Nalaiya Thiran

Batch No: **B7-1A3E**

Vel Tech Multi Tech Engineering college

Department of **Information Technology**

Smart Waste Management System For Metropolitan Cities

Team ID: PNT2022TMID22555

Team Members:

Keerthana.K

Sushma.P

Karpaga bhavani.V

Vemula swaroopa

Project Guide:

Industry mentor: Mr. Dinesh

Faculty Mentor: Ms. Madhavi

ABSTRACT

With increase in population, the scenario of cleanliness with respect to garbage management is degrading tremendously. The overflow of garbage in public areas creates the unhygienic condition in the nearby surrounding. It may provoke several serious diseases amongst the nearby people. It also degrades the valuation of the area. To avoid this and to enhance the cleaning, “garbage management system’ is proposed in this project. In the proposed system, admin create a garbage bin id and send to the driver to collect that garbage and also have facility to people lodged the complain against the garbage which is spread near him/her. It is a user friendly system which is used by any person easily.

Garbage Management System’ can lead to error free, secure, reliable and fast management system. It assist the user to concentrate on their other activities rather concentrate on the record keeping. Thus it will help organization in better utilization of resources. The organization can maintain computerized records without redundant entries. That means that one need not be distracted by information that not relevant, while being able to reach the information.

The aim to automate its existing manual system by the help of computerized equipments and full-fledge computer software, fulfilling their requirements, so that their valuable data/information can be stored for a long period with easy accessing and manipulation of the same. Basically the project describes how to manage for good performance and better services for the clients.

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CHAPTER 1: INTRODUCTION

1.1 Project Overview

Garbage Management System which helps in the management of waste witth the least human interaction in order to maintain a clean environment .

Provide route planning for the collection based on the

selected fill level and priorities of each bin.

It is very much faster than manual system.

Easy and fastest record finding technique.

It is very much flexible to work.

It is very user oriented.

Data can be stored for a longer period.

1.2 Purpose

Around 2.1 billion tonnes of municipal solid waste is generated annually around the globe. Population growth and rapid urbanization lead to a huge increase in waste generation, so the traditional methods of waste collection have become inefficient and costly. This system cannot measure the fullness levels of containers, and as a result, half-full containers can be emptied, and in contrast, pre-filled ones need to wait until the next collection period comes. Moreover, since drivers collect empty bins, predefined collection routes of the system cause waste of time, an increase in fuel consumption, and excessive use of resources.

In today’s ever-technological world, an innovative and data-driven approach is the only way forward, the waste sector needs a solution that empowers event-driven waste collection. The most efficient way this extraordinary amount of waste can be solved is through smart waste management without obsolete

methods of waste collection. This empowers municipalities, cities, and waste collectors to optimize their waste operations, become more sustainable, and make more intelligent business decisions.

CHAPTER 2: LITERATURE SURVEY

2.1 Existing Problem

Around 80% of waste collections happen at the wrong time. Late waste collections lead to overflowing bins, unsanitary environments, citizen complaints, illegal dumping, and increased cleaning and collection costs. Early waste collections mean unnecessary carbon emissions, more traffic congestion, and higher running costs. The old way of doing waste management is highly inefficient. And in today's ever-technological world, an innovative and data-driven approach is the only way forward. Traditionally, municipalities and waste management companies would operate on a fixed collection route and schedule. This means that waste collection trucks would drive the same collection route and empty every single waste container – even if the waste container did not need emptying. This means high labour and fuel costs – which residents ultimately foot the bill for.

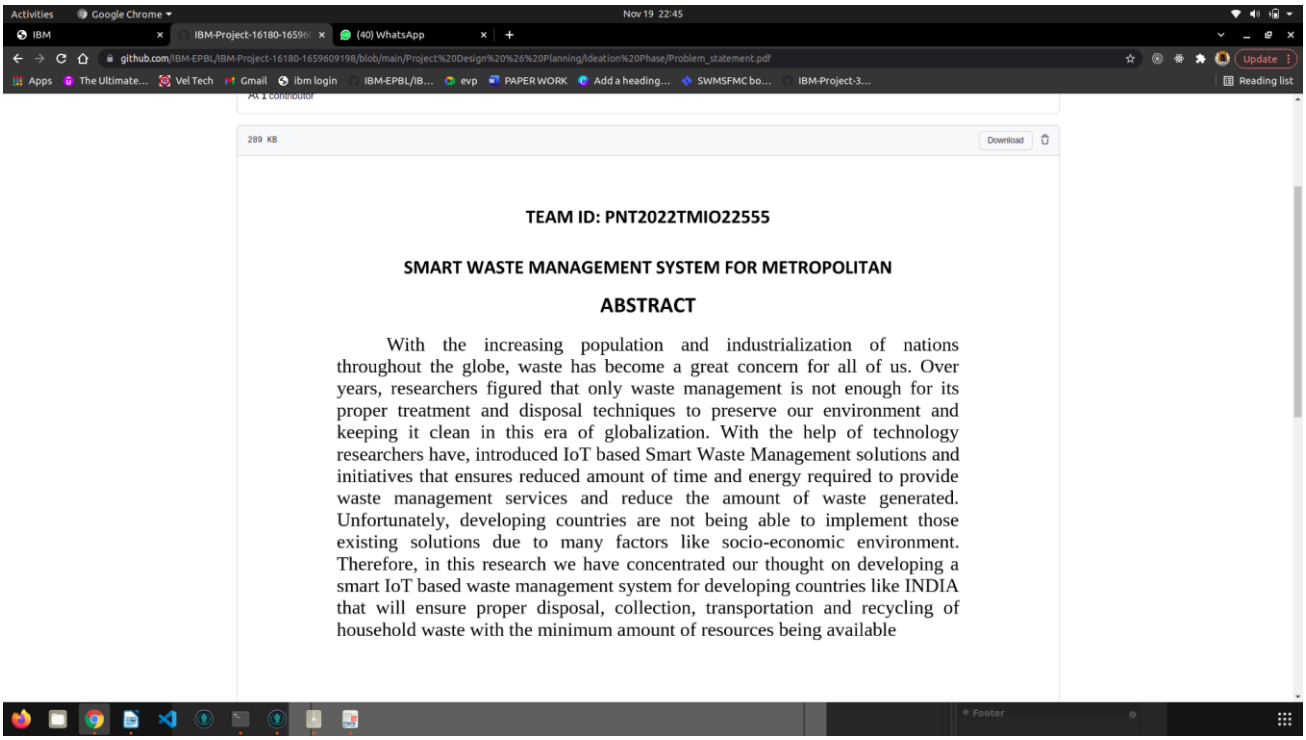
2.2 References

Paper Title	Author	Outcome
IOT based Smart Garbage System	1) T.Sinha 2) R.M. Sahuother	IoT Based Smart Garbage System which indicates directly that the dustbin is filled to a certain level by the garbage and cleaning or emptying them is a matter of immediate concern. This prevents lumping of garbage in the roadside dustbin which ends up giving foul smell and illness to people. The design of the smart dustbin includes a single by ultrasonic sensor which configured with Arduino Uno with this research, it is sending SMS to the Municipal Council that dustbin is to overflow.

Raspberry pi-based smart waste management system using Internet of Things.	1)Shaik Vaseem Akram 2)Rajesh Singh	Nowadays it is becoming a difficult task to distinguish wet and dry waste. The new waste management system covers several levels of enormous workforce. Every time, laborers must visit the garbage bins in the city area to check whether they are filled or not. The data communicates to the cloud server for real-time monitoring of the system. With the real-time fill level information collected via the monitoring platform, the system reduces garbage overflow by informing about such instances before they arrive
Smart Waste Management System.	1) Sanjiban Charkraborty	This Waste management is one of the serious challenges of the cities, the system now used in cities, we continue to use an old and outmoded paradigm that no longer serves the entail of municipalities, Still find over spilled waste containers giving off irritating smells causing serious health issues and atmosphere impairment.
Smart Solid Waste Management.	1) Mohd Helmy Abd Wahab	At the time of trash disposal, the material to be recycled could be identified using RFID technology.
Analysis of Load cell.	1) Ranjeet Kumar 2) Sandeep Chhabra	Load Cells 4.1 General Load Cell related information A load cell is meant to measure the size of a mass but actually is a force sensor which transforms force into an electrical signal. The load cell needs the earth gravity to work. Every mass is attracted by the earth gravimetric field, that force is named “load”.

Smart Waste Management using Wireless Sensor Network	1) Tarandeep Singh 2) Rita Mahajan 3) Deepak Bagai	In most of the places, garbage bins are not cleaned at periodic intervals, giving a hygienic issue. Thus, a system to manage bins, by using intelligent bins, gateway and remote base station is created. But this system is prone to attacks from hackers and complexity to build it is very high.
Smart Waste Management for Green Environment	1) T. P. Fei	The system is based on Bootstrap platform. This system works on the waterfall methodology which has 4 crucial phases: planning and analysis, system design, system implementation and system testing. Using this system, operators can get the information regarding collection from trash bins. The limitations of this approach are that the resultant product has a short life and uniformity is lost after a certain period.

2.3 Problem Statement Definition



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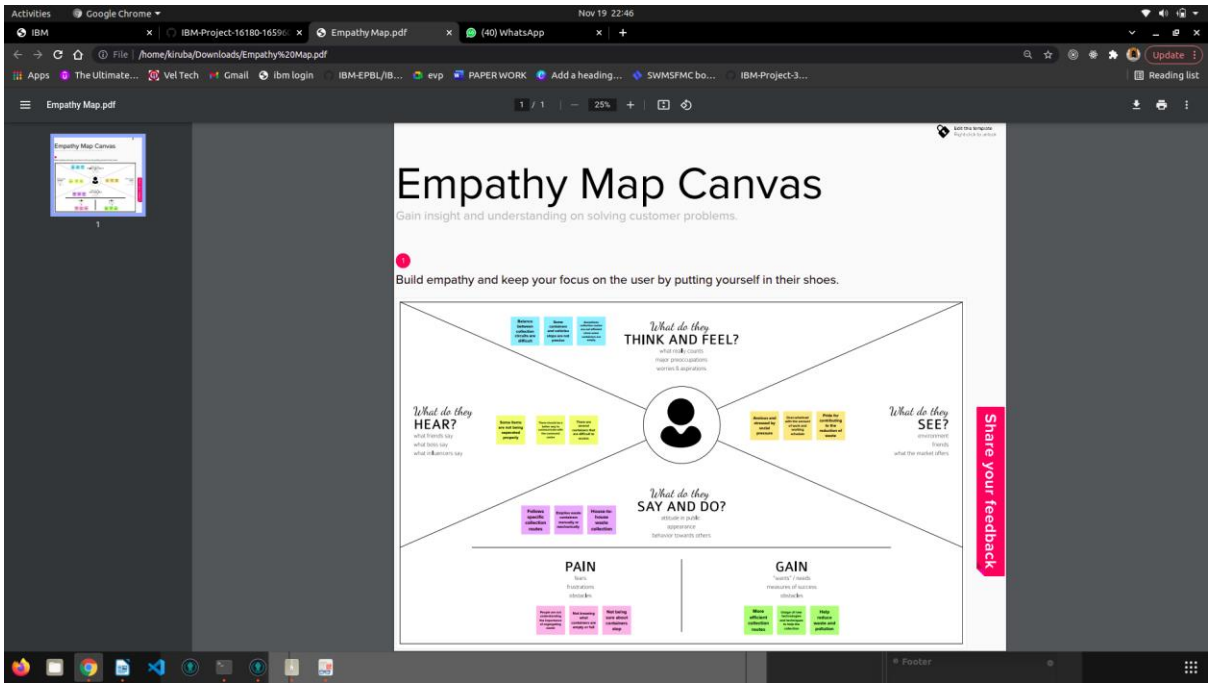
SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN

ABSTRACT

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

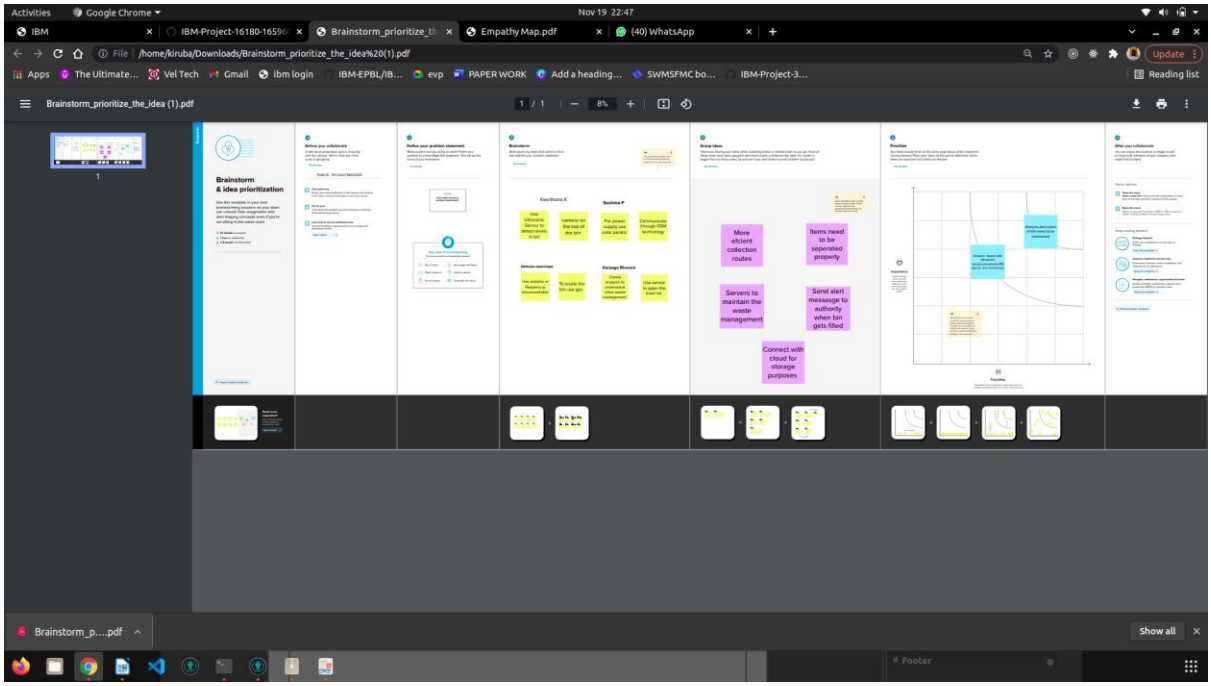
CHAPTER 3: IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

3.2.1 Brainstorm by team members



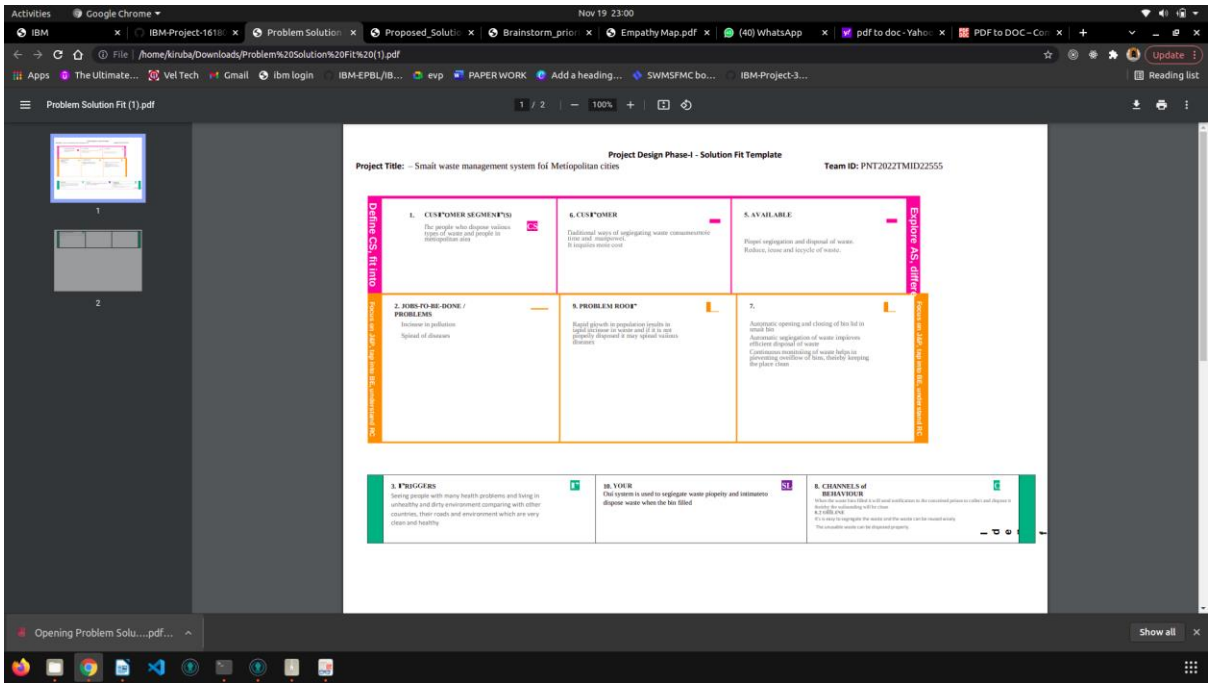
3.3 Proposed Solution

S. No.		Description
1.		Dumping garbage in public areas is a common thing found in all developing countries and this mainly end up affecting the environment and creating several unhygienic conditions.In this project we're aimed to develop an smart waste bin with cost effective manner.

2.	Idea / Solution description	It helps to keep track of the waste management system. The proposed system requires very minimal hardware components for implementation process. Here, we're using ultrasonic sensor to detect the level of the bin which is connected to a microcontroller. Once the level of the bin attains a certain threshold limit, the GSM will notify the central hub. When the central hub has been notified by GSM, it will glow the LED which makes the workers to understand that the bin has attained the maximum limit.
3.	Novelty / Uniqueness	All the existing systems and proposed papers has too many electrical and mechanical components which is hard to maintain as well as it is not cost effective.The main idealogy of this project is to be implemented in real-time. So, we can implement this in apartments, schools,college. The uniqueness is, it has a very simple user interface which can be understood by illiterate people too and requires only 4 components. It is way more easy to maintain.
4.	Social Impact / Customer Satisfaction	People don't have to worry about overflowing of bin especially in apartments where fifty plus houses are in same compound. This system helps to track and maintain it effectively.

5.	Business Model (Revenue Model)	As the system we're proposing is cost effective, at first it can be implemented in apartments because there is a certain amount are given by each individual for maintenance, this system can be implemented within that amount. And it can be implemented in organizations too.
6.	Scalability of the Solution	The waste collection for an entire major metropolitan area should be supported by the platform. The implementation of this will consider various implementation-related factors, including the storage and security of data in the cloud.

3.4 Proposed Solution fit



CHAPTER 4: REQUIRMENT ANALYSIS

4.1 Functional Requirements

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	GPS and Cloud	GPS location of the registered bin to be received. The data collected is to be stored in cloud. So cloud registration must be done.
FR-4	Bin details and its monitoring	The data about the bin is collected- The size, the capacity, the type of waste it holds, the time it takes approximately to get filled etc. Displays real-time data on fill-levels of bins monitored by smart sensors. With real-time data and predictions, you can eliminate the overflowing bins and stop collecting half-empty ones.
FR-5	Plan waste collection routes	Based on current bin fill-levels and predictions of reaching full capacity, you are ready to respond and schedule waste collection. Inefficient picks are thus avoided
FR-6	Bin distribution	Identify areas with either dense or sparse bin distribution. Based on the data collected on capacity or location, the bin can be adjusted, if necessary.

4.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	IoT device verifies and analyses user requirements, which can further improve the design quality. In the design process, with user experience as the core knowledge, usability can indeed help designers better understand users' potential needs in waste management, behaviour and experience.

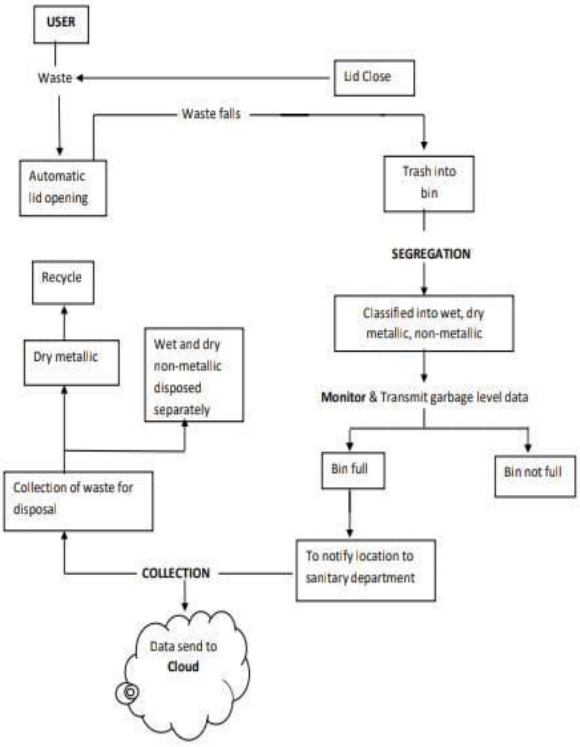
NFR-2	**Security**	Use reusable bottles Use reusable grocery bags Purchase wisely and recycle Avoid single use food and drink containers
NFR-3	**Reliability**	Smart waste management is also about creating better working conditions for waste collectors and drivers. Instead of driving the same collection routes and servicing empty bins, waste collectors will spend their time more efficiently, taking care of bins that need servicing
NFR-4	**Performance**	The Smart Sensors use ultrasound technology (ultrasonic sensor) to measure the fill levels in bins several times a day and saved in cloud which helps in performing many data driven operations in waste management app. Customers are hence provided with data-driven decision making, and optimization of waste collection routes, frequencies, and vehicle loads resulting in route reduction by at least 30%
NFR-5	**Availability**	By developing & deploying effective hardware and apt software we can empower cities to manage waste smarter
NFR-6	**Scalability**	Using smart waste bins, reduces the number of bins inside town or cities because we able to monitor the garbage 24/7 more cost effect and scalability when we move to smarter.

