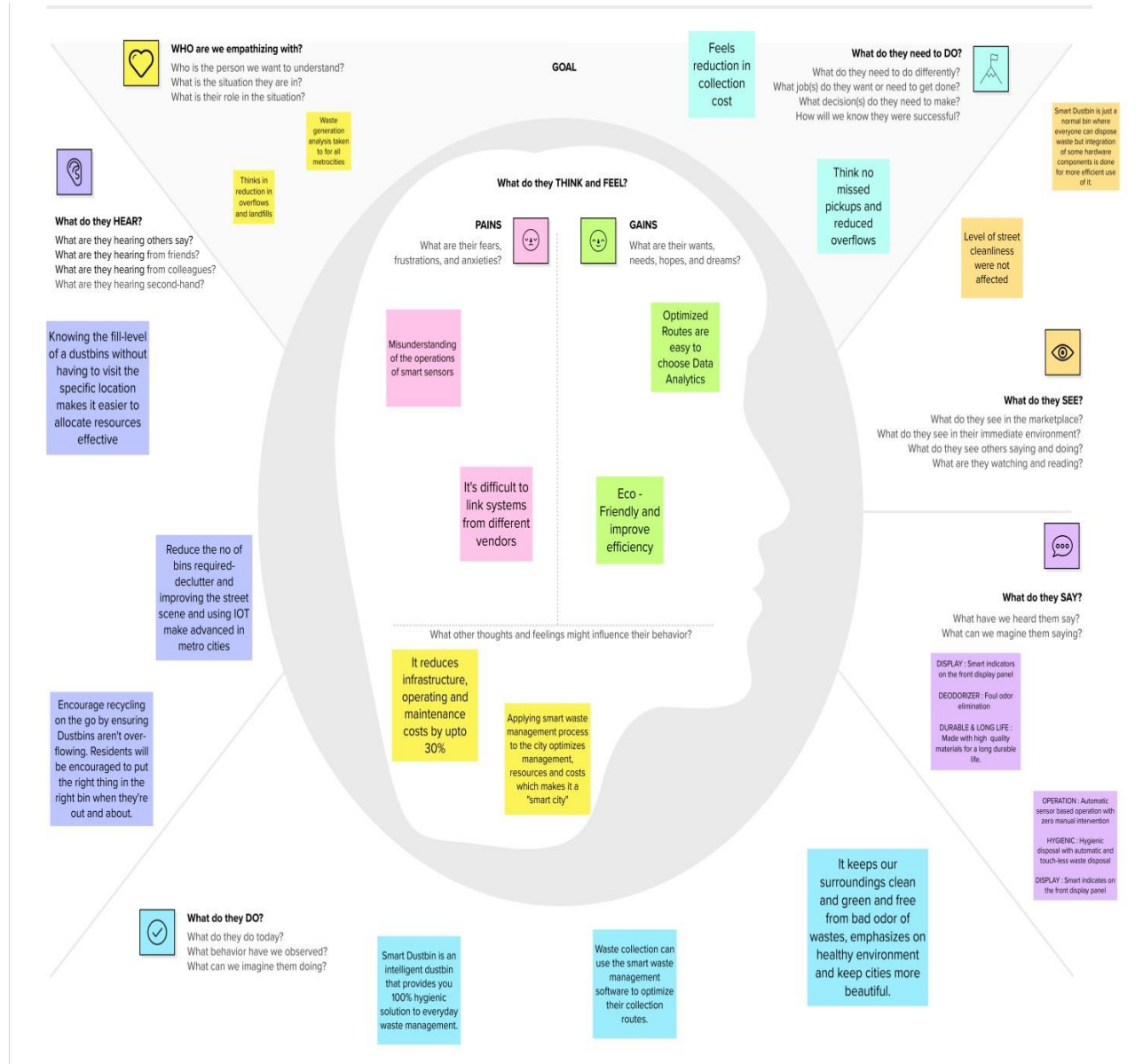
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### **2.3 Problem Statement Definition**

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

**Brainstorm & idea prioritization**

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

**Before you collaborate**

2-3 days out of preparation gives a long way with this session. Hence what you need to do is get going.

**TEAM ID: PNT2022TMD15872**

**Define your problem statement**

What problem are you trying to solve? Frame your problem as a clear brief for the statement. This will be the focus of your ideation.

**Brainstorm**

Write down any ideas that come to mind that address your problem statement.

**Group ideas**

Take turns sharing your ideas while clustering similar or related ideas as you go. Share all ideas before team members group. Give each cluster a sentence or the brief. It's better to begin than to skip ideas. By now you've brainstormed it up into smaller sub-groups.

**Prioritize**

You have shared ideas on the same page about what's important, meaning forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

**After you collaborate**

You can expect the result as an image or pdf to share with members of your company who might find it helpful.

**Key ideas of ideation/brainstorming**

Key ideas: Brainstorming session, Idea generation, Idea selection, Idea refinement, Idea implementation.

**Brainstorming session**

Brainstorming session is a meeting where a group of people brainstorm ideas to solve a problem. The session is usually led by a facilitator who encourages the group to think creatively and generate as many ideas as possible.

**Idea generation**

Idea generation is the process of coming up with new ideas. It is a key part of the brainstorming session.

**Idea selection**

Idea selection is the process of choosing the best ideas from the brainstorming session. It is a key part of the ideation process.

**Idea refinement**

Idea refinement is the process of improving the selected ideas. It is a key part of the ideation process.

**Idea implementation**

Idea implementation is the process of putting the selected ideas into action. It is a key part of the ideation process.

**Smart garbage management system**

The proposed system would be able to automate the solid waste monitoring process and management of the several collection points using IoT (Internet of Things).

**NARMADHA**

Placing Ultrasonic sensor to detect level of bins

**NANDHINI**

Enable GPS function to locate bins easier

Waste generation analysis to understand cities usages

**RANJANI**

Load cell on bottom of bins

Place Arduino board at left side of bins

**RITHIKASHREE**

Visual fill status indicators on top of bins

using GSM in bins achieve wireless communication with bins and managing center

**SARUMATHI**

when bins fill alert message to the authorized person

solar panels for power supply for IOT devices

**Smart garbage maintenance server**

**Transparency and sustainable solution than normal garbage bins**

**Optimized trash collection route**

**Collect only degradable and non-degradable wastes**

**IOT alert authorized person when bins going to fill**

**Waste generation analysis to understand cities usages**

**Raspberry-pi with ultrasonic, GPS, Load cell, are configured**

**Importance**

Importance of the problem statement is to identify the problem and its importance.

**Feasibility**

Feasibility of the problem statement is to identify the problem and its feasibility.

