SMART WASTE MANAGEMENT SYSTEM

FOR METROPOLITAN CITIES

DOMAIN – INTERNET OF THINGS (IoT)

A PROJECT REPORT

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CONTENT

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. **PROJECTDESIGN**
    - 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**

13.1 Source Code

13.2. GitHub & Project Demo Link

CHAPTER 1

1.INTRODUCTION

Internet of Things is the applications performing with the help of internet access. IoT Communication over the internet has grown from user - user interaction to device – device interactions these days. The IoT concepts were proposed years back but still it's in the initial stage of commercial deployment. Growth of IoT is been rapid in the home automation and transportation industries. The basic idea of the project is to design a smart waste detection system which would automatically notify the workers of the municipality, the currentstatus of variousgarbage bins in the city, with the help of real-time monitoring capabilities, which would be remotely controlled using IoT techniques. This paper introduces you to the use of IoT in Garbage Detection and see how this can also be a major part of developing a city into a smart city.

1.1.Project Overview

The rapid growth in the urbanization rate portraits the waste management in the urban cities as a big challenge and thus there is a need of sustainable urban development plans. In order to achieve this, the smart city plan is in the trend recent days and a huge role is played by the smart waste management system. There needs to be a system that gives prior information of filling of the bin that sends alert messages to the municipality so that they can clear the garbage when it is overflowed and safeguard the environment. To achieve a clean and

hygienic environment, a solution called "Smart Garbage Bin" is proposed, which will send alarm and inform the authorized person when the bin is about to fill. Then message will be sent to the authorized person who will be able to collect or assist to collect the garbage from the particular area. with the help of web application by sending a SMS. This system maintains the dry wastes and wet wastes separately. This will help to reduce the overflow of the garbage bin and thus keeping the environment clean.

1.2.Purpose

This project helps the citizens to keep their surroundings and environment clean, pollution free and lead a healthy life throughout. It avoids the garbage overflow, which makes the environment unhygienic, paves way for air-borne and water- borne diseases , etc..

CHAPTER 2

2. LITERATURE SURVEY

2.1.EXISTING PROBLEM

Increasing waste generation has become a significant challenge in developing countriesdue to unprecedented population growth and urbanization. From the literature, many issues have been investigated that signify direct connection with the increase in waste material generation and related difficulties to handle it in a smart city. Theseissues are the resultants of an impropercollection and disposalmechanism used for waste material,the increase in moving trendsof peoples towardbig cities and lack of intelligent technology used to support the municipal solid waste management system.Consequently, the management of waste materialhas become a challenge due to a large amount of waste littered everywhere. Furthermore, various problems also occur due to the existing systems that are not only inadequate and inefficient but alsotheir non-scientific procedures involved in the solid waste management. In this paper,an IoT-based smart waste bin monitoring and municipal solid waste management system is proposed. This system helps to solve the problemsassociated with management of waste material and the IoT-based waste collection for the smart cityas discussed above. The proposed system is capable in the collection of waste effectively, detection of fire in waste material and forecasting of the future wastegeneration. The IoT-based device performs the controlling and monitoring of the electric bins. These devices are wirelessly connected with the central hub to transmit the information about the bins filling level with the existing location. The significant advantage of the system is to collect waste material on time in order to avoid the overflow of bins thatwould help in saving the environment from pollution.

Disadvantages of Existing System

- Time Consuming and Less Effective.

- Overflow of Waste from the bin.
- Stinky smell and unpleasant situations.

PROPOSED SYSTEM:

In this proposed system there will be no issues repeated that of previous system. In this system the bin is designed in such a way that when the waste level reaches the threshold limit it automatically closes the bin and intimates the alert to the admin . The bins are provided with low cost embedded device which helps in tracking the level of the garbage bins and a unique ID will be provided for every dustbin in the city .These details can be accessed by the concern authorities from their place with the help of internet and an immediate action can be made to clean the bin. The admin can monitor the level of the bin and can trace the location where it exists.

Advantages:

- Real time information on the fill level of the dustbin.
- Deployment of dustbin based on the actual needs.
- Cost Reduction and resource optimization.
- Improves Environment quality .

2.2.REFERENCES:

[1] Ikuo Ihara; Nagaoka University of Technology; Ultrasonic Sensing:Fundamentals and Its Applications to Non-destructive Evaluation.

[2] Arduino, “Available at http://www.arduino.cc,” 2010.

[3] M. Batty, “Smart Cities, Big Data,” Environment and Planning B: Planning and Design 2012, vol. 39, pp. 191– 93.

[4] Xu Li, Student Member, IEEE, Performance Evaluation of Vehicle-Based Mobile Sensor Networks for Traffic Monitoring.

[5] Yusuf Abdullahi Badamasi, The Working Principle Of An Arduino, Electronics, Computer and Computation (ICECCO), 2014 11th International Conference on 29 Sept.-1 Oct. 2014.