4.2 Non-functional Requirements

CHAPTER 5: PROJECT DESIGN

5.1 Data Flow Diagram:

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



5.2 Solution and Technical Architecture

5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Admin (who manages web server)	Login	USN-1	As an admin, I gave user ID and password for every worker and manage them.	I can manage my account / dashboard	High	Sprint-1
Co admin	Login	USN-2	As a co admin, I will manage garbage level monitor. If garbage get filled I will send alert and will post location and garbage ID to trash truck.	I can manage monitoring	High	Sprint-1
Truck driver	Login	USN-3	As a Truck driver, I will follow the route sent by co admin to reach the filled garbage.	I can drive to reach the garbage filled route in shortest route given	Medium	Sprint-2
Local garbage collector	Login	USN-4	As a Waste collector, I will collect all the trash from garbage and load into garbage truck and send them to landfill.	I can collect trash and load it to truck and send off	Medium	Sprint-2
Municipality	Login	USN-5	As a Municipality, I will check the process if they are happening in disciplined manner without any issues.	I can manage all these process if going good	High	Sprint-1

CHAPTER 6: PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation:

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Login	USN-1	As a admin, I need to give access to both users and drivers for carring out the waste management system	20	High	Keerthana.K
Sprint-2	Dashboard	USN-2	As a co-admin, i will manage the user request And allocate, give instructions to drivers	20	Low	Karpaga bhavani.V
Sprint-3	Dashboard	USN-3	As a Truck Driver, I'll follow Admin's Instruction to reach the filling bin in short roots and save time	20	Medium	Vemula Swaroopa
Sprint-4	Dashboard	USN-4	As a officer, I will take care of reports That are given by both the parties	20	High	Sushma.P

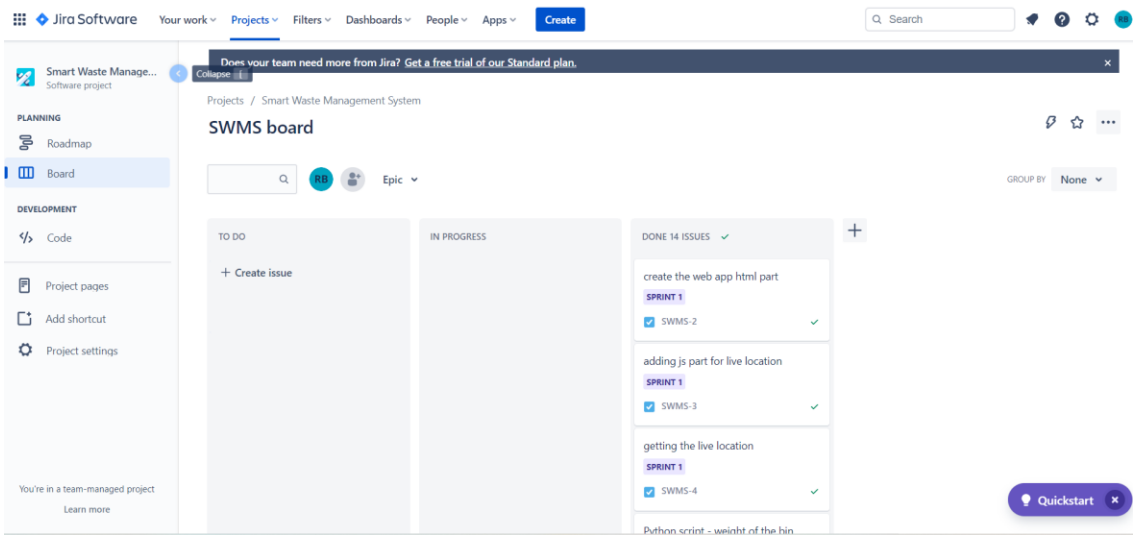
6.2 Sprint Delivery Schedule:

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

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

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

6.3 Reports from JIRA: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Filters
Dashboards
People
Apps
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Search
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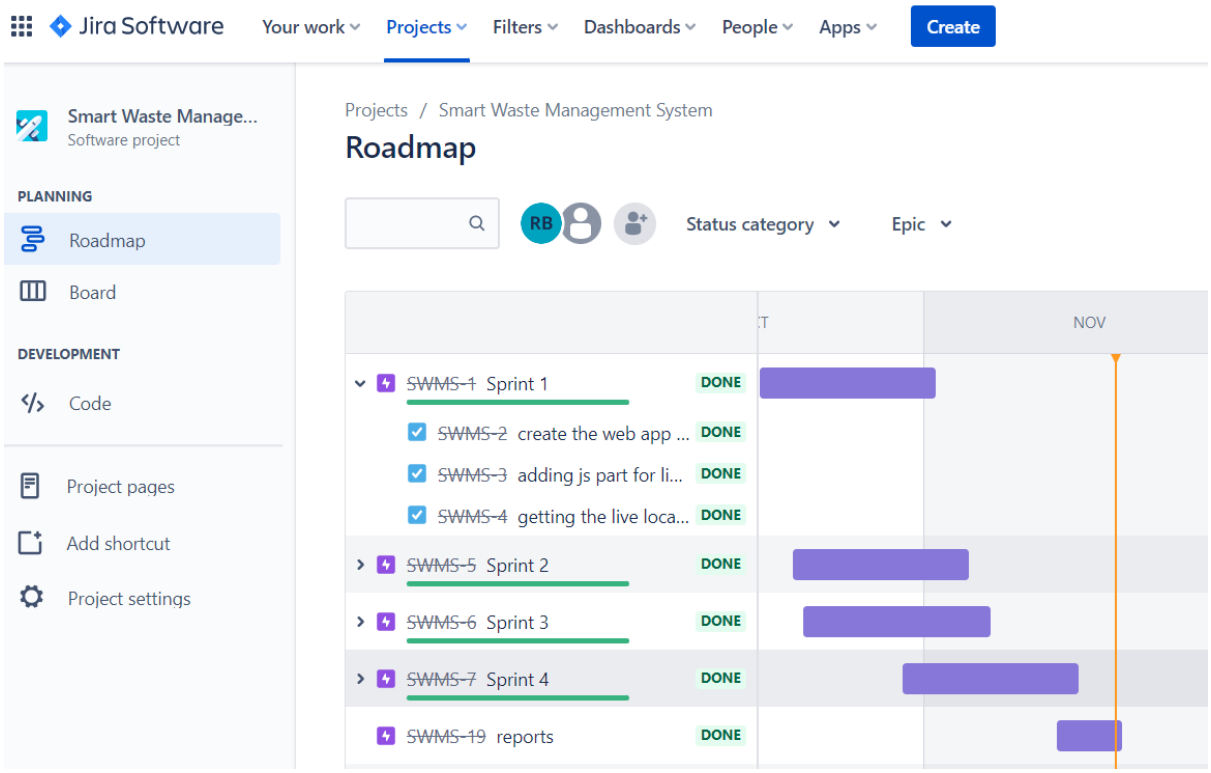
Projects / Smart Waste Management System
SWMS board
PLANNING
Roadmap
Board
DEVELOPMENT
Code
Project pages
Add shortcut
Project settings
Epic
GROUP BY
None
TO DO
IN PROGRESS
DONE 14 ISSUES
+ Create issue
create the web app html part
SPRINT 1
SWMS-2
adding js part for live location
SPRINT 1
SWMS-3
getting the live location
SPRINT 1
SWMS-4
You're in a team-managed project
Learn more
Quickstart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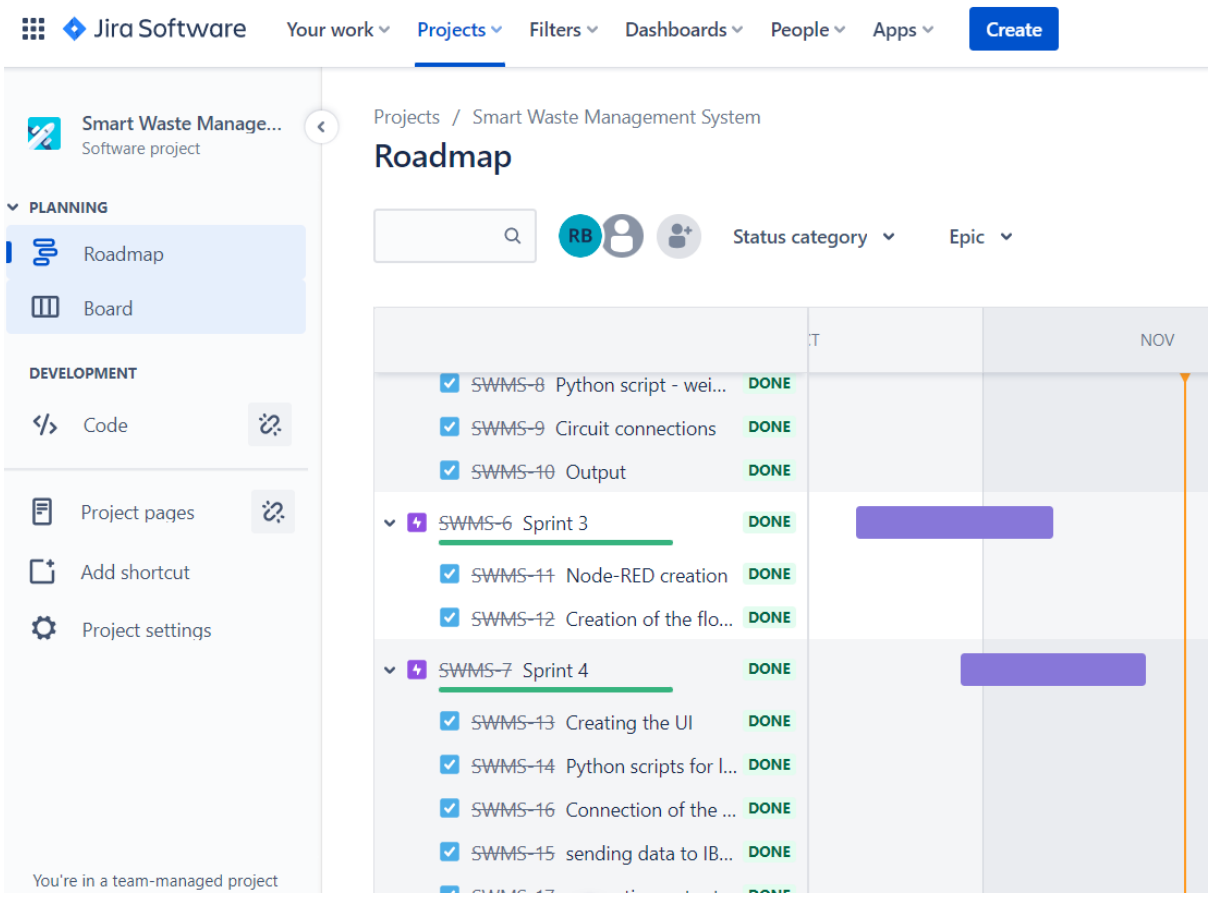
Your work
Projects
Filters
Dashboards
People
Apps
Create
Smart Waste Manage...
Software project
PLANNING
Roadmap
Board
DEVELOPMENT
Code
Project pages
Add shortcut
Project settings
Projects / Smart Waste Management System
Roadmap
RB
Status category
Epic
NOV
SWMS-1 Sprint 1 DONE
SWMS-2 create the web app ... DONE
SWMS-3 adding js part for li... DONE
SWMS-4 getting the live loca... DONE
SWMS-5 Sprint 2 DONE
SWMS-6 Sprint 3 DONE
SWMS-7 Sprint 4 DONE
SWMS-19 reports DONE


Jira Software
Your work
Projects
Filters
Dashboards
People
Apps
Create
Smart Waste Manage...
Software project
PLANNING
Roadmap
Board
DEVELOPMENT
Code
Project pages
Add shortcut
Project settings
You're in a team-managed project
Projects / Smart Waste Management System
Roadmap
RB
Status category
Epic
NOV
SWMS-8 Python script - wei... DONE
SWMS-9 Circuit connections DONE
SWMS-10 Output DONE
SWMS-6 Sprint 3 DONE
SWMS-11 Node-RED creation DONE
SWMS-12 Creation of the flo... DONE
SWMS-7 Sprint 4 DONE
SWMS-13 Creating the UI DONE
SWMS-14 Python scripts for l... DONE
SWMS-16 Connection of the ... DONE
SWMS-15 sending data to IB... DONE

CHAPTER 7: CODING AND SOLUTIONING

7.1 Feature 1:

The main and first feature of the smart waste management is to get the live location of anyone who access the website for putting out a request for garbage collection in their locality. The live location is obtained as a result of the below code.