## 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.	<p>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.</p>

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	<b>1. CUSTOMER SEGMENT(S)</b> <span>CS</span>  Each and every individual in the society	<b>6. CUSTOMER CONSTRAINTS</b> <span>CC</span>  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.	<b>5. AVAILABLE SOLUTIONS</b> <span>AS</span>  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
	<b>2. JOBS-TO-BE-DONE / PROBLEMS</b> <span>J&amp;P</span>  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.	<b>9. PROBLEM ROOT CAUSE</b> <span>RC</span>  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.	<b>7. BEHAVIOUR</b> <span>BE</span>  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	<b>3. TRIGGERS</b> <span>TR</span>  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.	<b>10. YOUR SOLUTION</b> <span>SL</span>  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.	<b>8. CHANNELS of BEHAVIOUR</b> <span>CH</span>  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.	Focus on J&P, tap into BE, understand RC
	<b>4. EMOTIONS: BEFORE / AFTER</b> <span>EM</span>  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.			
Identify strong TR & EM				Identify strong TR & EM

## 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.

<b>FR-4</b>	<b>Adjust bin distribution</b>	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.
<b>FR-5</b>	<b>Eliminate inefficient picks</b>	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.
<b>FR-6</b>	<b>Plan waste collection routes</b>	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

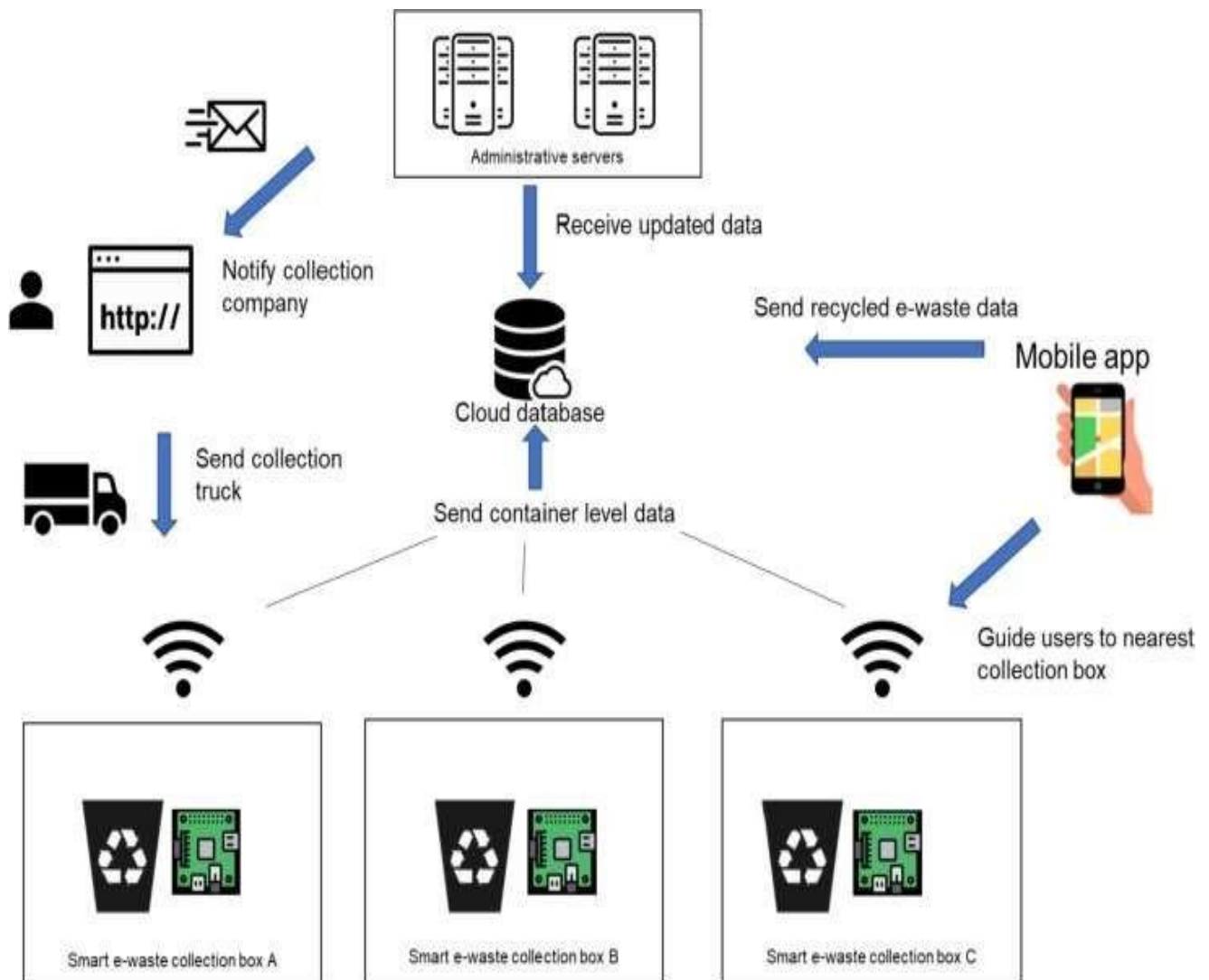
<b>FR No.</b>	<b>Non-Functional Requirement</b>	<b>Description</b>
<b>NFR-1</b>	<b>Usability</b>	IoT device verifies that usability is a special and important perspective to analyze user requirements, which can further improve the design quality. In the design process with user experience as the core,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

		users' potential needs in waste management, behavior and experience.
<b>NFR-2</b>	<b>Security</b>	<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>
<b>NFR-3</b>	<b>Reliability</b>	<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>
<b>NFR-4</b>	<b>Performance</b>	<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>
<b>NFR-5</b>	<b>Availability</b>	<p>By developing &amp; deploying resilient hardware and beautiful software we empower cities, businesses, and countries to manage waste smarter.</p>
<b>NFR-6</b>	<b>Scalability</b>	<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	Narmadha B
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	Narmadha B
Sprint-2	Login	As a team member, I can login to the IBM portal by entering email & password	1	Medium	Nandhini N
Sprint-2		As a team member, I can login to the IBM portal by entering email & password	1	Medium	Ranjani S
Sprint-2		As a team member, I can login to the IBM portal by entering email & password	1	Medium	Rithikashree B
Sprint-2		As a team member, I can login to the IBM portal by entering email & password	1	Medium	Sarumathi T