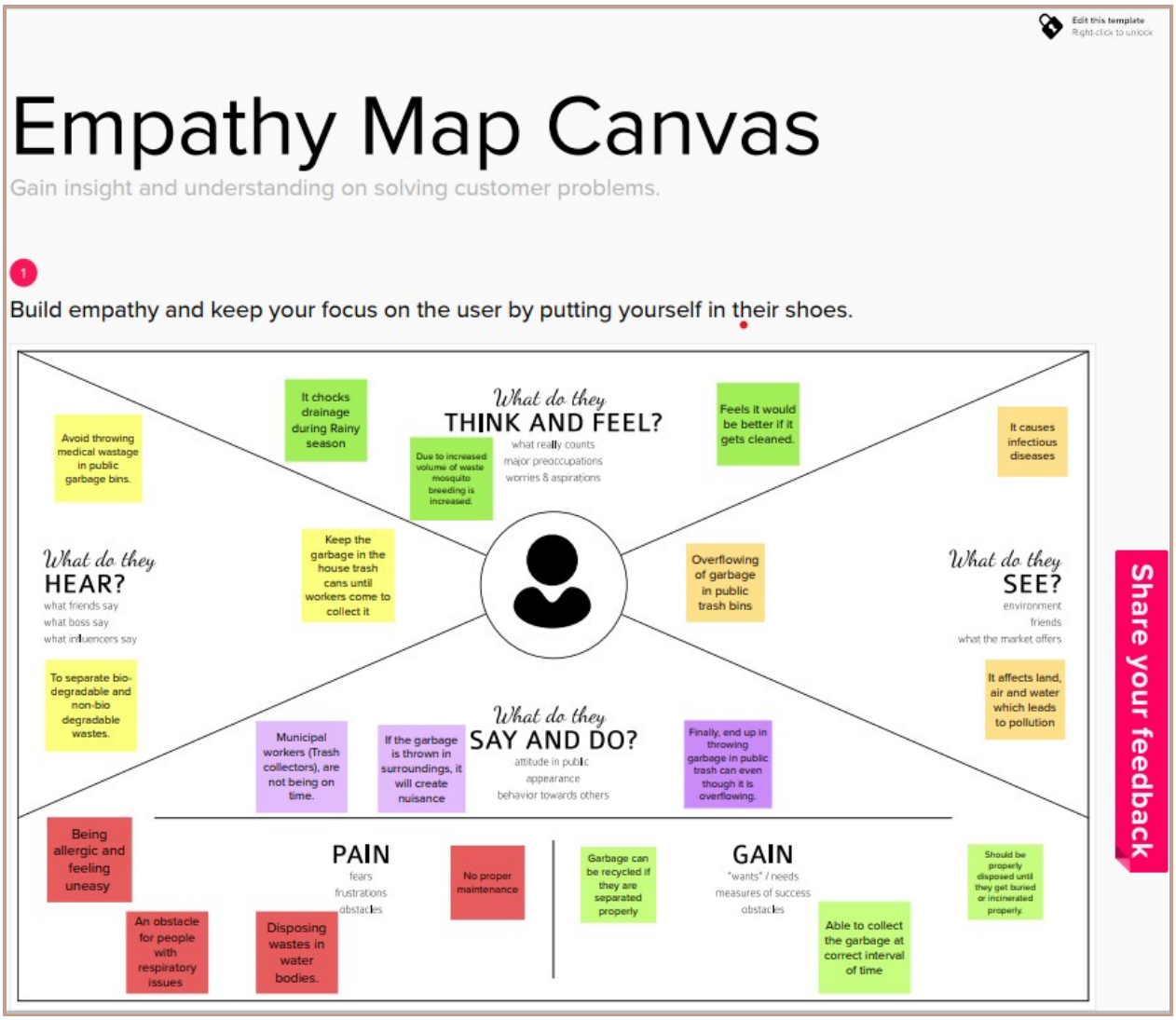
2.3.Problem Statement

The waste management system provided earlier are not very reliable,efficient, cost effective and does not have any advanced processing features like automatic close of bin and alert intimations system .The following is a well-articulated problem statement that allows you to find the ideal solution for the challenges faced.