Web Application to get the Live location:

index.html:

```
<!DOCTYPE html>
<html>
<head>
  <link rel="stylesheet"
href="https://cdn.jsdelivr.net/npm/bootstrap@4.3.1/dist/css/bootstrap.min.css"
integrity="sha384-
ggOyR0iXCbMQv3Xipma34MD+dH/1fQ784/j6cY/iJTQUOhcWr7x9JvoRxT2MZw1T"
crossorigin="anonymous">
   <meta charset="utf-8">
   <meta name="viewport" content="width=device-width">
   <title>Smart Waste Management System</title>
   <link rel="icon" type="image/x-icon" href="/imgs/DUMPSTER.png">
   <link href="style.css" rel="stylesheet" type="text/css" />
   <script src="https://www.gstatic.com/firebasejs/9.14.0/firebase-app.js"></script>
   <script src="https://www.gstatic.com/firebasejs/9.14.0/firebase-analytics.js"></script>
   <script src="https://www.gstatic.com/firebasejs/9.14.0/firebase-database.js"></script>

   <script>
      var firebaseConfig =
      {
         apiKey: "AIzaSyCcZk7b1CLOGviwUpthRDLotrmFX0MFuTs",
         authDomain: "swms-3840.firebaseapp.com",
         projectId: "swms-3840",
         storageBucket: "swms-3840.appspot.com",
         messagingSenderId: "479902726304",
         appId: "1:479902726304:web:3d822880d1275ee57a71c5",
         measurementId: "G-MHP4N77MTP"
      };
      firebase.initializeApp(firebaseConfig)
   </script>
   <script defer src="db.js"></script>
</head>

<body style="background-color:#1F1B24;">
   <script src="maps.js"></script>
   <div id="map_container">
```

```
        <h1 id="live_location_heading" >LIVE LOCATION</h1>
        <div id="map"></div>
        <div id="alert_msg">ALERT MESSAGE!</div>
    </div>
    </div>
    <center>
        <a href="https://goo.gl/maps/G9XET5mzSw1ynHQ18" type="button" class="btn
btn-dark">
            DUMPSTER
        </a>
    </center>
    <script
        src="https://maps.googleapis.com/maps/api/js?key=AIzaSyBBLyWj-
3FWtCbCXGW3ysEiI2fDfrv2v0Q&callback=myMap"></script></div>
</body>
</html>
```

db.js:

```
const cap_status = document.getElementById("cap_status");
const alert_msg = document.getElementById("alert_msg");

var ref = firebase.database().ref();

ref.on(
  "value",
  function (snapshot) {
    snapshot.forEach(function (childSnapshot) {
      var value = childSnapshot.val();

      const alert_msg_val = value.alert;
      const cap_status_val = value.distance_status;

      alert_msg.innerHTML = `${alert_msg_val}`;
    });
  },
  function (error) {
    console.log("Error: " + error.code);
  }
);
```

maps.js:

```
const database = firebase.database();

function myMap() {
  var ref1 = firebase.database().ref();

  ref1.on(
    "value",
```

```
    function (snapshot) {
      snapshot.forEach(function (childSnapshot) {
        var value = childSnapshot.val();
        const latitude = value.latitude;
        const longitude = value.longitude;

        var latlong = { lat: latitude, lng: longitude };
        var mapProp = {
          center: new google.maps.LatLng(latlong),
          zoom: 10,
        };
        var map = new google.maps.Map(document.getElementById("map"), mapProp);
        var marker = new google.maps.Marker({ position: latlong });
        marker.setMap(map);
      });
    },
    function (error) {
      console.log("Error: " + error.code);
    }
  );
}
```

7.2 Feature 2:

In this part, the filled level of the bin is measured with the help of IBM IOT Watson platform devices, IBM Cloud interface and Node-RED is used for creating the dashboard nodes that helps us create a UI to display the distance, that is, the fill level of the bin. It also intimates the location of the bin with the fill level and alerts the collection authority if the fill level goes beyond a threshold value.

Code to evaluate the level of the garbage in bin:

bin1.py:

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

# watson device details
organization = "73ffyv"
devicType =  "BIN1"
deviceId = "BIN1ID"
authMethod= "token"
authToken= "123456789"
```

```
#generate random values for randomo variables (temperature&humidity)
def myCommandCallback(cmd):
    global a
    print("command recieved is:%s" %cmd.data['command'])
    control=cmd.data['command']
    print(control)

try:
    deviceOptions={"org": organization, "type": devicType,"id": deviceId,"auth-
method":authMethod,"auth-token":authToken}
    deviceCli = ibmiotf.device.Client(deviceOptions)
except Exception as e:
    print("Exception while connecting device %s" %str(e))
    sys.exit()
#connect and send a datapoint "temp" with value integer value into the cloud as a type of event
for every 10 seconds
deviceCli.connect()

while True:
    distance= random.randint(10,70)
    loadcell= random.randint(5,15)
    data= {'dist':distance,'load':loadcell}


    if loadcell < 13 and loadcell > 15:
        load = "90 %"
    elif loadcell < 8 and loadcell > 12:
        load = "60 %"
    elif loadcell < 4 and loadcell > 7:
        load = "40 %"
    else:
        load = "0 %"

    if distance < 15:
        dist = 'Risk warning:' 'Garbage level is high, collection time :) 90 %'
    elif distance < 40 and distance >16:
        dist = 'Risk warning:' 'garbage is above 60%'
    elif distance < 60 and distance > 41:
        dist = 'Risk warning:' '40 %'
    else:
        dist = 'Risk warning:' '17 %'

    if load == "90 %" or distance == "90 %":
        warn  = 'alert :' ' Garbage level is high, collection time :)'
    elif load == "60 %" or distance == "60 %":
        warn = 'alert :' 'garbage is above 60%'
    else :
        warn = 'alert :' 'Levels are low, collection not needed '
```

```
    def myOnPublishCallback(lat=11.035081,long=77.014616):
        print("Peelamedu, Coimbatore")
        print("published distance = %s " %distance,"loadcell:%s " %loadcell,"lon = %s "
%long,"lat = %s" %lat)
        print(load)
        print(dist)
        print(warn)

    time.sleep(10)
    success=deviceCli.publishEvent ("IoTSensor","json",warn,qos=0,on_publish=
myOnPublishCallback)
    success=deviceCli.publishEvent ("IoTSensor","json",data,qos=0,on_publish=
myOnPublishCallback)

    if not success:
        print("not connected to ibmiot")

    time.sleep(30)
    deviceCli.commandCallback=myCommandCallback

#disconnect the device
deviceCli.disconnect()
```

bin2.py:

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

# watson device details
organization = "73ffyv"
devicType =  "BIN2"
deviceId = "BIN2ID"
authMethod= "token"
authToken= "123456789"

#generate random values for randomo variables (temperature&humidity)
def myCommandCallback(cmd):
    global a
    print("command recieved is:%s" %cmd.data['command'])
    control=cmd.data['command']
    print(control)

try:
    deviceOptions={"org": organization, "type": devicType,"id": deviceId,"auth-
method":authMethod,"auth-token":authToken}
    deviceCli = ibmiotf.device.Client(deviceOptions)
```

```
except Exception as e:
   print("Exception while connecting device %s" %str(e))
   sys.exit()

#connect and send a datapoint "temp" with value integer value into the cloud as a type of event
for every 10 seconds
deviceCli.connect()

while True:
   distance= random.randint(10,70)
   loadcell= random.randint(5,15)
   data= {'dist':distance,'load':loadcell}


   if loadcell < 13 and loadcell > 15:
      load = "90 %"
   elif loadcell < 8 and loadcell > 12:
        load = "60 %"
   elif loadcell < 4 and loadcell > 7:
        load = "40 %"
   else:
        load = "0 %"


   if distance < 15:
        dist = 'Risk warning:' 'Garbage level is high, collection time :) 90 %'
   elif distance < 40 and distance >16:
        dist = 'Risk warning:' 'garbage is above 60%'
   elif distance < 60 and distance > 41:
        dist = 'Risk warning:' '40 %'
   else:
        dist = 'Risk warning:' '17 %'


   if load == "90 %" or distance == "90 %":
        warn  = 'alert :' ' Garbage level is high, collection time :)'
   elif load == "60 %" or distance == "60 %":
        warn = 'alert :' 'garbage is above 60%'
   else :
        warn = 'alert :' 'Levels are low, collection not needed '

   def myOnPublishCallback(lat=11.068774,long=77.092978):
      print("PSG iTech, Coimbatore")
      print("published distance = %s " %distance,"loadcell:%s " %loadcell,"lon = %s "
%long,"lat = %s" %lat)
      print(load)
      print(dist)
      print(warn)

   time.sleep(10)
```

```
   success=deviceCli.publishEvent                ("IoTSensor","json",warn,qos=0,on_publish=
myOnPublishCallback)
   success=deviceCli.publishEvent                 ("IoTSensor","json",data,qos=0,on_publish=
myOnPublishCallback)

   if not success:
      print("not connected to ibmiot")

   time.sleep(30)
   deviceCli.commandCallback=myCommandCallback

#disconnect the device
deviceCli.disconnect()
```

bin3.py:

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

# watson device details
organization = "73ffyv"
devicType =  "BIN3"
deviceId = "BIN3ID"
authMethod= "token"
authToken= "123456789"

#generate random values for randomo variables (temperature&humidity)
def myCommandCallback(cmd):
   global a
   print("command recieved is:%s" %cmd.data['command'])
   control=cmd.data['command']
   print(control)