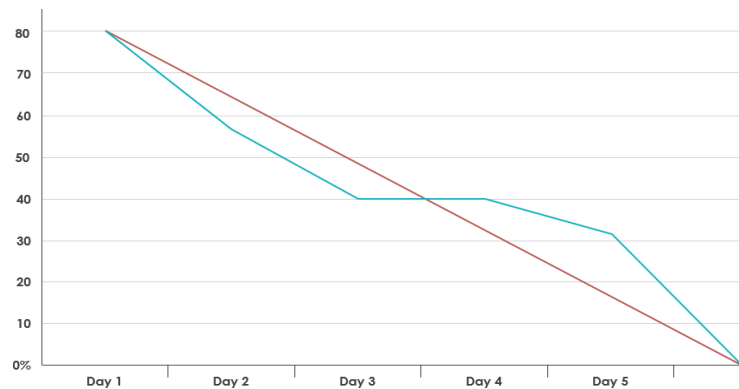
## 6.2 Sprint delivery Schedule

### 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>
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`<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 () {

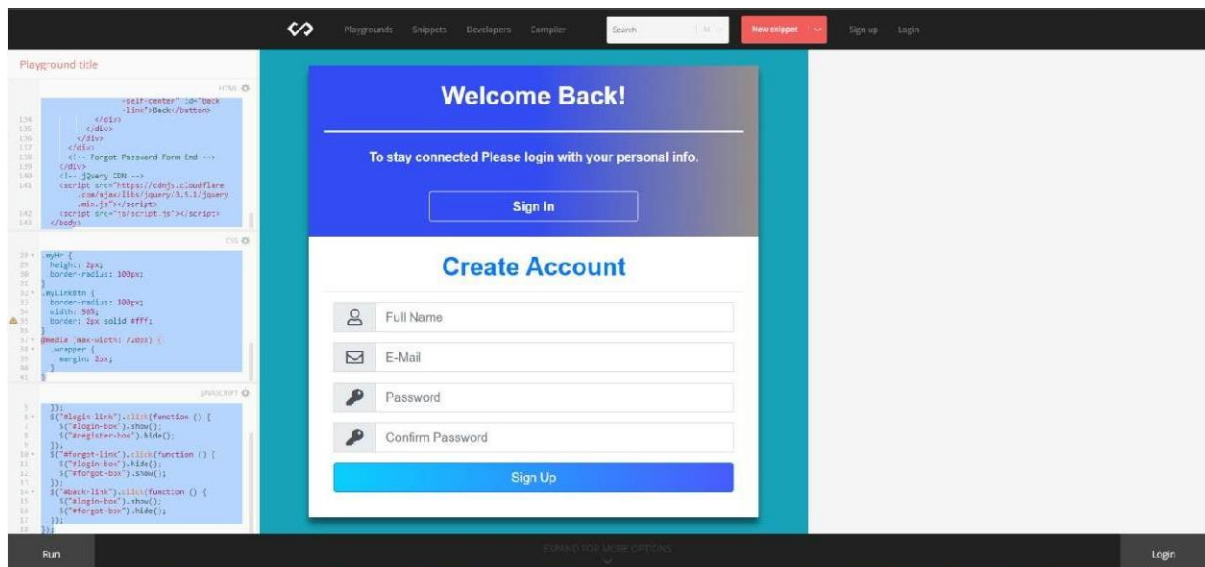
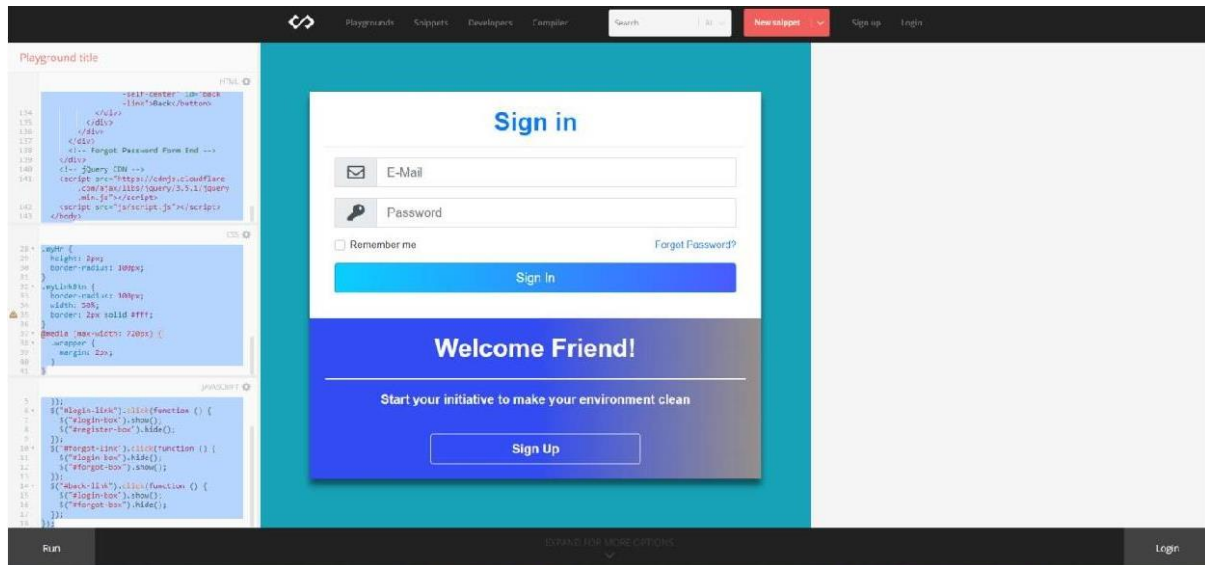
$("#login-box").show();