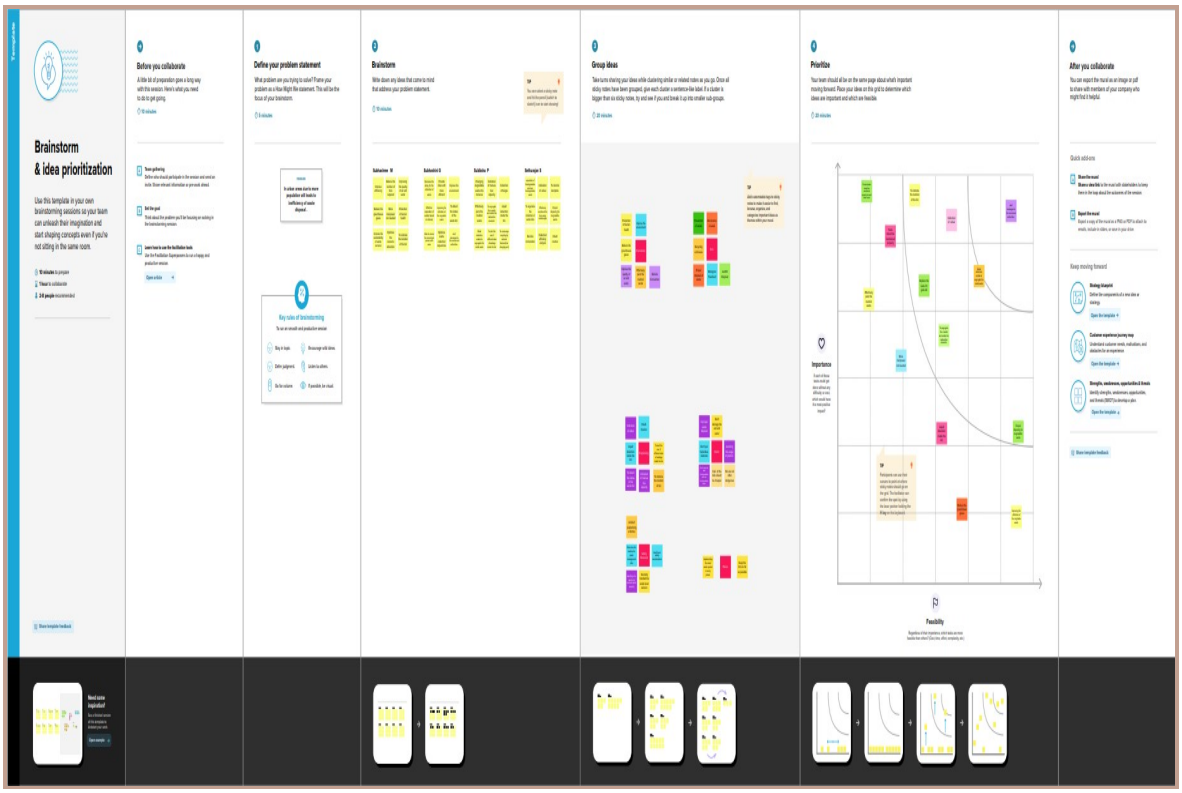
CHAPTER 3

3.IDEATION & PROPOSED SOLUTION

3.1.EMPATHY MAP CANVAS



3.2.IDEATION AND BRAINSTROMING

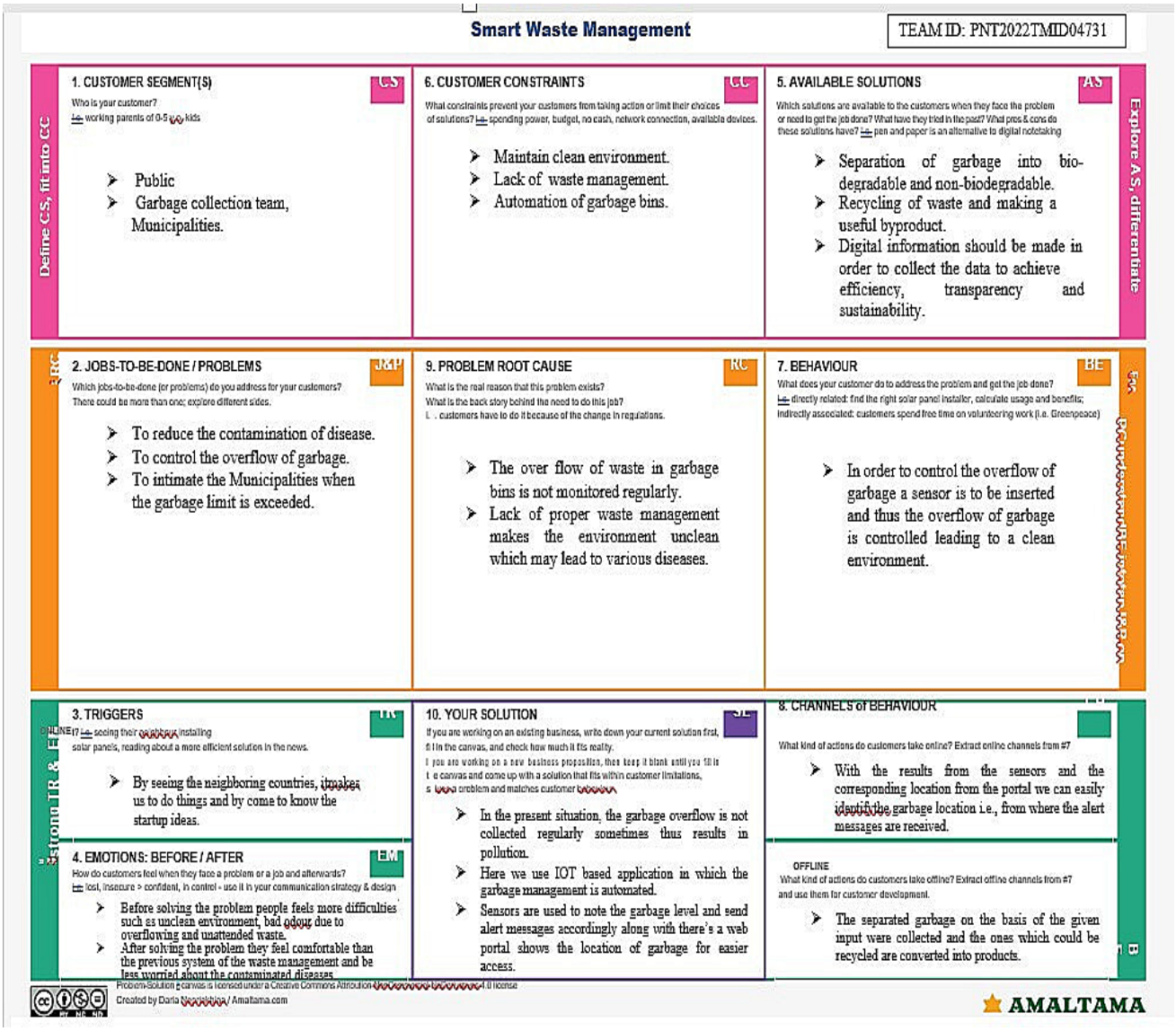


3.3. PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Indiscriminate disposal of solid waste is a major issue in urban centers of most developing countries and it poses a serious threat to healthy living of the citizens. Access to reliable data on the state of solid waste at different locations within the city will help both the local authorities and the citizens to effectively manage the menace.
2.	Idea / Solution description	To develop the intelligent solid waste monitoring system using Internet of Things (IoT) and cloud computing technologies. The fill level of solid waste in each of the containers, which are strategically situated across the communities, is detected using ultrasonic sensors.
3.	Novelty / Uniqueness	Analysing the different type of waste.
4.	Social Impact / Customer Satisfaction	Customer satisfaction is an important goal. To meet this goal ,it is necessary to use an evaluation model for measuring the customer satisfaction level. Some important criteria such as, Quality of trash bin ,responsibility of municipal etc. are distinguished and used in the proposed model.

5.	Business Model (Revenue Model)	Smart waste management is one of the essential component of today's technology. It will reduce the waste in cities and reduce the man power.It help
		to calculate types of waste and amount of the waste. The waste management services take care of a healthy environment allowing optimization of the utilities and prevent overloading the carrier for waste disposal
6.	Scalability of the Solution	We can use the capacitance sensor in the bin continuously monitors the level of the bin in real time and communicates to the central cloud where the bins are connected. Ultrasonic sensor is used to open and close the lid of the bin whenever the persons are nearby the bin.

3.4.PROBLEM SOLUTION FIT:



CHAPTER 4

4. REQUIREMENT ANALYSIS

4.1.FUNCTIONAL REQUIREMENT

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Fitting IoT device in the trashcans.	The IoT device need to be fixed in the dustbin with water proof safety. The IoT device consists Ultrasonic sensor,level sensor,Servo motor,LCD. To send data to the cloud GSM/GPRS is used.
FR-2	Connecting to the cloud.	The device should configure to connect to the cloud. The data of sensors need to be received and processed.
FR-3	Predictions for bin fulness.	In this system, a 24×7 monitoring system is designed for monitoring dumpsters, A smart and organized system is designed for selective clearing the ultrasonic sensor is used for measuring the level of waste in the dustbin, DC motor powered platform is to open the lid of the dustbin.Level sensor is used to the dustbin to be indicated full or not.If either of the containers is full then an alert message is sent from the dustbin to employees and the cloud. In turn, employees can clear the corresponding dumpster.
FR-4	Real-time waste monitoring	Trash and recycling containers can be outfitted or produced with low-cost sensors that monitor everything from the amount and types of material in a container to temperature, odour and location of the bin.
FR-5	Do not miss a pick	For periodically picked bins, we provide Pick evaluation. The tool records picks (sensor) and compares them to the schedule. Authorized person can immediately identify any missed, or off-schedule picks.

FR-6	Routes to the dumpsters	Based on current bin fill-levels and predictions of reaching full capacity, you are ready to respond and schedule waste collection driver can compare planned vs. executed routes to identify any inconsistencies.

4.2.NON-FUNCTIONAL REQUIREMENT

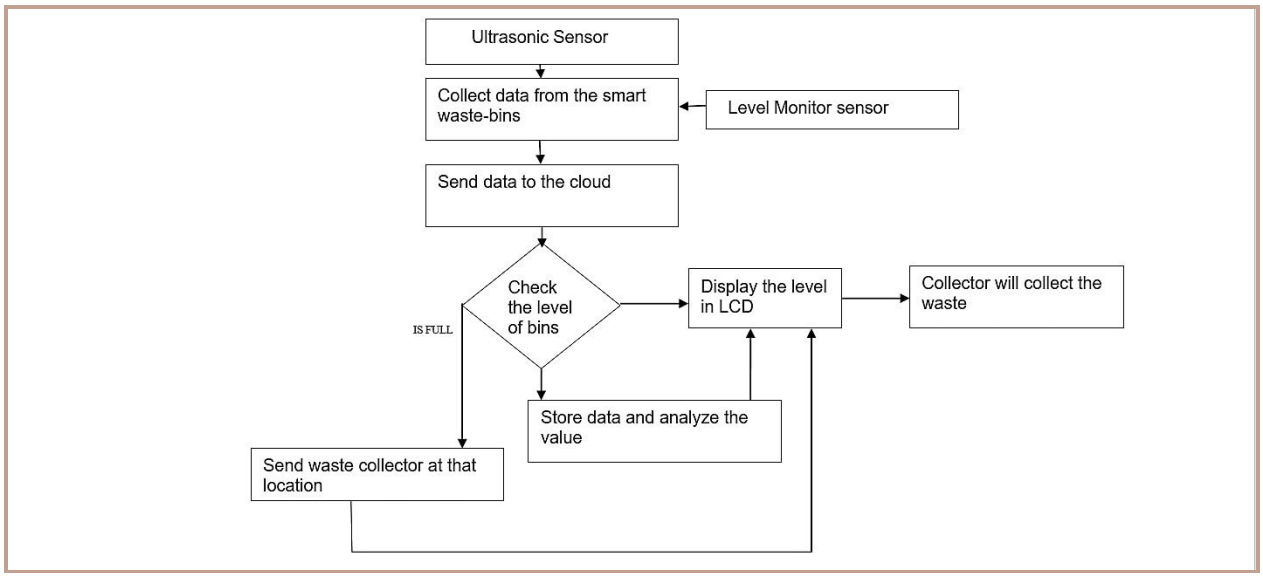
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	IoT solutions for waste management problems offer municipalities data intelligence and real- time insights. In that regard, the fill patterns of specific containers can be identified by historical data and managed accordingly in the long term. In addition to hardware solutions, mobile applications are used to overcome the challenges in the regular waste management system, such as keeping track of the drivers while they are operating on the field.
NFR-2	**Security**	Building and deploying IoT-based smart waste management in cities can be a complex, time- consuming and resource-intensive process. Many municipal IT departments will not have the resources or in-house skills to support such a project internally.

NFR-3	**Reliability**	One of the difficult operational problems of municipal and local authorities are facing is the collection of municipal solid waste. In recent years, due to environmental concerns and number of costs, most of the municipalities have been forced for assessing their solid waste management and examining their cost- effectiveness and environmental impact, for example, designing the collection of routes. During the past 15 years
NFR-4	**Performance**	An integrated Arduino program is developed to synchronize the identification system, automated lid system, micro-controller, display system, and communication system. An ultrasonic sensor is attached to the front side of the garbage bin. The transmitter of the ultrasonic sensor emits an ultrasonic sound that is beyond the human ear listening range, and the receiver receives the reflected sound waves by the solid objects.
NFR-5	**Availability**	Another purpose of this project is to make the proposed waste management system as cheap as possible. A cost in BDT is presented in the following Table 3 needs for the construction of the proposed smart bin.
NFR-6	**Scalability**	The city diverts about 80% of its waste from landfills and hopes to go “zero waste” by the end of 2020. Besides strict regulations and high waste management fees for end consumers and businesses.