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

#connect and send a datapoint "temp" with value integer value into the cloud as a type of event
for every 10 seconds
deviceCli.connect()

while True:
```

```
    distance= random.randint(10,70)
    loadcell= random.randint(5,15)
    data= {'dist':distance,'load':loadcell}

    if loadcell < 13 and loadcell > 15:
       load = "90 %"
    elif loadcell < 8 and loadcell > 12:
         load = "60 %"
    elif loadcell < 4 and loadcell > 7:
         load = "40 %"
    else:
         load = "0 %"


    if distance < 15:
         dist = 'Risk warning:' 'Garbage level is high, collection time :) 90 %'
    elif distance < 40 and distance >16:
         dist = 'Risk warning:' 'garbage is above 60%'
    elif distance < 60 and distance > 41:
         dist = 'Risk warning:' '40 %'
    else:
         dist = 'Risk warning:' '17 %'


    if load == "90 %" or distance == "90 %":
         warn  = 'alert :' ' Garbage level is high, collection time :)'
    elif load == "60 %" or distance == "60 %":
         warn = 'alert :' 'garbage is above 60%'
    else :
         warn = 'alert :' 'Levels are low, collection not needed '

    def myOnPublishCallback(lat=11.007403,long=76.963439):
       print("Kattoor, Coimbatore")
       print("published distance = %s " %distance,"loadcell:%s " %loadcell,"lon = %s "
%long,"lat = %s" %lat)
       print(load)
       print(dist)
       print(warn)

    time.sleep(10)
    success=deviceCli.publishEvent                ("IoTSensor","json",warn,qos=0,on_publish=
myOnPublishCallback)
    success=deviceCli.publishEvent                 ("IoTSensor","json",data,qos=0,on_publish=
myOnPublishCallback)

    if not success:
       print("not connected to ibmiot")

    time.sleep(30)
    deviceCli.commandCallback=myCommandCallback
```

```
#disconnect the device
deviceCli.disconnect()
```

bin4.py:

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

# watson device details
organization = "73ffyv"
devicType =  "BIN4"
deviceId = "BIN4ID"
authMethod= "token"
authToken= "123456789"

#generate random values for randomo variables (temperature&humidity)
def myCommandCallback(cmd):
   global a
   print("command recieved is:%s" %cmd.data['command'])
   control=cmd.data['command']
   print(control)

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

#connect and send a datapoint "temp" with value integer value into the cloud as a type of event
for every 10 seconds
deviceCli.connect()

while True:
   distance= random.randint(10,70)
   loadcell= random.randint(5,15)
   data= {'dist':distance,'load':loadcell}


   if loadcell < 13 and loadcell > 15:
      load = "90 %"
   elif loadcell < 8 and loadcell > 12:
        load = "60 %"
   elif loadcell < 4 and loadcell > 7:
```

```
        load = "40 %"
    else:
        load = "0 %"


    if distance < 15:
        dist = 'Risk warning:' 'Garbage level is high, collection time :) 90 %'
    elif distance < 40 and distance >16:
        dist = 'Risk warning:' 'garbage is above 60%'
    elif distance < 60 and distance > 41:
        dist = 'Risk warning:' '40 %'
    else:
        dist = 'Risk warning:' '17 %'


    if load == "90 %" or distance == "90 %":
        warn  = 'alert :' ' Garbage level is high, collection time :)'
    elif load == "60 %" or distance == "60 %":
        warn = 'alert :' 'garbage is above 60%'
    else :
        warn = 'alert :' 'Levels are low, collection not needed '

    def myOnPublishCallback(lat=11.453306,long=77.426024):
       print("Seethammal Colony, Gobichittipalayam")
       print("published distance = %s " %distance,"loadcell:%s " %loadcell,"lon = %s "
%long,"lat = %s" %lat)
       print(load)
       print(dist)
       print(warn)

    time.sleep(10)
    success=deviceCli.publishEvent                ("IoTSensor","json",warn,qos=0,on_publish=
myOnPublishCallback)
    success=deviceCli.publishEvent                 ("IoTSensor","json",data,qos=0,on_publish=
myOnPublishCallback)

    if not success:
       print("not connected to ibmiot")

    time.sleep(30)
    deviceCli.commandCallback=myCommandCallback

#disconnect the device
deviceCli.disconnect()
```

7.3 Feature 3:

An additional feature added to the smart waste management system is to measure the weight of the bin using hx711 load cell. The weight of the bin is the output of the below code.

Measuring the weight of the garbage bin:

main.py:

```
from hx711 import HX711
hx = HX711(5,4,64)
print(1)
while True:
    hx.tare()
    read = hx.read()
    value=hx.read_average()
    print(value,"#")
```

hx711.py:

```
from machine import Pin, enable_irq, disable_irq, idle

class HX711:
    def __init__(self, dout, pd_sck, gain=128):
        self.pSCK = Pin(pd_sck , mode=Pin.OUT)
        self.pOUT = Pin(dout, mode=Pin.IN, pull=Pin.PULL_DOWN)
        self.pSCK.value(False)

        self.GAIN = 0
        self.OFFSET = 0
        self.SCALE = 1
        self.time_constant = 0.1
        self.filtered = 0
        self.set_gain(gain);

    def set_gain(self, gain):
        if gain is 128:
            self.GAIN = 1
        elif gain is 64:
            self.GAIN = 3
        elif gain is 32:
            self.GAIN = 2
        self.read()
        self.filtered = self.read()
        print('Gain & initial value set')

    def is_ready(self):
        return self.pOUT() == 0

    def read(self):
        # wait for the device being ready
```

```
    while self.pOUT() == 1:
        idle()

    # shift in data, and gain & channel info
    result = 0
    for j in range(24 + self.GAIN):
        state = disable_irq()
        self.pSCK(True)
        self.pSCK(False)
        enable_irq(state)
        result = (result << 1) | self.pOUT()

    # shift back the extra bits
    result >>= self.GAIN

    # check sign
    if result > 0x7fffff:
        result -= 0x1000000

    return result

def read_average(self, times=3):
    s = 0
    for i in range(times):
        s += self.read()
    ss=(s/times)/210
    return '%.1f' %(ss)

def read_lowpass(self):
    self.filtered += self.time_constant * (self.read() - self.filtered)
    return self.filtered

def get_value(self, times=3):
    return self.read_average(times) - self.OFFSET

def get_units(self, times=3):
    return self.get_value(times) / self.SCALE

def tare(self, times=15):
    s = self.read_average(times)
    self.set_offset(s)

def set_scale(self, scale):
    self.SCALE = scale

def set_offset(self, offset):
    self.OFFSET = offset
```

```
def set_time_constant(self, time_constant = None):
    if time_constant is None:
        return self.time_constant
    elif 0 < time_constant < 1.0:
        self.time_constant = time_constant

def power_down(self):
    self.pSCK.value(False)
    self.pSCK.value(True)

def power_up(self):
    self.pSCK.value(False)
```

CHAPTER 8: TESTING

8.1 Test cases:

Unit testing

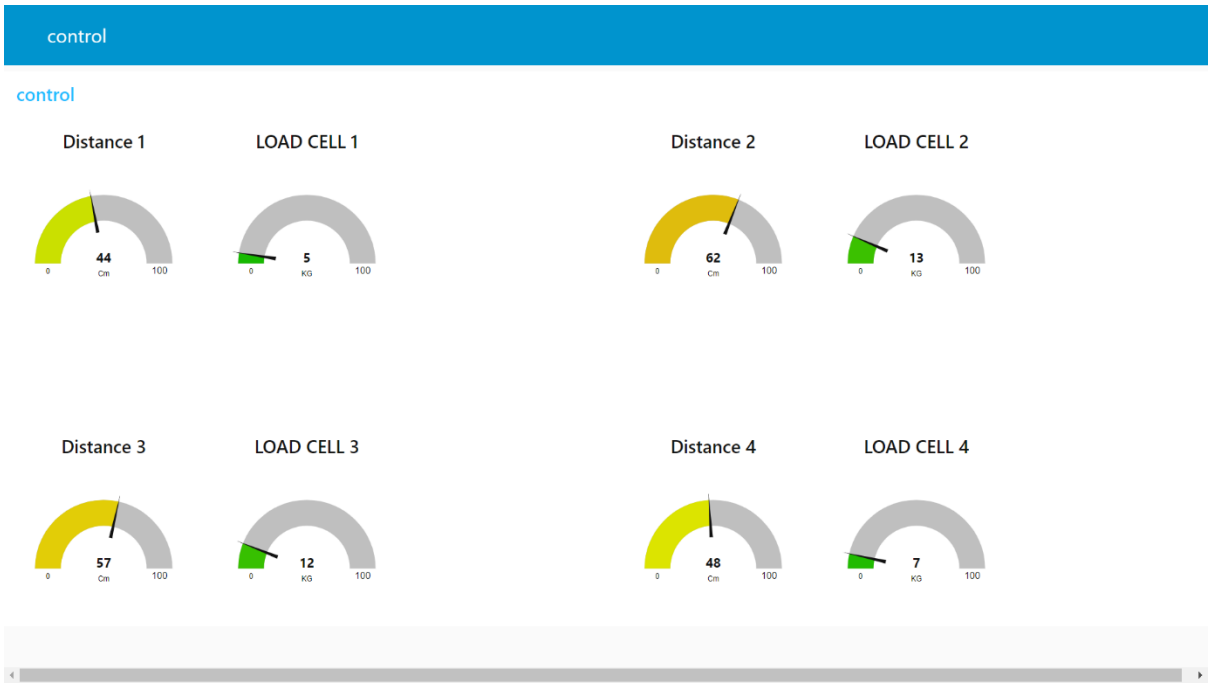
Test case no.	Sensor/Stage	Input	Expected output	Obtained output	Status
1.	Ultrasonic	Garbage level in bin i)Null ii)Full iii)Range in %	Correct level or distance	As expected	Pass
2.	ESP – 32	Microcontroller to process the input data	To collect the data from sensor	As expected	Pass
3.	Load cell	To measure mechanical force	Calculate the force due to the bin weight	As expected	Pass
4.	Gauge	To display the tares	Display the level for collection	As expected	Pass
5.	HX710	Weight of the bin (in kg)	Measure the weight	As expected	Pass

8.2 User Acceptance testing

Acceptance testing - is the final phase of product testing prior to public launch. A level of the software testing process where a system is tested for acceptability. The purpose of this test is to evaluate the system's compliance with the business requirements and assess whether it is acceptable for delivery.

CHAPTER 9: RESULTS

Sample output:



Before implementation of Smart waste management system

		Ground truth	
		Emptying	Nonemptying
Predicted	Emptying	911	68
	Nonemptying	990	6041

After implementation of smart waste management system

		Ground truth	
		Emptying	Nonemptying
Predicted	Emptying	1720	90
	Nonemptying	181	6091

CHAPTER 10: ADVANTAGES AND DISADVANTAGES

10.1 Advantages:

- Intelligent compaction of waste by monitoring fill level in real-time using sensors.
- It keeps our surroundings clean and keeps free from bad odour.
- Reduces manpower requirement to handle the garbage collection
- Emphasizes of healthy environment and keep the cities cleaner and more beautiful.
- It reduces infrastructure, operating and maintenance costs by upto 30%.
- Increases recycling rate of waste.

10.2 Disadvantages:

- Initial large-scale implementation takes cost.
- System requires more number waste bins for separate waste collection.
- Wireless technologies used should have proper connections as they have shorter range and lower data speed
- Training programs should be provided to people involving in the ecosystem of smart waste management.
- Sensors may encounter damage so it should be kept under protective ambience to prevent the damage.
- Replacement of sensors require knowledgeable people and thus acknowledgement of malfunction of sensor.

CHAPTER 11: CONCLUSION

Improper disposal and improper maintenance of domestic waste create issues in public health and environment pollution thus this paper attempts to provide practical solution towards managing the waste collaborating it with the use of IOT. by using the smart waste management system, we can manage waste properly we are also able to sort the Bio-degradable and non-Biodegradable waste properly which reduces the pollution in the environment. Various waste management initiatives taken for human well-being and to improve the TWM practices were broadly discussed in this chapter. The parameters that influence the technology and economic aspects of waste management were also discussed clearly. Different types of barriers in TWM, such as economic hitches, political issues, legislative disputes, informative and managerial as well as solutions and success factors for implementing an effective management of toxic organic waste within a globular context, were also discussed giving some real examples. The effect of urbanization on the environmental degradation and economic growth was also discussed. The proposed system will help to overcome all the serious issues related to waste and keep the environment clean.