$("#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

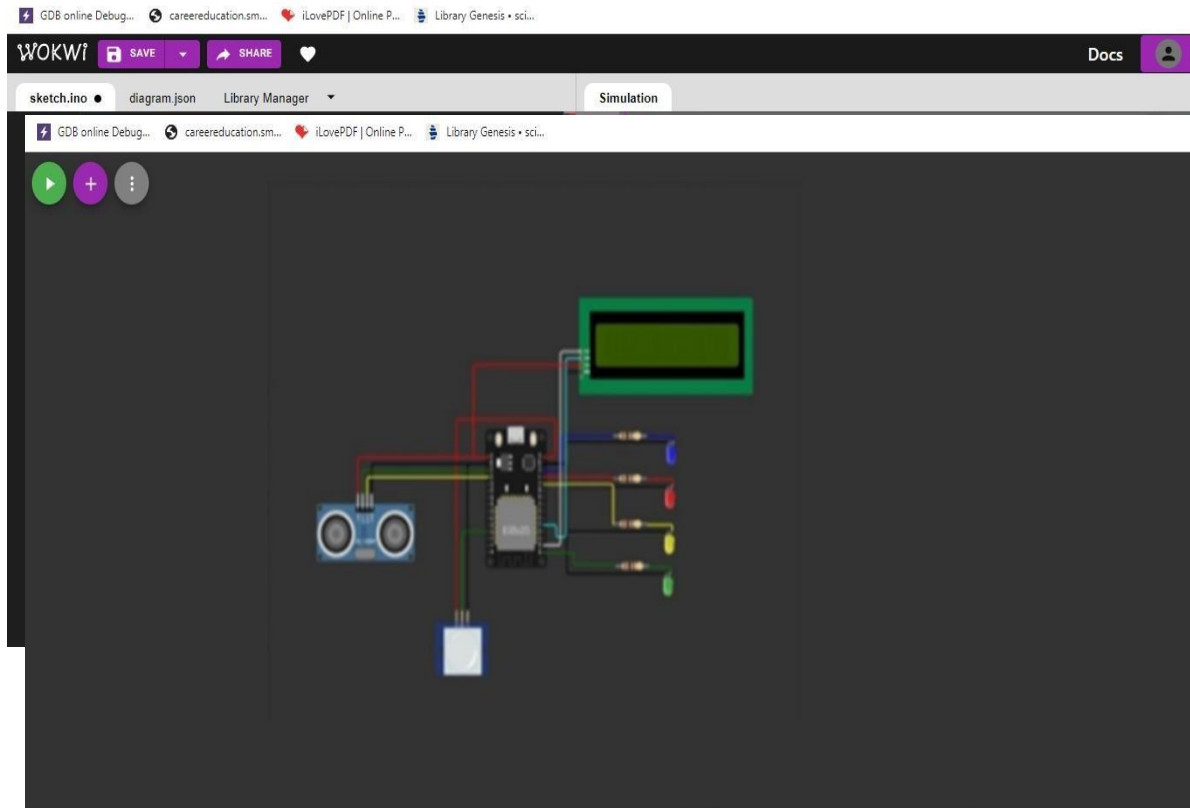
Serial.println();

}

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 = "zncs13"

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)

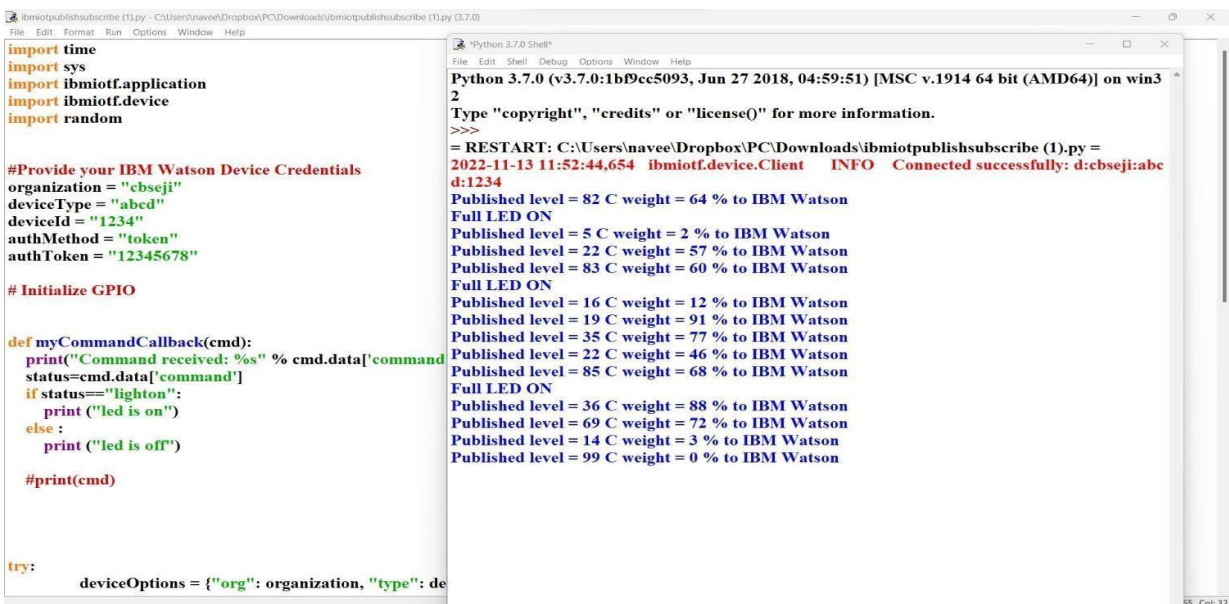
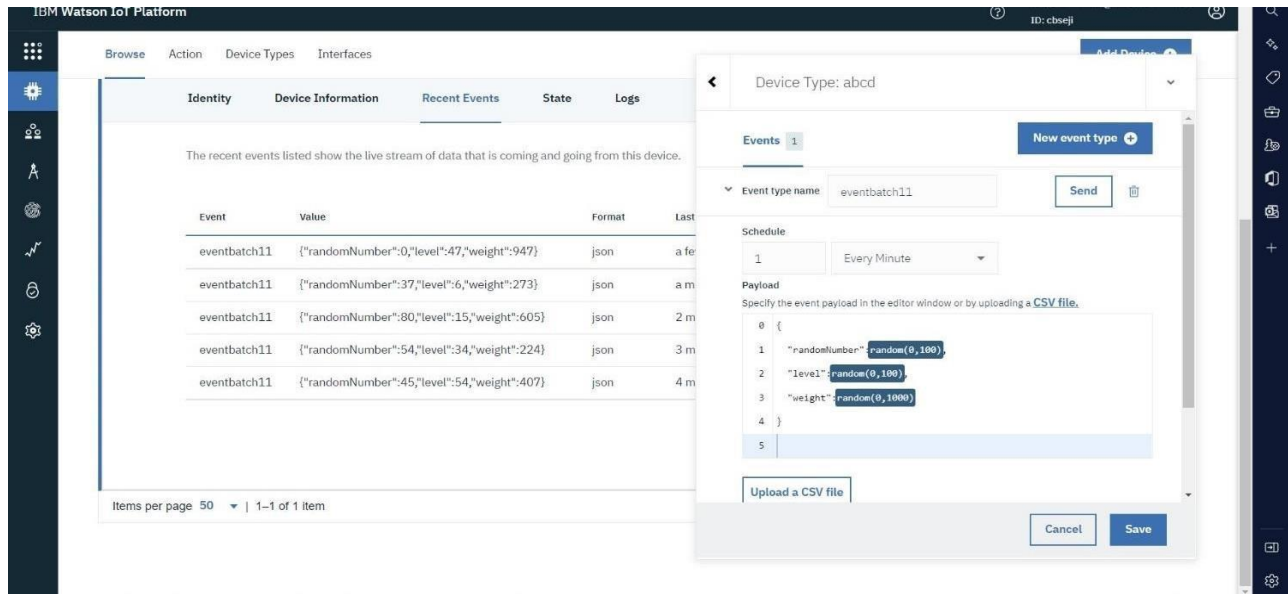
try:
    deviceOptions = {"org": organization, "type": deviceType, "id":
deviceId, "auth-method": authMethod, "auth-token": authToken}deviceCli =
ibmiotf.device.Client(deviceOptions) #.....
    except Exception as e:
        print("Caught exception connecting device: %s" % str(e))sys.exit()
# Connect 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):