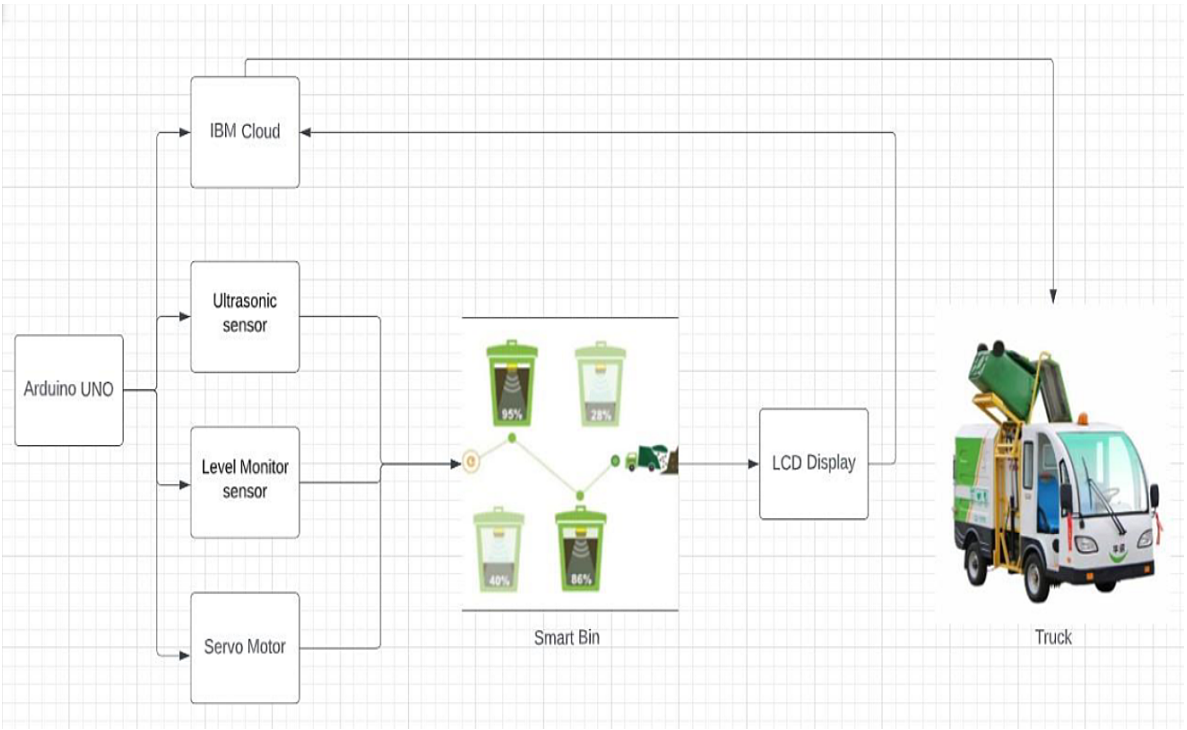
CHAPTER 5

5.PROJECT DESIGN

5.1.DATA FLOW DIAGRAM



5.2.SOLUTION ARCHITECTURE AND TECHNICAL ARCHITECTURE



5.3.USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Admin	Registration	USN-1	As an admin, I give user id and password to every worker andmanage them	I can manage account/dash board	Medium	Sprint-1
Co admin	Supervision	USN-2	As a Co Admin , I'll manage the garbage level monitor, If the garbage get filled alert I will postlocation and garbage id to trash truck	I can manage garbage monitoring	High	Sprint-1
Truck Driver	Maintenance	USN-3	As truck driver , I'll follow the route send by Co Admin to reach the filledgarbage	I can drive to reach the garbage filled route in shortest route given	Medium	Sprint-1
Local Garbage Collector	Maintenance	USN-4	As a Waste Collector , I'll collect allthe trash from garbage and load into garbage truck and send them to landfill	I can collect trash and pulled to truck and send off	Medium	Sprint-1
Municipality	Maintenance	USN-5	As a Municipality , I'll check the process are happening in discipline manner without anyissues	I can manage all these processes going good	High	Sprint-1

CHAPTER 6

6. PROJECT PLANNING AND SCHEDULING

6.1. SPRINT PLANNING AND ESTIMATION

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers,research publications etc.	10 SEPTEMBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements	15 SEPTEMBER 2022
Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	26 SEPTEMBER 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	21 OCTOBER 2022
Problem Solution Fit	Prepare problem - solution fit document.	26 OCTOBER 2022

Solution Architecture	Prepare solution architecture document.	19 OCTOBER 2022
Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application.	31 OCTOBER 2022
Functional Requirement	Prepare the functional requirement document.	7 NOVEMBER 2022
Data Flow Diagrams	Draw the data flow diagrams and submit for review.	31 OCTOBER 2022
Technology Architecture	Prepare the technology architecture diagram.	7 NOVEMBER 2022
Prepare Milestone & Activity List	Prepare the milestones & activity list of the project.	13 NOVEMBER 2022
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developed code by testing it.	IN PROGRESS..

6.2.SPRINT DELIVERY SCHEDULE

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Login	USN-1	As an admin,I give user id and password to every worker and manage them	10	High	Subhashree M
Sprint-1	Login	USN-2	As a Co Admin , I'll manage the garbage level monitor.If the garbage get filled alert I will post location and garbage id to trash truck	10	High	Subhashree M
Sprint-2	Dashboard	USN-3	As truck driver , I'll follow the route send by Co Admin to reach the filled garbage	20	Low	Subhashini G
Sprint-3	Dashboard	USN-4	As a Waste Collector , I'll collect all the trash from garbage and load into garbage truck and send them to landfill	20	Medium	Subiksha P
Sprint-4	Dashboard	USN-5	As a Municipality , I'll check the process are happening in discipline manner without any issues	20	High	Sethurajan S

Project Tracker, Velocity & Burndown Chart: (4 Marks)

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

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

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

6.3 JIRA

REPORTS

CHAPTER 7

7.CODING AND SOLUTION

7.1.FEATURES

● IOT DEVICE
● WOKWI SOFTWARE
● IOT WATSON PLATFORM
● NODE RED
● WEB UI
● CLOUDANT DB

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 "9gbe4w" // IBM organisation id
#define DEVICE_TYPE "SWMSMC" // Device type mentioned in ibm watson iot platform
#define DEVICE_ID "ibmproject" // Device ID mentioned in ibm watson iot platform#define
TOKEN "sUNA41tG6-Pq)0rk5X" // Token
// customise above values
charserver[] = ORG ".messaging.internetofthings.ibmcloud.com"; // server name char
publishTopic[] = "iot-2/evt/data/fmt/json";
char topic[] = "iot-2/cmd/led/fmt/String"; // cmd Represent type and command is test format
ofstrings
char authMethod[] = "use-token-auth"; // authentication method char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID; //Client id
//
WiFiClient wifiClient; // creating instance for wificlient
PubSubClient client(server, 1883, wifiClient);
#define ECHO_PIN 12
#define TRIG_PIN 13
float dist;
void setup()
{
```

```
Serial.begin(115200);
pinMode(LED_BUILTIN,
OUTPUT); pinMode(TRIG_PIN,
OUTPUT
); pinMode(ECHO_PIN, INPUT);
//pir pin
pinMode(4,
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()
{
lcd.clear();
publishData();
delay(500);
if (!client.loop())
{
mqttConnect(); // function call to connect to IBM
}
}
/* retrieving to cloud */
```

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