CHAPTER 12: FUTURE WORK

Based on the real-time and historical data collected and stored in the cloud waste collection schedules and routes can be optimized. Predictive analytics could be used to make decisions ahead of time and offers insight into waste bin locations. Graph theory optimization algorithms can be used to manage waste collection strategies dynamically and efficiently. Every day, the workers can receive the newly calculated routes in their navigation devices. The system can be designed to learn from experience and to make decisions not only on the daily waste level status but also on future state forecast, traffic congestion, balanced cost-efficiency functions, and other affecting factors that a priori humans cannot foresee.

Garbage collectors could access the application on their mobile phone/tablets using the internet. Real-time GPS assistance can be used to direct them to the pre-decided route. As they go collecting the garbage from the containers, the management is also aware of the progress as the vehicle, as well as the garbage containers, are traced in real-time. The management staff gets their own personalized administration panel over a computer/tablet which gives them a bird eye view over the entire operations.

An alternative solution using image processing and camera as a passive sensor could be used. But, the cost of those image processing cameras is higher as compared to the ultrasonic sensors, which leads to high solution implementation cost.

CHAPTER 13: APPENDIX

13.1 Source Code:

Web Application to get the Live location:

index.html:

```
<!DOCTYPE html>
<html>
<head>
  <link rel="stylesheet"
href="https://cdn.jsdelivr.net/npm/bootstrap@4.3.1/dist/css/bootstrap.min.css"
integrity="sha384-
ggOyR0iXCbMQv3Xipma34MD+dH/1fQ784/j6cY/iJTQUOhcWr7x9JvoRxT2MZw1T"
crossorigin="anonymous">
   <meta charset="utf-8">
   <meta name="viewport" content="width=device-width">
   <title>Smart Waste Management System</title>
   <link rel="icon" type="image/x-icon" href="/imgs/DUMPSTER.png">
   <link href="style.css" rel="stylesheet" type="text/css" />
   <script src="https://www.gstatic.com/firebasejs/9.14.0/firebase-app.js"></script>
   <script src="https://www.gstatic.com/firebasejs/9.14.0/firebase-analytics.js"></script>
   <script src="https://www.gstatic.com/firebasejs/9.14.0/firebase-database.js"></script>

   <script>
      var firebaseConfig =
      {
         apiKey: "AIzaSyCcZk7b1CLOGviwUpthRDLotrmFX0MFuTs",
         authDomain: "swms-3840.firebaseapp.com",
         projectId: "swms-3840",
         storageBucket: "swms-3840.appspot.com",
         messagingSenderId: "479902726304",
         appId: "1:479902726304:web:3d822880d1275ee57a71c5",
         measurementId: "G-MHP4N77MTP"
      };
      firebase.initializeApp(firebaseConfig)
   </script>
   <script defer src="db.js"></script>
</head>

<body style="background-color:#1F1B24;">
   <script src="maps.js"></script>
   <div id="map_container">
      <h1 id="live_location_heading" >LIVE LOCATION</h1>
      <div id="map"></div>
      <div id="alert_msg">ALERT MESSAGE!</div>
   </div>
   </div>
   <center>
```

```
        <a href="https://goo.gl/maps/G9XET5mzSw1ynHQ18" type="button" class="btn btn-
dark">
            DUMPSTER
        </a>
    </center>
    <script
        src="https://maps.googleapis.com/maps/api/js?key=AIzaSyBBLyWj-
3FWtCbCXGW3ysEiI2fDfrv2v0Q&callback=myMap"></script></div>
</body>
</html>
```

db.js:

```
const cap_status = document.getElementById("cap_status");
const alert_msg = document.getElementById("alert_msg");

var ref = firebase.database().ref();

ref.on(
  "value",
  function (snapshot) {
    snapshot.forEach(function (childSnapshot) {
      var value = childSnapshot.val();

      const alert_msg_val = value.alert;
      const cap_status_val = value.distance_status;

      alert_msg.innerHTML = `${alert_msg_val}`;
    });
  },
  function (error) {
    console.log("Error: " + error.code);
  }
);
```

maps.js:

```
const database = firebase.database();

function myMap() {
  var ref1 = firebase.database().ref();

  ref1.on(
    "value",
    function (snapshot) {
      snapshot.forEach(function (childSnapshot) {
        var value = childSnapshot.val();
        const latitude = value.latitude;
        const longitude = value.longitude;
```

```
        var latlong = { lat: latitude, lng: longitude };
        var mapProp = {
          center: new google.maps.LatLng(latlong),
          zoom: 10,
        };
        var map = new google.maps.Map(document.getElementById("map"), mapProp);
        var marker = new google.maps.Marker({ position: latlong });
        marker.setMap(map);
      });
    },
    function (error) {
      console.log("Error: " + error.code);
    }
  );
}
```

style.css:

```
html,
body {
  height: 100%;
  margin: 0px;
  padding: 0px;
}
#container {
  display: flex;
  flex-direction: row;
  height: 100%;
  width: 100%;
  position: relative;
}
#logo_container {
  height: 100%;
  width: 12%;
  background-color: #c5c6d0;
  display: flex;
  flex-direction: column;
  vertical-align: text-bottom;
}
.logo {
  width: 70%;
  margin: 5% 15%;

  /*  border-radius: 50%; */
}
#logo_3 {
  vertical-align: text-bottom;
}
#data_container {
```

```
  height: 100%;
  width: 20%;
  margin-left: 1%;
  margin-right: 1%;
  display: flex;
  flex-direction: column;
}
#data_status {
  height: 60%;
  width: 8%;
  margin: 7%;
  background-color: #691f6e;
  display: flex;
  flex-direction: column;
  border-radius: 20px;
}
#load_status {
  background-image: url("/imgs/KG.png");
  background-repeat: no-repeat;
  background-size: 170px;
  background-position: left center;
}
#cap_status {
  background-image: url("/imgs/dust.png");
  background-repeat: no-repeat;
  background-size: 150px;
  background-position: left center;
}
.status {
  width: 80%;
  height: 40%;
  margin: 5% 10%;
  background-color: #185adc;
  border-radius: 20px;
  display: flex;
  justify-content: center;
  align-items: center;
  color: white;
  font-size: 60px;
}
.datas {
  width: 86%;
  margin: 2.5% 7%;
  height: 10%;
  background: url(water.png);
  background-repeat: repeat-x;
  animation: datas 10s linear infinite;
```

```
  box-shadow: 0 0 0 6px #98d7eb, 0 20px 35px rgba(0, 0, 0, 1);
}
#map_container {
  height: 100%;
  width: 100%;
  display: flex;
  flex-direction: column;
}
#live_location_heading {
  margin-top: 10%;
  text-align: center;
  color: GREY;
}
#map {
  height: 70%;
  width: 90%;
  margin-left: 4%;
  margin-right: 4%;
  border: 10px solid white;
  border-radius: 25px;
}
#alert_msg {
  width: 92%;
  height: 20%;
  margin: 4%;
  background-color: grey;
  border-radius: 20px;
  display: flex;
  justify-content: center;
  align-items: center;
  color: #41af7f;
  font-size: 25px;
  font-weight: bold;
}
.lat {
  margin: 0px;
  font-size: 0px;
}

@keyframes datas {
  0% {
    background-position: -500px 100px;
  }
  40% {
    background-position: 1000px -10px;
  }

  80% {
```

```
    background-position: 2000px 40px;
   }
   100% {
    background-position: 2700px 95px;
   }
  }
```

Code to evaluate the level of the garbage in bin and intimate the collection authority with the location of the bin:

bin1.py:

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

# watson device details
organization = "73ffyv"
devicType =  "BIN1"
deviceId = "BIN1ID"
authMethod= "token"
authToken= "123456789"

#generate random values for randomo variables (temperature&humidity)
def myCommandCallback(cmd):
    global a
    print("command recieved is:%s" %cmd.data['command'])
    control=cmd.data['command']
    print(control)

try:
    deviceOptions={"org": organization, "type": devicType,"id": deviceId,"auth-
method":authMethod,"auth-token":authToken}
    deviceCli = ibmiotf.device.Client(deviceOptions)
except Exception as e:
    print("Exception while connecting device %s" %str(e))
    sys.exit()
#connect and send a datapoint "temp" with value integer value into the cloud as a type of event for
every 10 seconds
deviceCli.connect()

while True:
    distance= random.randint(10,70)
    loadcell= random.randint(5,15)
    data= {'dist':distance,'load':loadcell}
```

```
    if loadcell < 13 and loadcell > 15:
       load = "90 %"
    elif loadcell < 8 and loadcell > 12:
         load = "60 %"
    elif loadcell < 4 and loadcell > 7:
         load = "40 %"
    else:
         load = "0 %"

    if distance < 15:
         dist = 'Risk warning:' 'Garbage level is high, collection time :) 90 %'
    elif distance < 40 and distance >16:
         dist = 'Risk warning:' 'garbage is above 60%'
    elif distance < 60 and distance > 41:
         dist = 'Risk warning:' '40 %'
    else:
         dist = 'Risk warning:' '17 %'

    if load == "90 %" or distance == "90 %":
         warn  = 'alert :' ' Garbage level is high, collection time :)'
    elif load == "60 %" or distance == "60 %":
         warn = 'alert :' 'garbage is above 60%'
    else :
         warn = 'alert :' 'Levels are low, collection not needed '

    def myOnPublishCallback(lat=11.035081,long=77.014616):
       print("Peelamedu, Coimbatore")
       print("published distance = %s " %distance,"loadcell:%s " %loadcell,"lon = %s " %long,"lat
= %s" %lat)
       print(load)
       print(dist)
       print(warn)

    time.sleep(10)
    success=deviceCli.publishEvent                    ("IoTSensor","json",warn,qos=0,on_publish=
myOnPublishCallback)
    success=deviceCli.publishEvent                     ("IoTSensor","json",data,qos=0,on_publish=
myOnPublishCallback)

    if not success:
       print("not connected to ibmiot")

    time.sleep(30)
    deviceCli.commandCallback=myCommandCallback

#disconnect the device
deviceCli.disconnect()
```

bin2.py:

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

# watson device details
organization = "73ffyv"
devicType =  "BIN2"
deviceId = "BIN2ID"
authMethod= "token"
authToken= "123456789"

#generate random values for randomo variables (temperature&humidity)
def myCommandCallback(cmd):
    global a
    print("command recieved is:%s" %cmd.data['command'])
    control=cmd.data['command']
    print(control)

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

#connect and send a datapoint "temp" with value integer value into the cloud as a type of event for
every 10 seconds
deviceCli.connect()

while True:
    distance= random.randint(10,70)
    loadcell= random.randint(5,15)
    data= {'dist':distance,'load':loadcell}


    if loadcell < 13 and loadcell > 15:
        load = "90 %"
    elif loadcell < 8 and loadcell > 12:
         load = "60 %"
    elif loadcell < 4 and loadcell > 7:
         load = "40 %"
    else:
         load = "0 %"
```

```
    if distance < 15:
        dist = 'Risk warning:' 'Garbage level is high, collection time :) 90 %'
    elif distance < 40 and distance >16:
        dist = 'Risk warning:' 'garbage is above 60%'
    elif distance < 60 and distance > 41:
        dist = 'Risk warning:' '40 %'
    else:
        dist = 'Risk warning:' '17 %'


    if load == "90 %" or distance == "90 %":
        warn  = 'alert :' ' Garbage level is high, collection time :)'
    elif load == "60 %" or distance == "60 %":
        warn = 'alert :' 'garbage is above 60%'
    else :
        warn = 'alert :' 'Levels are low, collection not needed '

    def myOnPublishCallback(lat=11.068774,long=77.092978):
        print("PSG iTech, Coimbatore")
        print("published distance = %s " %distance,"loadcell:%s " %loadcell,"lon = %s " %long,"lat
= %s" %lat)
        print(load)
        print(dist)
        print(warn)

    time.sleep(10)
    success=deviceCli.publishEvent                    ("IoTSensor","json",warn,qos=0,on_publish=
myOnPublishCallback)
    success=deviceCli.publishEvent                     ("IoTSensor","json",data,qos=0,on_publish=
myOnPublishCallback)

    if not success:
        print("not connected to ibmiot")

    time.sleep(30)
    deviceCli.commandCallback=myCommandCallback

#disconnect the device
deviceCli.disconnect()
```

bin3.py:

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

# watson device details
```

```
organization = "73ffyv"
devicType =  "BIN3"
deviceId = "BIN3ID"
authMethod= "token"
authToken= "123456789"

#generate random values for randomo variables (temperature&humidity)
def myCommandCallback(cmd):
    global a
    print("command recieved is:%s" %cmd.data['command'])
    control=cmd.data['command']
    print(control)

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

#connect and send a datapoint "temp" with value integer value into the cloud as a type of event for
every 10 seconds
deviceCli.connect()

while True:
    distance= random.randint(10,70)
    loadcell= random.randint(5,15)
    data= {'dist':distance,'load':loadcell}


    if loadcell < 13 and loadcell > 15:
        load = "90 %"
    elif loadcell < 8 and loadcell > 12:
        load = "60 %"
    elif loadcell < 4 and loadcell > 7:
        load = "40 %"
    else:
        load = "0 %"


    if distance < 15:
        dist = 'Risk warning:' 'Garbage level is high, collection time :) 90 %'
    elif distance < 40 and distance >16:
        dist = 'Risk warning:' 'garbage is above 60%'
    elif distance < 60 and distance > 41:
        dist = 'Risk warning:' '40 %'
    else:
        dist = 'Risk warning:' '17 %'
```

```
    if load == "90 %" or distance == "90 %":
        warn  = 'alert :' ' Garbage level is high, collection time :)'
    elif load == "60 %" or distance == "60 %":
        warn = 'alert :' 'garbage is above 60%'
    else :
        warn = 'alert :' 'Levels are low, collection not needed '

    def myOnPublishCallback(lat=11.007403,long=76.963439):
        print("Kattoor, Coimbatore")
        print("published distance = %s " %distance,"loadcell:%s " %loadcell,"lon = %s " %long,"lat
= %s" %lat)
        print(load)
        print(dist)
        print(warn)

    time.sleep(10)
    success=deviceCli.publishEvent                    ("IoTSensor","json",warn,qos=0,on_publish=
myOnPublishCallback)
    success=deviceCli.publishEvent                     ("IoTSensor","json",data,qos=0,on_publish=
myOnPublishCallback)

    if not success:
        print("not connected to ibmiot")

    time.sleep(30)
    deviceCli.commandCallback=myCommandCallback

#disconnect the device
deviceCli.disconnect()
```

bin4.py:

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

# watson device details
organization = "73ffyv"
devicType =  "BIN4"
deviceId = "BIN4ID"
authMethod= "token"
authToken= "123456789"

#generate random values for randomo variables (temperature&humidity)
def myCommandCallback(cmd):
    global a
```

```
    print("command recieved is:%s" %cmd.data['command'])
    control=cmd.data['command']
    print(control)

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

#connect and send a datapoint "temp" with value integer value into the cloud as a type of event for
every 10 seconds
deviceCli.connect()

while True:
    distance= random.randint(10,70)
    loadcell= random.randint(5,15)
    data= {'dist':distance,'load':loadcell}


    if loadcell < 13 and loadcell > 15:
        load = "90 %"
    elif loadcell < 8 and loadcell > 12:
         load = "60 %"
    elif loadcell < 4 and loadcell > 7:
         load = "40 %"
    else:
         load = "0 %"


    if distance < 15:
         dist = 'Risk warning:' 'Garbage level is high, collection time :) 90 %'
    elif distance < 40 and distance >16:
         dist = 'Risk warning:' 'garbage is above 60%'
    elif distance < 60 and distance > 41:
         dist = 'Risk warning:' '40 %'
    else:
         dist = 'Risk warning:' '17 %'


    if load == "90 %" or distance == "90 %":
         warn  = 'alert :' ' Garbage level is high, collection time :)'
    elif load == "60 %" or distance == "60 %":
         warn = 'alert :' 'garbage is above 60%'
    else :
         warn = 'alert :' 'Levels are low, collection not needed '

    def myOnPublishCallback(lat=11.453306,long=77.426024):
```

```
        print("Seethammal Colony, Gobichittipalayam")
        print("published distance = %s " %distance,"loadcell:%s " %loadcell,"lon = %s " %long,"lat
= %s" %lat)
        print(load)
        print(dist)
        print(warn)

    time.sleep(10)
    success=deviceCli.publishEvent                    ("IoTSensor","json",warn,qos=0,on_publish=
myOnPublishCallback)
    success=deviceCli.publishEvent                     ("IoTSensor","json",data,qos=0,on_publish=
myOnPublishCallback)

    if not success:
        print("not connected to ibmiot")

    time.sleep(30)
    deviceCli.commandCallback=myCommandCallback

#disconnect the device
deviceCli.disconnect()
```

Measuring the weight of the garbage bin:

main.py:

```
from hx711 import HX711
hx = HX711(5,4,64)
print(1)
while True:
    hx.tare()
    read = hx.read()
    #average=hx.read_average()
    value=hx.read_average()
    print(value,"#")
```

hx711.py:

```
from machine import Pin, enable_irq, disable_irq, idle

class HX711:
    def __init__(self, dout, pd_sck, gain=128):

        self.pSCK = Pin(pd_sck , mode=Pin.OUT)
        self.pOUT = Pin(dout, mode=Pin.IN, pull=Pin.PULL_DOWN)
        self.pSCK.value(False)

        self.GAIN = 0
        self.OFFSET = 0
        self.SCALE = 1
```

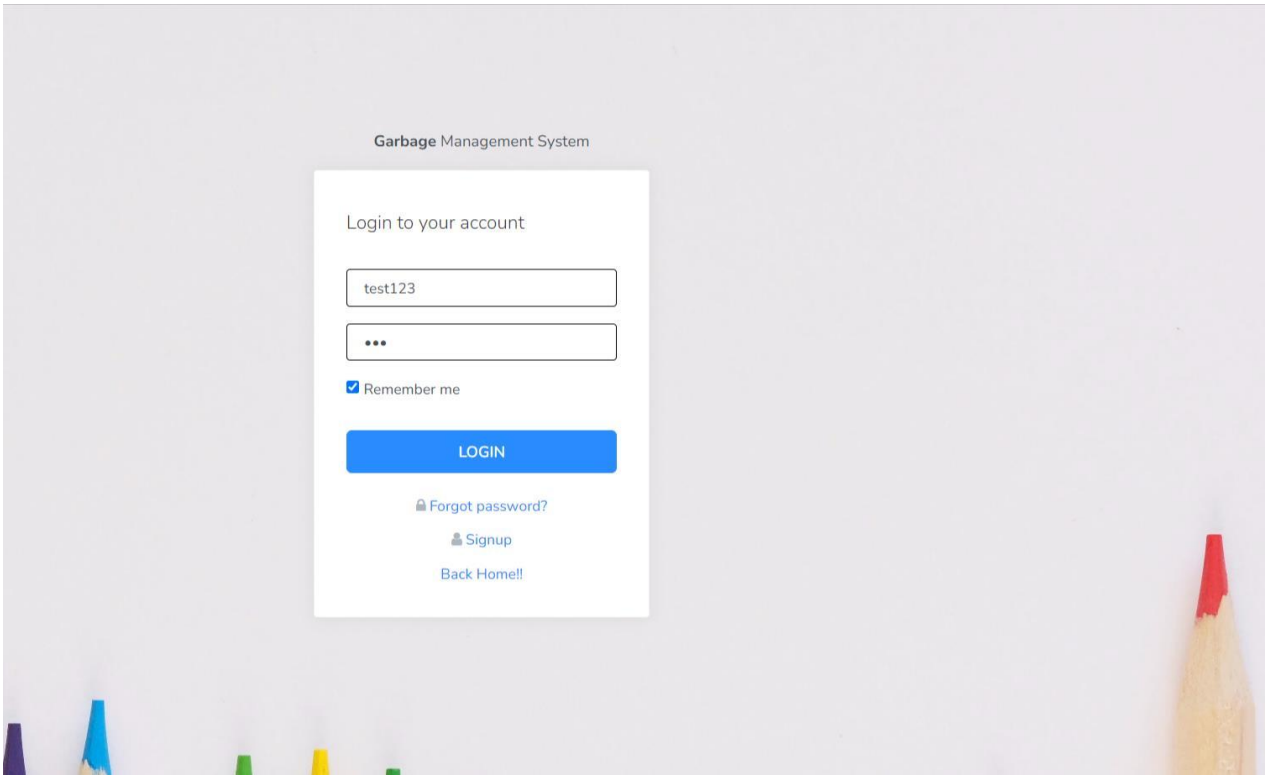
```
    self.time_constant = 0.1
    self.filtered = 0

    self.set_gain(gain);

def set_gain(self, gain):
    if gain is 128:
        self.GAIN = 1
    elif gain is 64:
        self.GAIN = 3
    elif gain is 32:
        self.GAIN = 2

    self.read()
    self.filtered = self.read()
    print('Gain & initial value set')

def is_ready(self):
    return self.pOUT() == 0

def read(self):
    # wait for the device being ready
    while self.pOUT() == 1:
        idle()

    # shift in data, and gain & channel info
    result = 0
    for j in range(24 + self.GAIN):
        state = disable_irq()
        self.pSCK(True)
        self.pSCK(False)
        enable_irq(state)
        result = (result << 1) | self.pOUT()

    # shift back the extra bits
    result >>= self.GAIN

    # check sign
    if result > 0x7fffff:
        result -= 0x1000000

    return result

def read_average(self, times=3):
    s = 0
    for i in range(times):
        s += self.read()
    ss=(s/times)/210
```