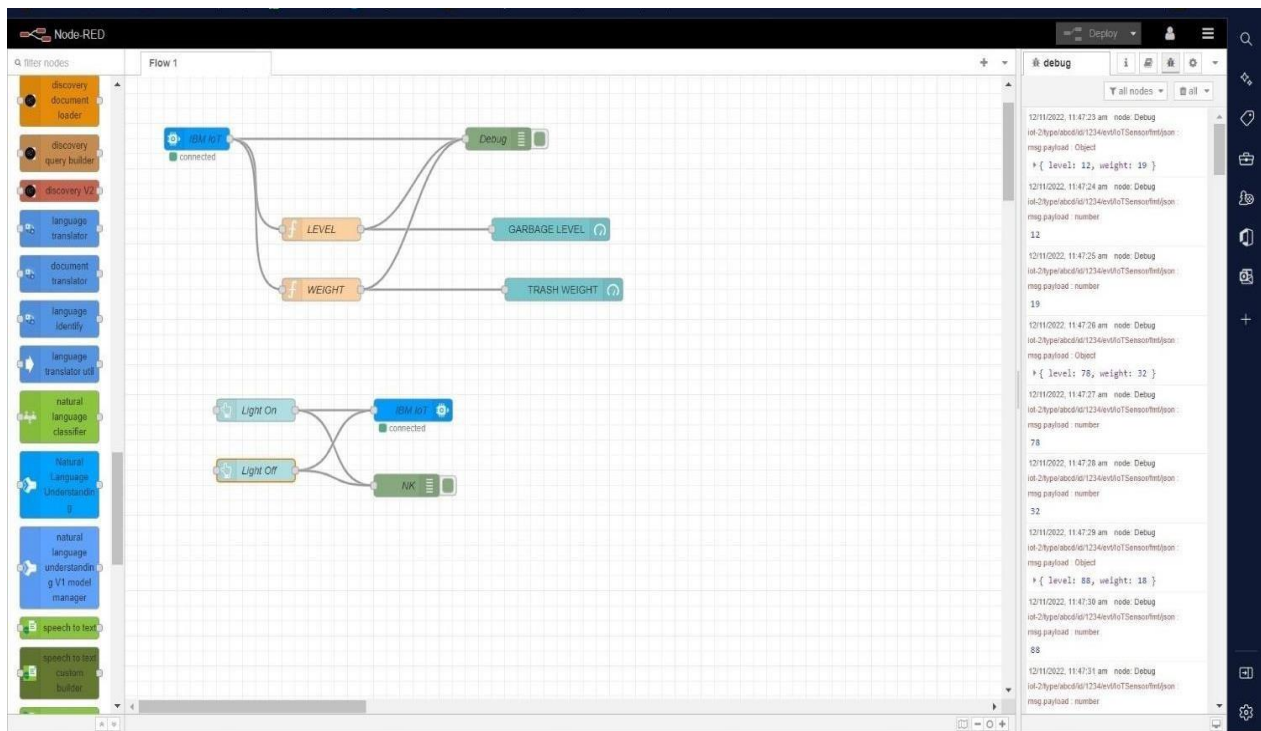
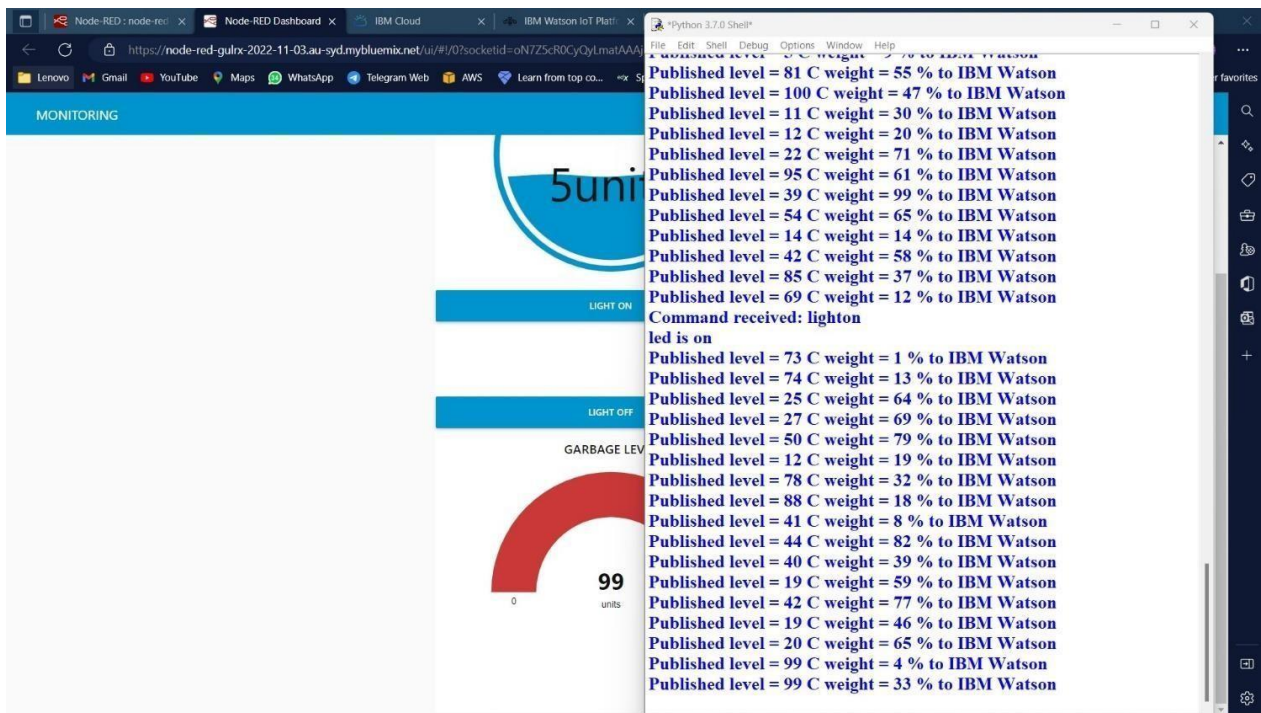
```

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

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

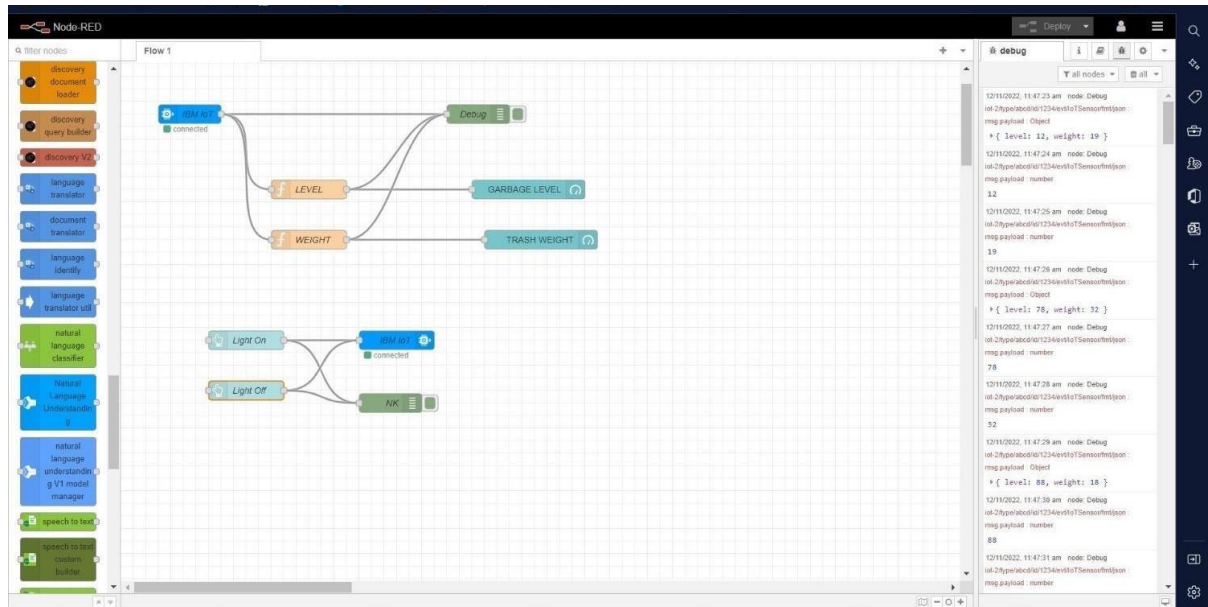
## OUTPUT

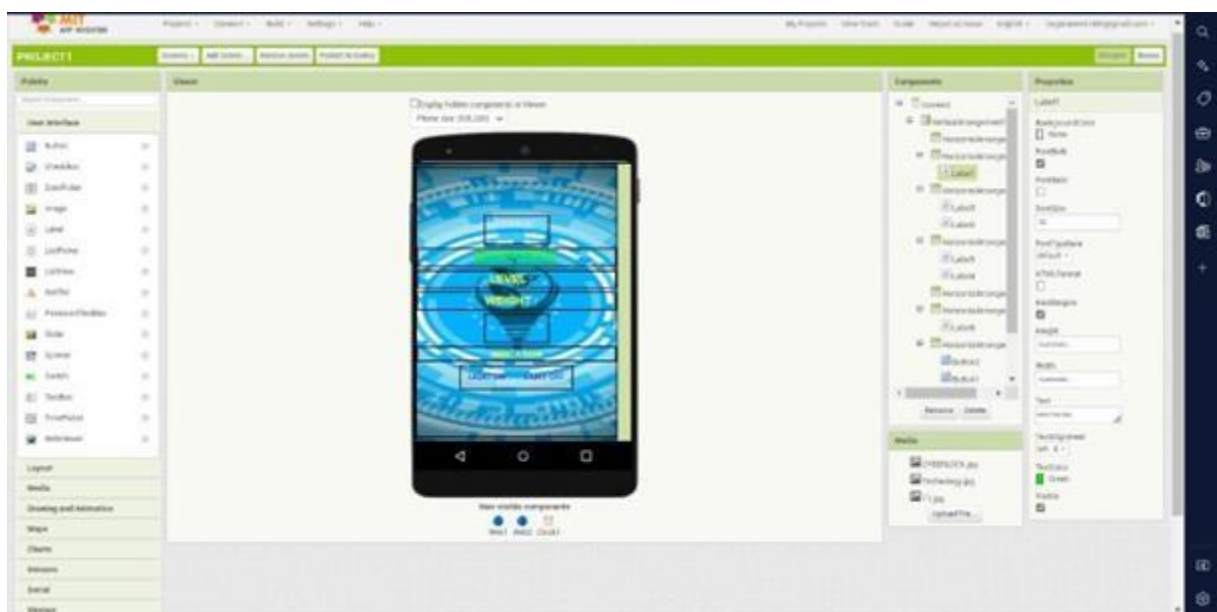
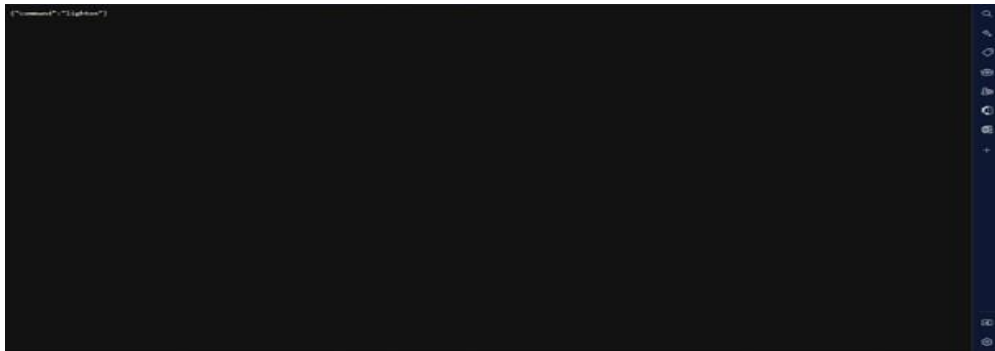






## SPRINT 4

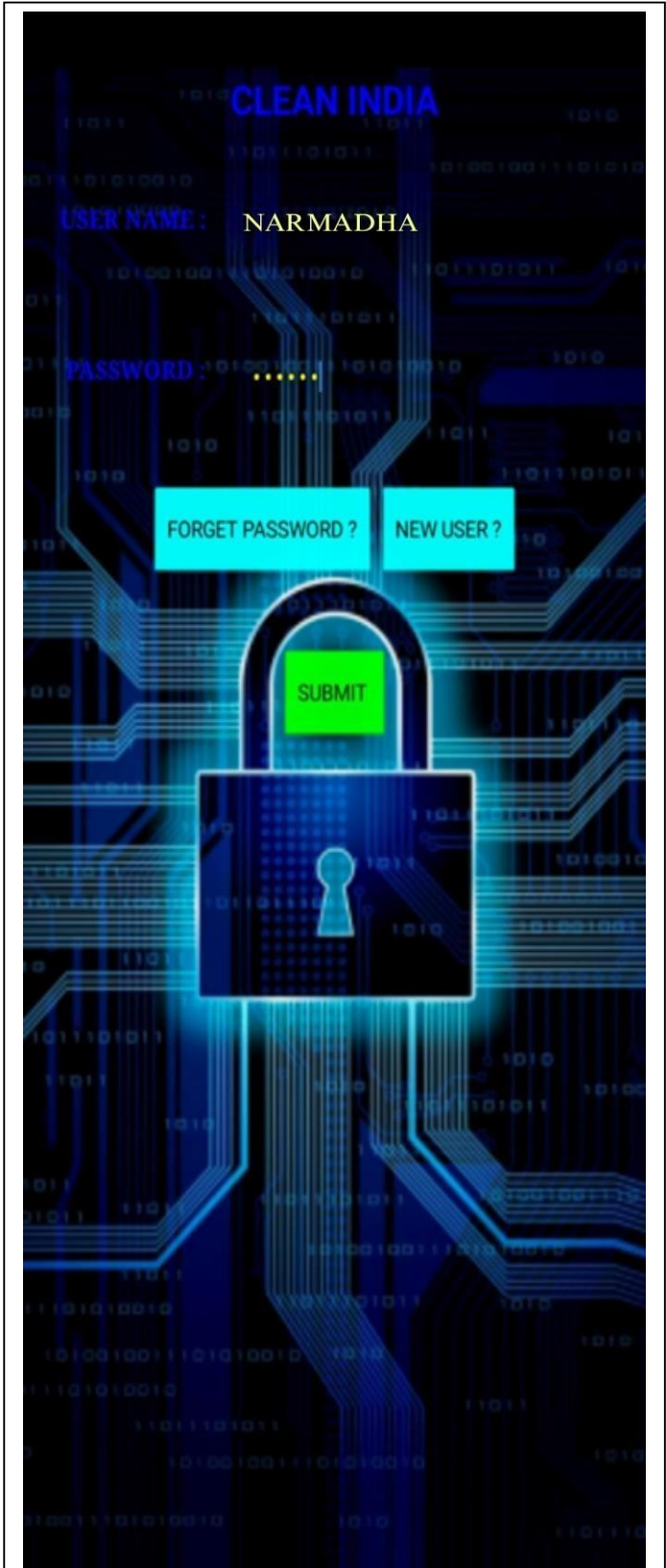




## OUTPUT BY PHONE :

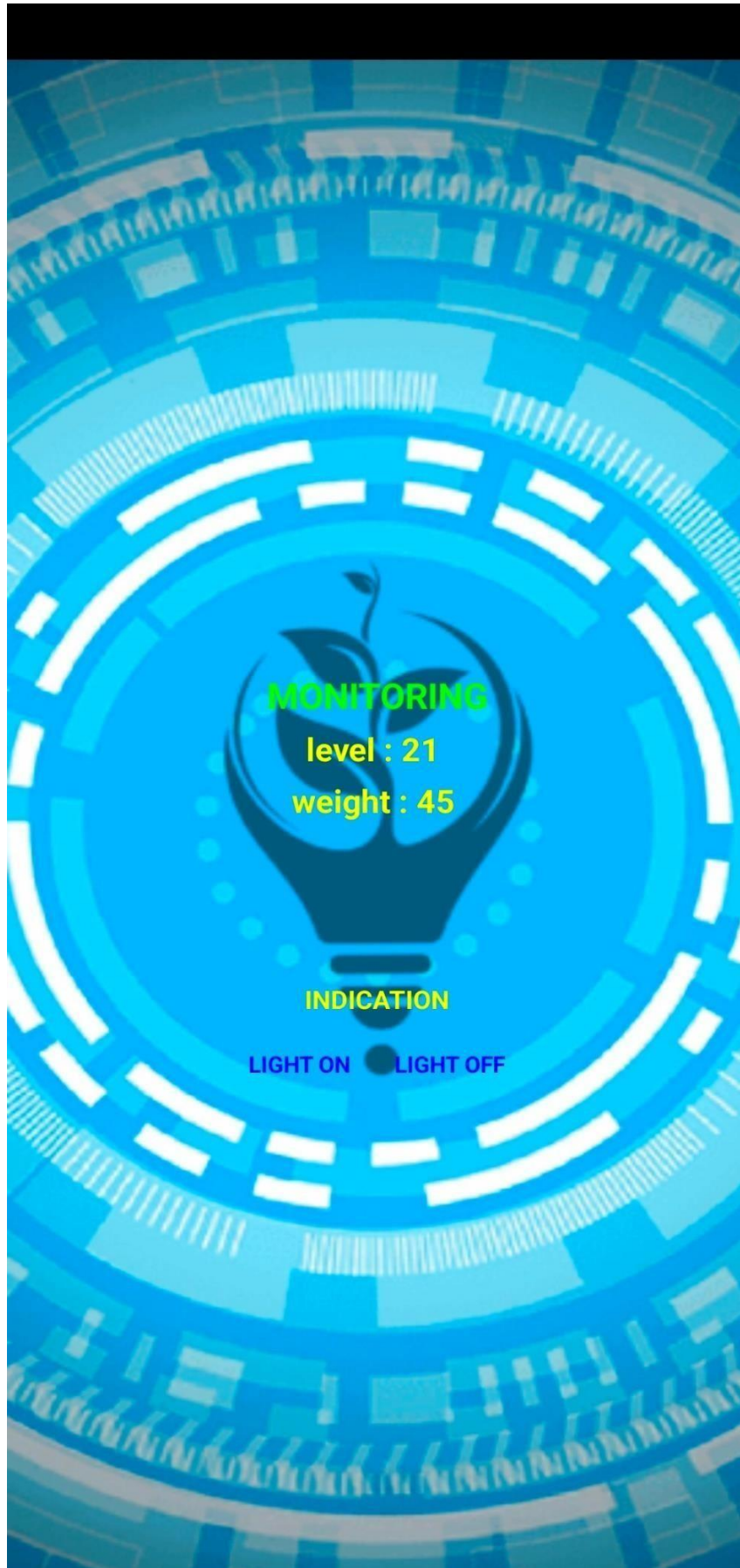


SCREEN 1



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**

TEAM ID PNT2022TMID15872

PROJECT Smart Waste Management System For

## 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 IoT")
```

```
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

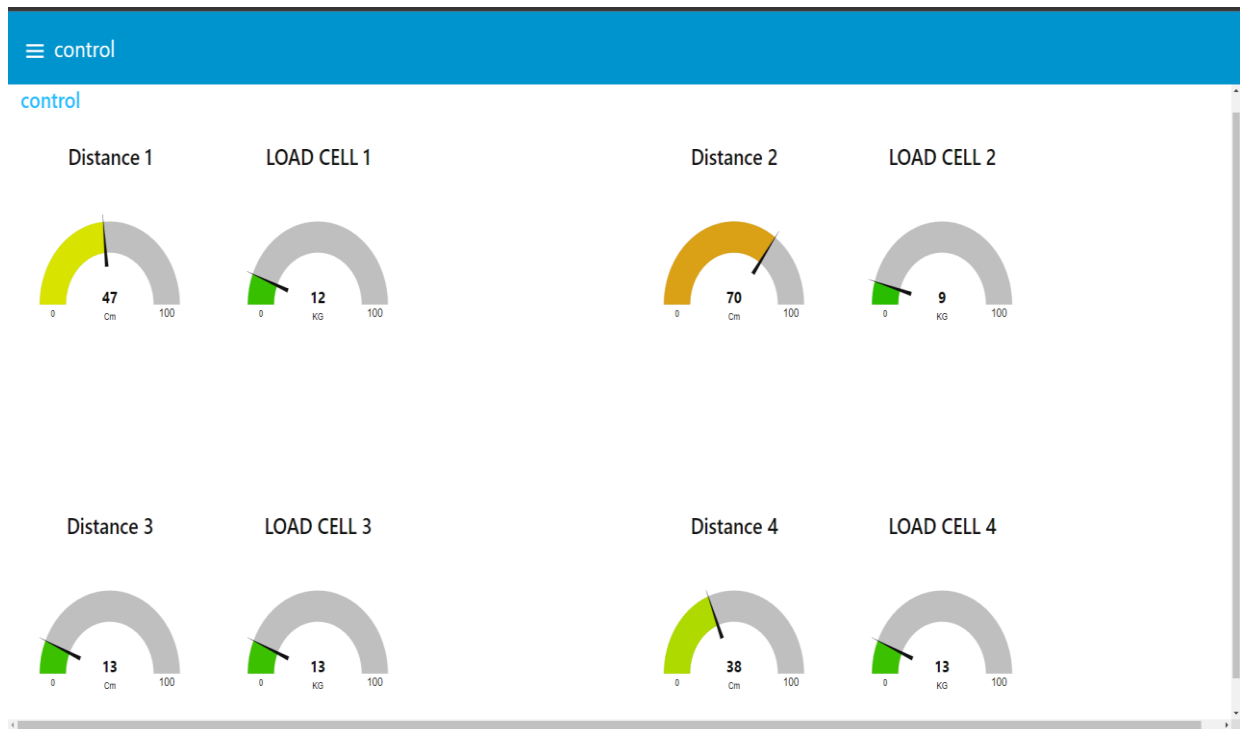
Here the IOT device is created using the cloud login credentials, the sample test case is deployed in the device and code is uploaded and tested in the testing environment.

### 8.2 User Acceptance Testing

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation(Y/N)	BUG ID	Executed By