```
cmd
FAILE
D"
);
}
}
void publishData()
{
float cm = readcmCM();
if(digitalRead(34)) //PIR motion detection
{
Serial.println("Motion Detected");
Serial.println("Lid Opened");
digitalWrite(15, HIGH);
}
else
{
digitalWrite(15, LOW);
}
if(digitalRead(34)== true)
{
if(cm <= 100) //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 > 150 && cm < 250)
{
digitalWrite(4, HIGH);
Serial.println("Warning!!,Trash is about to cross 50% of bin
level"); digitalWrite(2, LOW); digitalWrite(23, LOW);
}
else if(cm > 250 && cm <=400)
{
```

```
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");
```

7.2 FEATURE 2

- REGISTRATION
- LOGIN
- VERIFICATION
- SELECT THE CITY
- DISPLAY THE STATUS OF BIN
- ADD QUERY

CODE:

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" />
<form action="#" method="post" class="px-3" id="register-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-user fa-lg fa-fw"></i></span>
</div>
<input type="text" id="name" name="name" class="form-control rounded-0" placeholder="Full
Name" 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="far fa-envelope fa-lg fa-fw"></i></span>
</div>
<input type="email" id="remail" 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="rpassword" name="password" class="form-control rounded-0"
minlength="5"
placeholder="Password" 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="cpassword" name="cpassword" class="form-control rounded-0"
minlength="5"
placeholder="Confirm Password" required />
</div>
<div class="form-group">
<div id="passError" class="text-danger font-weight-bolder"></div>
</div>
<div class="form-group">
<input type="submit" id="register-btn" value="Sign Up" class="btn btn-primary btn-lg btn-block
myBtn" />
</div>
</form>
</div>
</div>
</div>
</div>
<!-- Registration Form End -->
<!-- Forgot Password Form Start -->
<div class="row justify-content-center wrapper" id="forgot-box" style="display: none;">
<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
adddress 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=sw
ap");
* {
margin: 0; padding: 0; boxsizing: 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();
});
});
```

7.3 DATABASE SCHEMA

```
labl_0 = Label(base, text=&quot;Registration form&quot;,width=20,font=(&quot;bold&quot;,20))
labl_0.place(x=90,y=53)
lb1= Label(base, text=&quot;Enter Name&quot;, width=10, font=(&quot;arial&quot;,12))
lb1.place(x=20, y=120)
en1= Entry(base) en1.place(x=200, y=120)
lb3= Label(base, text=&quot;Enter Email&quot;, width=10, font=(&quot;arial&quot;,12))
lb3.place(x=19, y=160)
en3= Entry(base) en3.place(x=200, y=160)
lb4= Label(base, text=&quot;Contact Number&quot;, width=13,font=(&quot;arial&quot;,12))
lb4.place(x=19, y=200)
en4= Entry(base) en4.place(x=200, y=200)
lb5= Label(base, text=&quot;Select Gender&quot;, width=15, font=(&quot;arial&quot;,12))
lb5.place(x=5, y=240)
var = IntVar()
Radiobutton(base, text=&quot;Male&quot;, padx=5,variable=var, value=1).place(x=180, y=240)
Radiobutton(base, text=&quot;Female&quot;, padx =10,variable=var, value=2).
place(x=240,y=240)
Radiobutton(base, text=&quot;others&quot;, padx=15, variable=var,
value=3).place(x=310,y=240)
list_of_cntry = (&quot;United States&quot;, &quot;India&quot;, &quot;Nepal&quot;,
&quot;Germany&quot;) cv =StringVar()
drplist= OptionMenu(base, cv, *list_of_cntry) drplist.config(width=15)
cv.set(&quot;United States&quot;)
lb2= Label(base, text=&quot;Select Country&quot;, width=13,font=(&quot;arial&quot;,12))
lb2.place(x=14,y=280)
drplist.place(x=200, y=275)
lb6= Label(base, text=&quot;Enter Password&quot;, width=13,font=(&quot;arial&quot;,12))
lb6.place(x=19, y=320)
en6= Entry(base, show=&#39;*&#39;) en6.place(x=200, y=320)
lb7= Label(base, text=&quot;Re-Enter Password&quot;, width=15,font=(&quot;arial&quot;,12))
lb7.place(x=21, y=360)
```

```
en7 =Entry(base, show=&#39;*&#39;) en7.place(x=200, y=360)Button(base,
text=&quot;Register&quot;, width=10).place(x=200,y=400) base.mainloop()
def generateOTP() :
# Declare a digits variable # which stores all digits digits = &quot;0123456789&quot;
OTP = &quot;&quot;
# length of password can be changed # by changing value in range
for i in range(4) :
OTP += digits[math.floor(random.random() * 10)] return OTP
# Driver code
if name == &quot; main &quot; :
print(&quot;OTP of 4 digits:&quot;, generateOTP()) digits=&quot;0123456789&quot;
OTP=&quot;&quot;
for i in range(6): OTP+=digits[math.floor(random.random()*10)]
otp = OTP + &quot; is your OTP&quot; msg= otp
s = smtplib.SMTP(&#39;smtp.gmail.com&#39;, 587) s.starttls()
s.login(&quot;Your Gmail Account&quot;, &quot;You app password&quot;) emailid =
input(&quot;Enter your email: &quot;)
s.sendmail(&#39;&amp;&amp;&amp;&amp;&amp;&amp;&amp;&amp;&amp;&amp;&amp;&amp;&#39;,e
mailid,msg) a = input(&quot;Enter Your OTP &gt;&gt;: &quot;)
if a == OTP: print(&quot;Verified&quot;)
else:
print(&quot;Please Check your OTP again&quot;)
```

Sensor Connection Setup

PHYSICAL COMPONENTS:

i. PIR MOTION SENSOR

ii. ULTRASONIC DISTANCE SENSOR

iii. ESP32-ARDUINO MICROCONTROLLER

OUTPUT: WOKWI SETUP

WEB UI

The admin gets notification when the bin detects motion and if the bin level crosses 50 percent it indicates warning and if it crosses 90 percent it gives a High alert and closes the bin. If the admin wants to seal the bin the admin can command seal bin until it is accessed for cleaning

CHAPTER 8

8.TESTING

8.1.Test Case:

Maximum Size of Bin : 200 cm

Safelimit: below 100 cm

Minimum threshold limit of bin: 100 cm

Maximum threshold limit of bin: 180 cm

S.no	Bin Level (cm filled)	Bin Status	Location
1	*45*	*Safe*	*Kanyakumari*
2	*78*	*Safe*	*Coimbatore*
3	*112*	*Warning*	*Trichy*
4	*169*	*Warning*	*Chennai*
5	*186*	*Warning*	*Ooty*
6	*193*	*High_Alert*	*Tirunelveli*
8	*0*	*Safe*	*Chengalpattu*
9	*35*	*Safe*	*Madurai*
10	*101*	*Warning*	*Salem*
11	*132*	*Warning*	*Thanjavore*
12	*158*	*Warning*	*Vellore*
13	*93*	*High_Alert*	*Erode*
14	*93*	*High_Alert*	*Karur*
15	*93*	*High_Alert*	*Cuddalore*

16	*30*	*Safe*	*Kumbakonam*
17	*110*	*Warning*	*Ambur*
18	*180*	*Warning*	*Sivakasi*
19	*195*	*High_Alert*	*Neyveli*
20	*80*	*Safe*	*Krishnagiri*

Note: *The bin location provided above is default. When the user access the bin , the location and status of the bin displayed to the admin.*

8.2.USER ACCEPTANCE TESTING

Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Smart Waste Management System project at the time of the release to User Acceptance Testing (UAT).