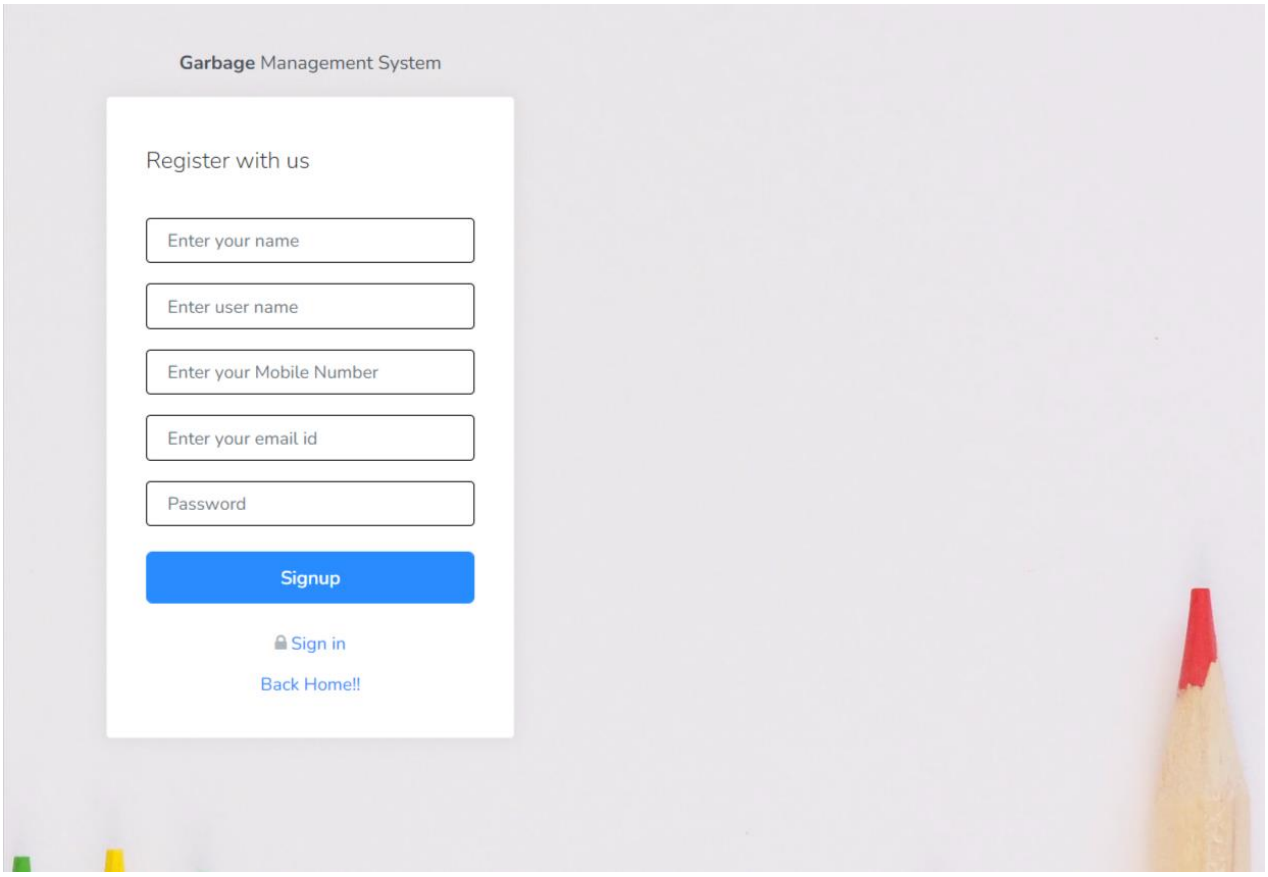
```
        return '%.1f' %(ss)

    def read_lowpass(self):
        self.filtered += self.time_constant * (self.read() - self.filtered)
        return self.filtered

    def get_value(self, times=3):
        return self.read_average(times) - self.OFFSET

    def get_units(self, times=3):
        return self.get_value(times) / self.SCALE

    def tare(self, times=15):
        s = self.read_average(times)
        self.set_offset(s)

    def set_scale(self, scale):
        self.SCALE = scale

    def set_offset(self, offset):
        self.OFFSET = offset

    def set_time_constant(self, time_constant = None):
        if time_constant is None:
            return self.time_constant
        elif 0 < time_constant < 1.0:
            self.time_constant = time_constant

    def power_down(self):
        self.pSCK.value(False)
        self.pSCK.value(True)

    def power_up(self):
        self.pSCK.value(False)
```

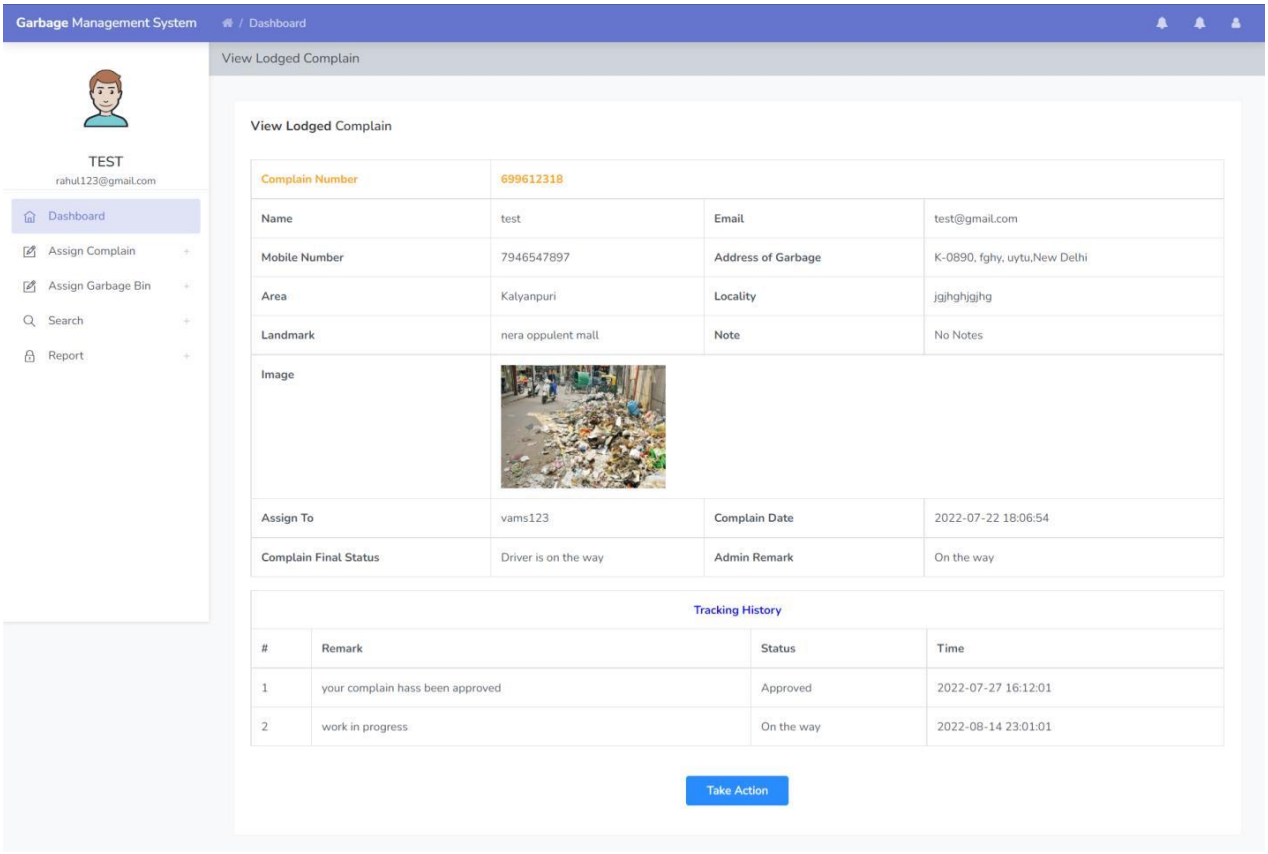
13.2 Project Links:

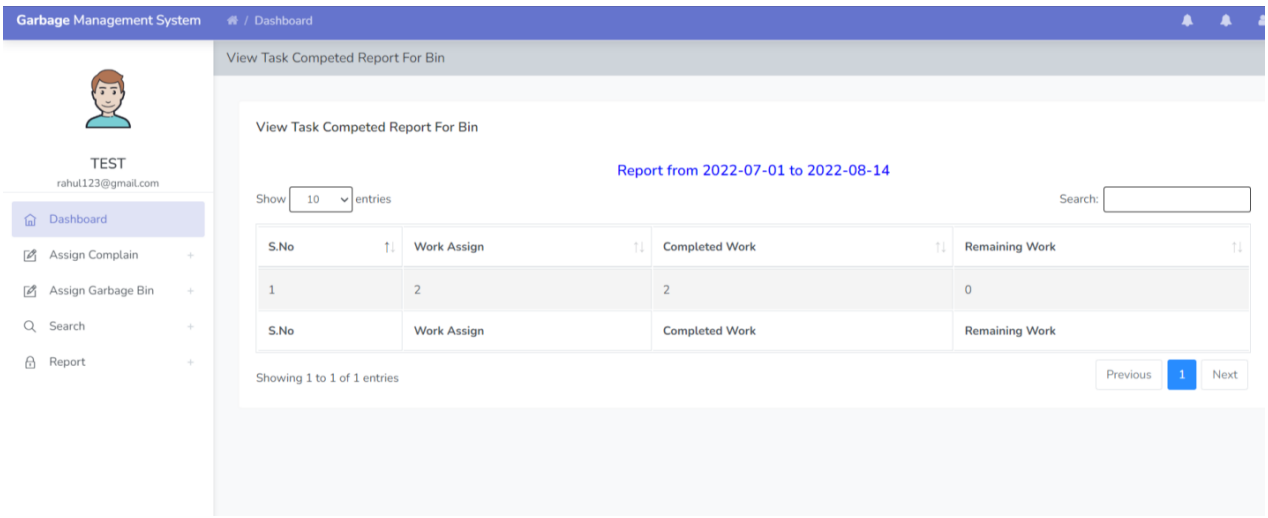
https://github.com/IBM-EPBL/IBM-Project-16180-1659609198

13.3 Output sample:


Garbage Management System
Login to your account
test123
Remember me
LOGIN
Forgot password?
Signup
Back Home!!


Garbage Management System
Register with us
Enter your name
Enter user name
Enter your Mobile Number
Enter your email id
Password
Signup
Sign in
Back Home!!


Garbage Management System
/ Dashboard
View Lodged Complain
TEST
rahul123@gmail.com
Dashboard
Assign Complain
Assign Garbage Bin
Search
Report
View Lodged Complain
Complain Number
699612318
Name
test
Email
test@gmail.com
Mobile Number
7946547897
Address of Garbage
K-0890, fghy, uytu,New Delhi
Area
Kalyanpuri
Locality
jgjhghjgjhg
Landmark
nera oppulent mall
Note
No Notes
Image
Assign To
vams123
Complain Date
2022-07-22 18:06:54
Complain Final Status
Driver is on the way
Admin Remark
On the way
Tracking History
Remark Status Time
1 your complain hass been approved Approved 2022-07-27 16:12:01
2 work in progress On the way 2022-08-14 23:01:01
Take Action


Garbage Management System
/ Dashboard
View Task Competed Report For Bin
TEST
rahul123@gmail.com
Dashboard
Assign Complain
Assign Garbage Bin
Search
Report
View Task Competed Report For Bin
Report from 2022-07-01 to 2022-08-14
Show 10 entries
Search:
S.No
Work Assign
Completed Work
Remaining Work
1
2
2
0
S.No
Work Assign
Completed Work
Remaining Work
Showing 1 to 1 of 1 entries
Previous
1
Next