LoginPage_TC_002	UI	Home Page	Verify whether user is able to access the URL	APP URL	<a href="https://node-red-pi3v2-1-13-bc-pal.mallumina.net/#/IoTDeviceId=00ab-Fu6k6dFu6k6d">https://node-red-pi3v2-1-13-bc-pal.mallumina.net/#/IoTDeviceId=00ab-Fu6k6dFu6k6d</a>	URL	New User able to access the URL	Able to access in mobile	Pass	Able to access in Chrome and Edge	YES		SMEHA
LoginPage_TC_003	Functional	Home page	User can enter the data in specified format	APP URL	To have browsers to have enhanced capabilities	URL	enter a data in specified format only	specified input is not received	Fail	Specify the User formats	NO	110	SWATHIVA
LoginPage_TC_004	Functional	Home page	User can enter the data in any format	APP URL	User can enter the data in required format	URL	User can enter the data in specified format now	Input received properly	Pass	Format specified	YES		SELVANAYAGHI
CLOUD_STORAGE_TC_005	Functional	Cloud	Verify if User input is stored in the cloud	CLOUD	User is able to access the URL with the given link User has to enter the data(name,time and date) and click the SUBMIT button.Data to be stored in IBM cloud	MEDICINE NAME: Time(YH:MM): DATE(YYYY-MM-DD)	User inputs has to be stored in cloud	Failed to storing the inputs	Fail	Cloud not connected properly	YES	111	SMEHA