Defect Analysis

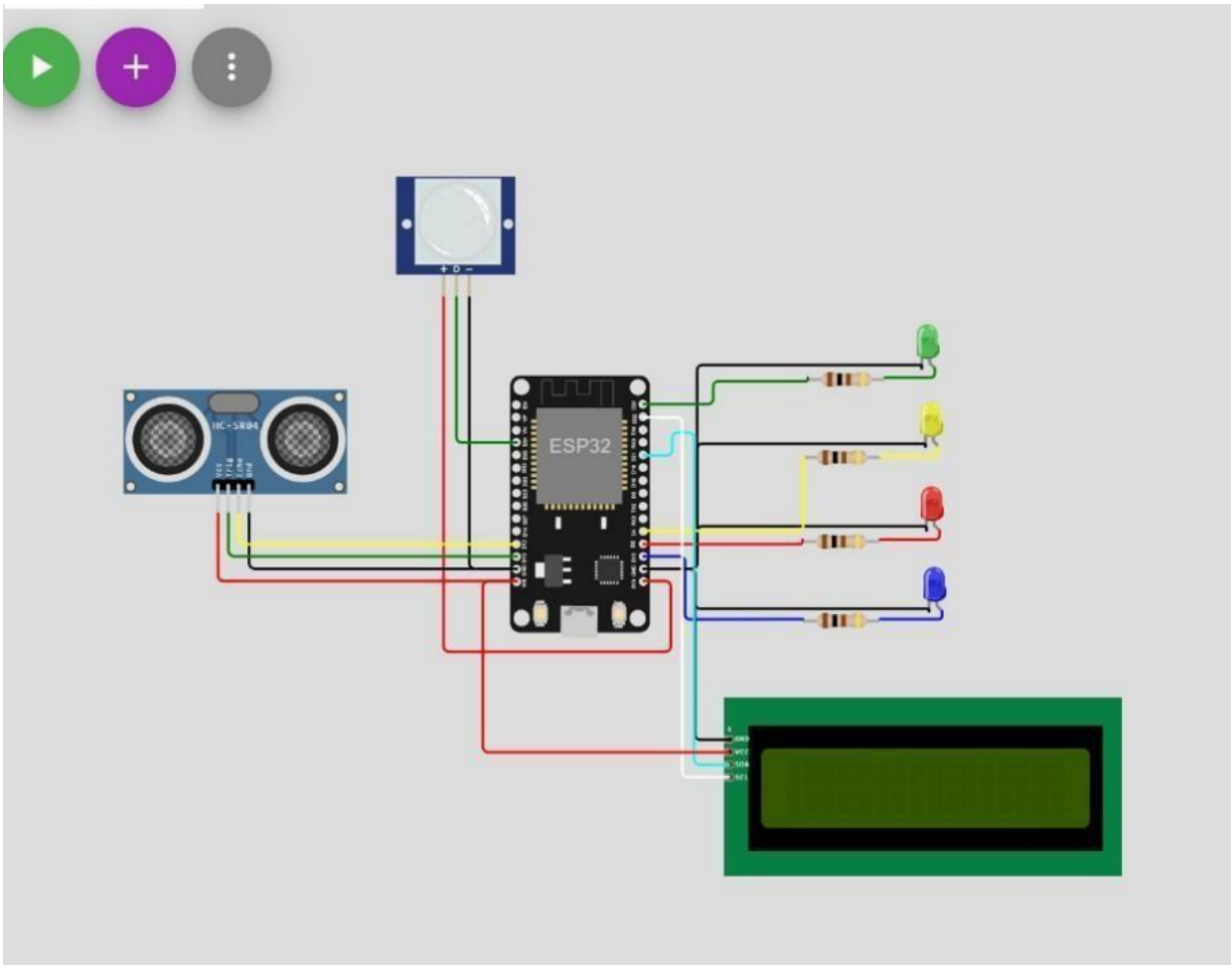
This report shows the number of resolved or closed bugs at each severity level, and how they were resolved.

CHAPTER 9

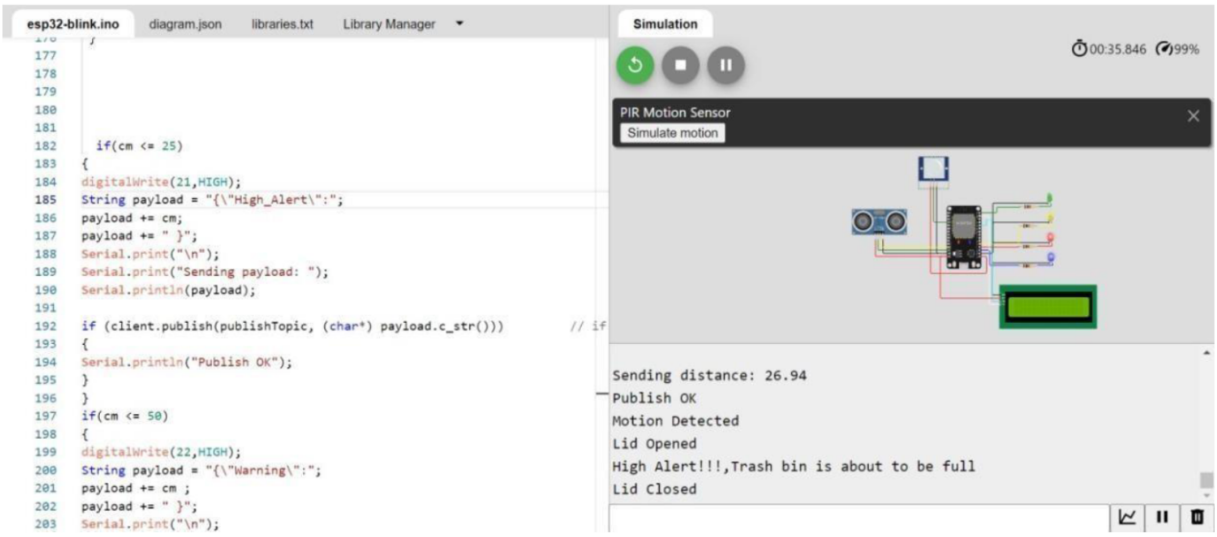
9.RESULTS

9.1Performance Metrics

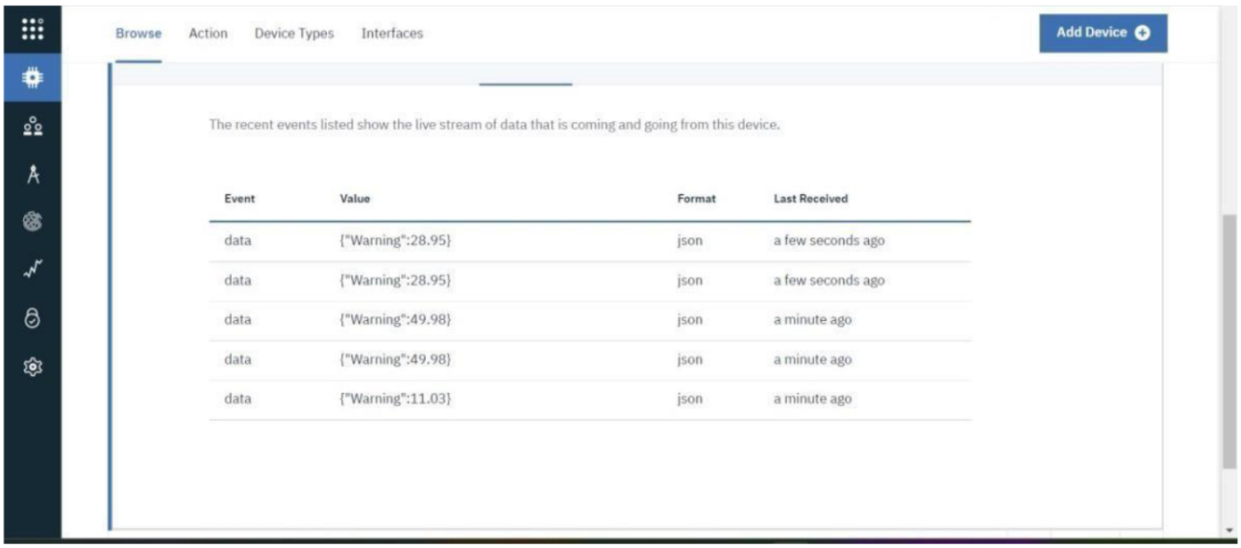
Circuit Diagram:



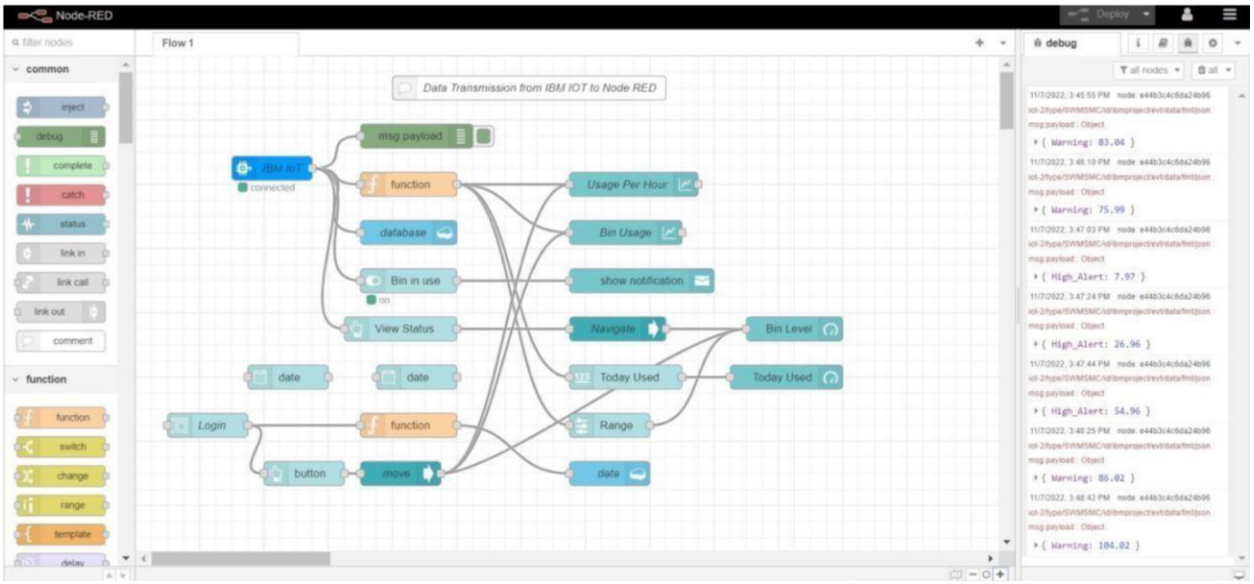
Workwi Simulation:



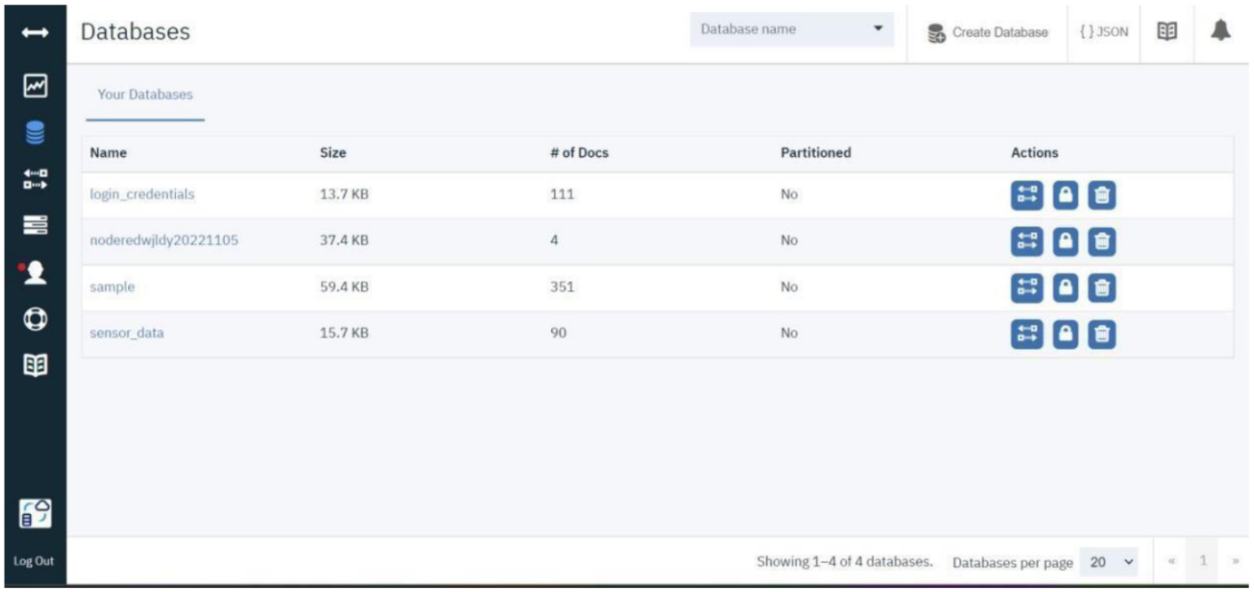
Data transfer to Watson IOT platform :

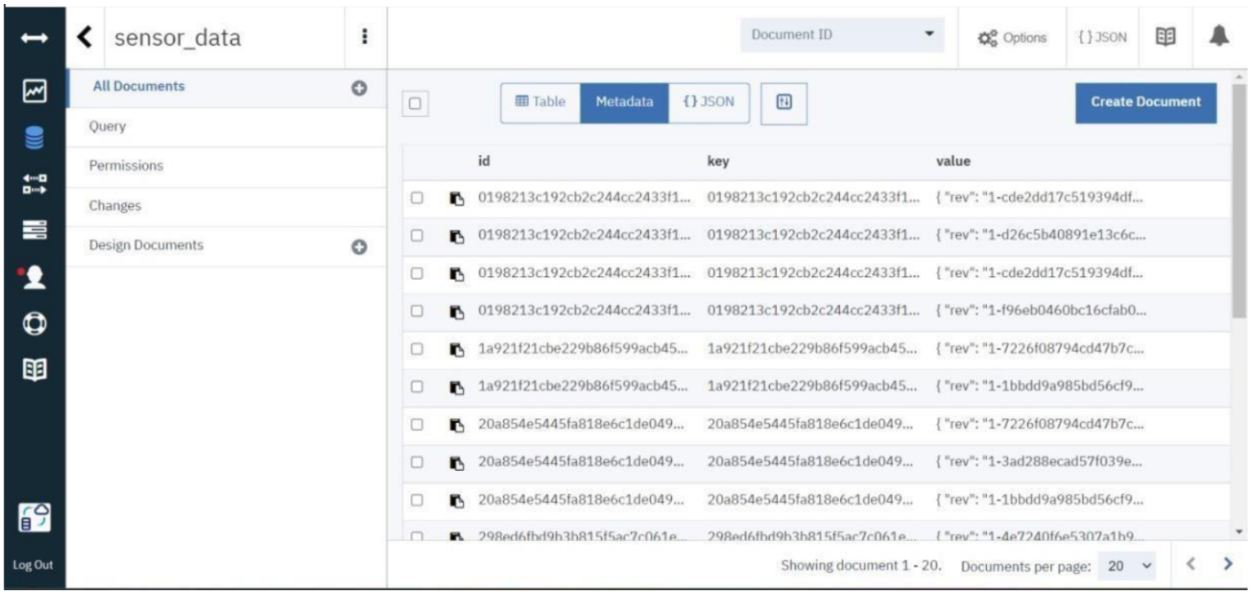


Node-RED Connection setup for data transmission from IBM Watson IOTplatform to Node-RED dashboard:

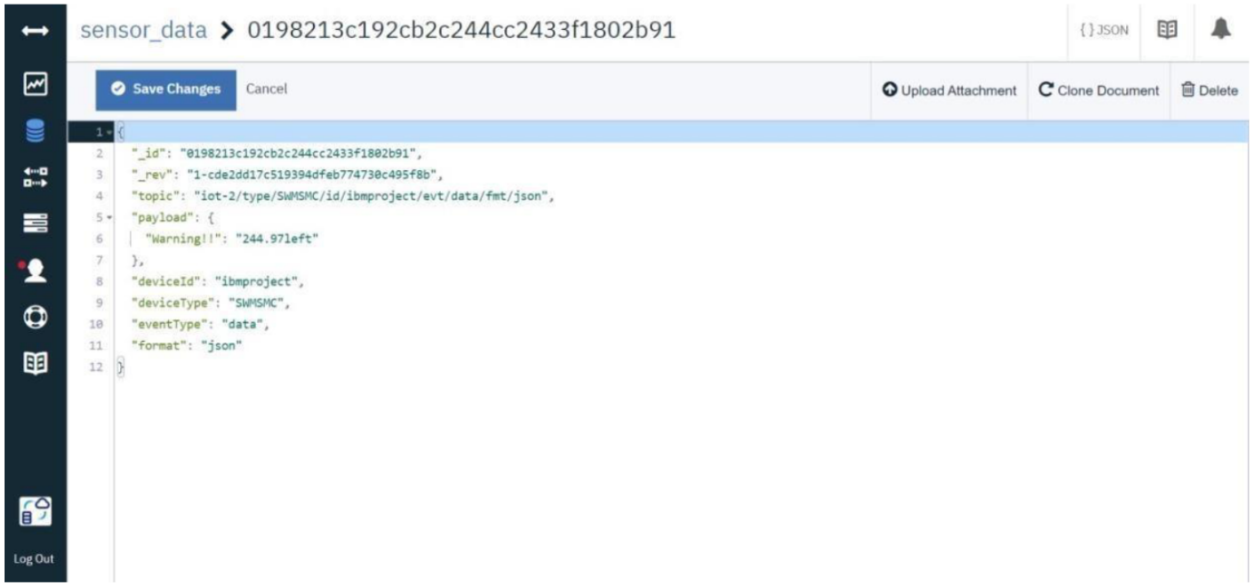


Storing database in IBM cloudant DB:





Data is stored in JSON format:



CHAPTER 10

10.ADVANTAGES AND DISADVANTAGES

10.1.ADVANTAGES

1. Reduction in Collection Cost
2. No Missed Pickups
3. Reduced Overflows
4. Waste Generation Analysis
5. CO2 Emission Reduction

10.2.DISADVANTAGES

a. System requires a greater number of waste bins for separate waste collection as per population in the city.
b. This resultsinto high initialcost due to expensive smartdustbins compare to other methods. Sensor nodes used in the dustbins have limited memory size.

CHAPTER 11

11.CONCLUSION :

A Smart Waste Management system that is more effective than the one in use now is achievable by using sensors to monitor the filling of bins. Our conception of a "smart waste management system" focuses on monitoring waste management, offering intelligent technology for waste systems, eliminating human intervention, minimizing human time and effort, and producing a healthy and trash- free environment. The suggested approach can be implemented in smart cities where residents have busy schedules that provide little time for garbage management. If desired, the bins might be put into place in a metropolis where a sizable container would be able to hold enough solid trash for a single unit. But these may price bit high.

CHAPTER 12

12.FUTURE SCOPE:

There are several future works and improvements for the proposed system, including the following:

- Changes the system of user authentication and atomic lock of bins, whichwould aid in protecting the bin from damage or theft.

- The concept of green points would encourage the involvement of residents or end users, making the idea successful and aiding in the achievement of collaborative waste management efforts, thus fulfilling the idea of 'Swachh Bharath'.

- Having case study or data analytics on the type and times waste is collected on different days or seasons, making the bin level predictable and remove the reliance on electronic components, and fixing the coordinates.

- Improving the Server's and Android's graphical interfaces

CHAPTER 13

13.APPENDIX

- **Esp32 - Microcontroller** :

ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth.

  - Memory: 320 KiB
  - SRAM CPU: Tensilica Xtensa LX6 microprocessor @ 160 or 240 MHz
  - Power: 3.3 V DC
  - Manufacturer: Espressif Systems
  - Predecessor: ESP8266

- **Sensors :**

  - PIR motion sensor: PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range.
  - Ultrasonic Distance Sensor : Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception.

13.1. Source 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 "9gbe4w" // IBM organisation id
#define DEVICE_TYPE "SWMSMC" // Device type mentioned in ibm watson iot platform
#define DEVICE_ID "ibmproject" // Device ID mentioned in ibm watson iot
platform#define
TOKEN "sUNA41tG6-Pq)0rk5X" // Token
// customise above values
charserver[] = ORG ".messaging.internetofthings.ibmcloud.com"; // server name char
publishTopic[] = "iot-2/evt/data/fmt/json";
char topic[] = "iot-2/cmd/led/fmt/String"; // cmd Represent type and command is test
format ofstrings
char authMethod[] = "use-token-auth"; // authentication method char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID; //Client id
//
WiFiClient wifiClient; // creating instance for wificlient
PubSubClient client(server, 1883, wifiClient);
#define ECHO_PIN 12
#define TRIG_PIN 13
float dist;
void setup()
{
Serial.begin(115200);
pinMode(LED_BUILTIN,
OUTPUT); pinMode(TRIG_PIN,
OUTPUT
); pinMode(ECHO_PIN, INPUT);
//pir pin
pinMode(4,
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()
{
lcd.clear();
publishData();
delay(500);
if (!client.loop())
{
mqttConnect(); // function call to connect to IBM
}
}
/* retrieving to cloud */
void wifiConnect()
{
Serial.print("Connecting to ");
Serial.print("Wifi");
WiFi.begin("Wokwi-GUEST", "",
6);
while (WiFi.status() != WL_CONNECTED)
{
delay(500);
Serial.print(".");
}
Serial.print("WiFi connected, IP address: ");
Serial.println(WiFi.localIP());
}
void mqttConnect()
{
if (!client.connected())
{
Serial.print("Reconnecting MQTT client to ");
Serial.println(server); while (!client.connect(clientId,
authMethod, token))
```

```
{
Serial.print(".")
; delay(500);
}
initManagedDevice();
Serial.println();
}
}
void initManagedDevice()
{
if (client.subscribe(topic))
{
}
else
{
Serial.println("IBM subscribe to cmd OK");
Serial.p
rintln("s
ubscrib
e to
cmd
FAILE
D"
);
}
}
void publishData()
{
float cm = readcmCM();
if(digitalRead(34)) //PIR motion detection
{
Serial.println("Motion Detected");
Serial.println("Lid Opened");
digitalWrite(15, HIGH);
}
else
{
digitalWrite(15, LOW);
}
if(digitalRead(34)== true)
{
```

```
if(cm <= 100) //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 > 150 && cm < 250)
{
digitalWrite(4, HIGH);
Serial.println("Warning!!,Trash is about to cross 50% of bin
level"); digitalWrite(2, LOW); digitalWrite(23, LOW);
}
else if(cm > 250 && cm <=400)
{
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");
```

13.2 . GITHUB LINK

LINK : *https://github.com/IBM-EPBL/IBM-Project-39181-1660399380*