CLOUD_STORAGE_TC_006	Functional	Cloud	Verify if User input is stored in the cloud	CLOUD	User is able to access the URL with the given link User has to enter the data(name,time and date) and click the SUBMIT button.Data to be stored in IBM cloud	MEDICINE NAME: Time(YH:MM): DATE(YYYY-MM-DD)	User inputs has to be stored in cloud	Inputs are stored in the cloud	Pass	Cloud connected properly	YES		VARSHITHA
OUTPUT_TC_007	Functional	Iot device	Verify if it reminds the medicine intake to the user	IOT device	Comparing the UTC time and medicine intake time	Real time and medicine intake time	Gives True when both times match	Null	Fail	Check the input	YES	113	SWATHIVA
OUTPUT_TC_007	Functional	Iot device	Verify if it reminds the medicine intake to the user	IOT device	Comparing the UTC time and medicine intake time	Real time and medicine intake time	Gives True when both times match	TRUE	Fail	verified	Yes		SMEHA
TTS_TC_008	Functional	Iot device	Verify if it gives voice notifications	IOT device and TTS	When True it gives a voice notifications	Voice notifications	Voice notifications	Voice notifications service didn't work	Fail	its program, commands are as object instead of noise	NO	121	SELVANAYAGHI
TTS_TC_008	Functional	Iot device	Verify if it gives voice notifications	IOT device and TTS	When True it gives a voice format notifications	Voice notifications	Voice notifications	Voice notifications arrived	Pass	New string functions were added	YES		VARSHITHA
ADU_TC_010	Functional	URL	Verify whether the patient has taken the medicine or not	IOT device	The TAKEN button has been included	The status of the medicine intake	The User clicks the TAKEN button to show that medicine has been taken	Button is unfunctional	Fail	Error occurs due to failure of call and connect function of the Taken button.	NO	132	SELVANAYAGHI
ADU_TC_011	Functional	URL	Verify whether the patient has taken the medicine or not	Iot device	The TAKEN button has been included	The status of the medicine intake	The User clicks the TAKEN button to show that medicine has been taken	The Taken status is updated in the cloud	Pass	The status of the medicine intake is updated in the cloud	Yes		SWATHIVA

## 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)

TEAM ID PNT2022TMID15872

PROJECT Smart Waste Management System For
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>