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TEAM ID	PNT2022TMID42279
PROJECT NAME	SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES
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CONTENTS

1. INTRODUCTION

1.1 PROJECT OVERVIEW

From densely populated cities to smaller rural profession, waste management systems keep our homes and profession free from unwanted clutter. Although these waste management services exist in every profession, the industry's current operating standards have proven inefficient resource-intensive. This inefficiency is due to outdated manual collection methods and logistic processes which lack efficient data-driven solutions. Therefore, we are planned to design of a Waste Bin with real time monitoring is presented and a smart waste management system is proposed using the recent technical advancements of automation and Internet of Things (IoT).

1.2 PURPOSE

Here Smart Bins are connected to the cloud, where the bin status are communicated, recorded and monitored by the local bodies through the android app . It gives details about dustbin level to both the users and the drivers. Thus, the designed smart bin and proposed waste management system have better level of smartness compared to existing ones in metropolitan cities in a centralized manner.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

The amount of garbage that humans generate is rapidly increasing, and it will be impossible to control without radical adjustments. The uncollected garbage when the dustbin is full is a common and serious issue at all places. In addition, improper garbage disposal would increase the risk of fire occurrence in garbage dumping yards, risking the safety of neighboring residential places. To monitor and control the occurrence of fire manually in large dumping grounds are very difficult.

2.2 REFERENCES

S. NO	TITLE	AUTHORS	DESCRIPTION
1.	Smart Waste Management System using IoT	Prof. S.A. Mahajan, Akshay Kokane, Apoorva Shewale, Mrunaya Shinde, Shivan	IoT based “Smart Waste Management” is the best and trending solution. In the proposed system, public dustbins will be provided with embedded devices which help in real time monitoring of the level of garbage in garbage bins. The data regarding the garbage levels will be used to provide an optimized route for garbage collecting vans, which will reduce the cost associated with fuel. The load sensors will increase efficiency of data related to garbage level and moisture sensors will be used to provide data of waste segregation in a dust bin.
2.	RFID based Real-time Smart Waste Management System	Belal Chowdhury ,Morshed U. Chowdhury	In an environmental context, the use of RFID (Radio Frequency Identification) and load cell sensor technology can be employed for not only bringing down waste management costs, but also to facilitate automating and streamlining waste (e.g., garbage, recycling, and green) identification and weight measurement processes for designing smart waste management systems. In this paper, we outline a RFID and sensor model for designing a system in real-time waste management. An application of the architecture is described in the area of RFID and sensor based Automatic Waste Identity, Weight, and Stolen Bins Identification System (WIWSBIS).
3.	Elements of Innovative Scenario’s Development of Waste Management System in Russia	E.Y.Prisyach O.A.Shvetsova	Development of the Industry for the Processing, Utilization and Disposal of Production and Consumption Wastes for the Period to 2030"; an innovative element of eco-technical parks is analyzed; the level of useful waste generation for 2017 - early 2018 is estimated; the definition of manufacture equipment's localization for processing, recycling and neutralization of a waste is resulted.
4.	Smart City Waste Management System Using Internet of	Prof.Aderemi A. Atayero ,Segun I.Popoola	The fill level of solid waste in each of the containers, which are strategically situated across the communities, is detected using ultrasonic sensors. A

	Things and Cloud Computing	Rotimi Williams,Joke A.Badejo,Sanjay Misra	Wireless Fidelity (Wi-Fi) communication link is used to transmit the sensor data to an IoT cloud platform known as Thing Speak. Depending on the fill level, the system sends appropriate notification messages (in form of tweets) to alert relevant authorities and concerned citizen(s) for necessary action. Also, the fill level is monitored on Thing Speak in real-time. The system performance shows that the proposed solution may be found useful for efficient waste management in smart and connected communities.
5.	IOT Enabled Smart Waste Bin with Real Time Monitoring for efficient waste management in Metropolitan Cities	Manju Mohan,Kuppan Chetty Ramanathan,Vijayram Sriram,Mohd Azeem	Waste Bin with real time monitoring is presented and a smart waste management system is proposed using the recent technical advancements of automation and Internet of Things (IoT). 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. Such smart bins are connected to the cloud, where the bin status is communicated, recorded and monitored by the local bodies through an android app or a centralized server.
6.	Research on Manufacturer's Product Pricing Model under Waste Self-Selection Disposal Mode	Di Wu,Chunyou Wu	Waste disposal, which caused the increase of its operating cost. Therefore, it is important for studying in product pricing under the waste self-selection disposal mode of manufacturer to advance the formation of competitive advantage of product price. Based on this, this paper establishes an organic contact between three kinds of waste and waste self-selection disposal mode, analyses the basic characteristics of different modes and constructs the pricing models by the method of econometrics. This paper confirms the optimal product pricing and profits of different waste and provides references for manufacturers to choose appropriate disposal modes.
7.	Municipal Solid Waste Management in China	M.A. Borisova ,M.V. Ryshivoka,A.A. Gomazova	Metropolitan areas of the people's Republic of China, as well as the study of methods used in our country, which allowed on the basis of this work to assess the quality of municipal waste management in the Russian Federation and to propose possible solutions to the problems found. To overcome the problems associated with the method of municipal waste

			management, we propose the creation and expansion of the domestic industrial base, providing the industry for the processing, disposal and disposal of waste modern Russian high-tech competitive, environmentally friendly equipment.
8.	E-waste Generation and Awareness on Managing Disposal Practices at Delhi National Capital Region in India	Shadma Parveen,Shao Yunfei,Jian Ping Li,Jalaluddin Khan,Amin UI Haq,Sun Ruinan	This research is focused on E-waste generation and awareness of its managing disposal practices based on a high standard questionnaire. This study focusses only on mobile, laptop, notebook, computer and Television as an E-waste. The structured questionnaire is widely spread and received around 200 households of the different working sectors as well as different income groups individual's reactions. The findings of individual awareness of generation and managing disposal practices are considerably lacking. It should be negative impact of health issues in the Delhi (NCR) area.
9.	Electron linacs in radioactive waste disposal problem	N.P .Dikiy,A.N.Dovbnya, S.Yu.Sayenko,V.L.Uvarov	NSC KIPT based on /spl gamma/-activation analysis using bremsstrahlung of the high-current electron linac. On the other hand disposal of the radioactive waste faces a problem of confinement materials (including geological structures). Such materials have to keep their protection properties with respect to radionuclide transport under absorbed dose value up to /spl sim/10/sup 7/ Gy during thousand years or so. The elaborated methods for production of radionuclide-tracers and operative determination of their diffusion coefficients into barriers under different doses of the braking photons are described.
10.	Implementation of Automatic Waste Management System Using IOT & Android for Smart Cities	Pulkit Bindal,Utkarsh Srivastava,Chirag Agarwal, Himanshu Gupta,Chhaya Sharma	IoT Technology as a possible option for waste management alerts in the system. We need to take some smart measures in order to solve this concern. The Department measurement mechanism will alert the local government or staff to the garbage problem in various sectors of the city. That dustbins will be connected to a central system and a microcontroller ATSAM3X8E Board additionally an ultrasonic sensor will be there. This shows the present state of the trash. The GUI module, which plays a big role in our project, is critical to its success.

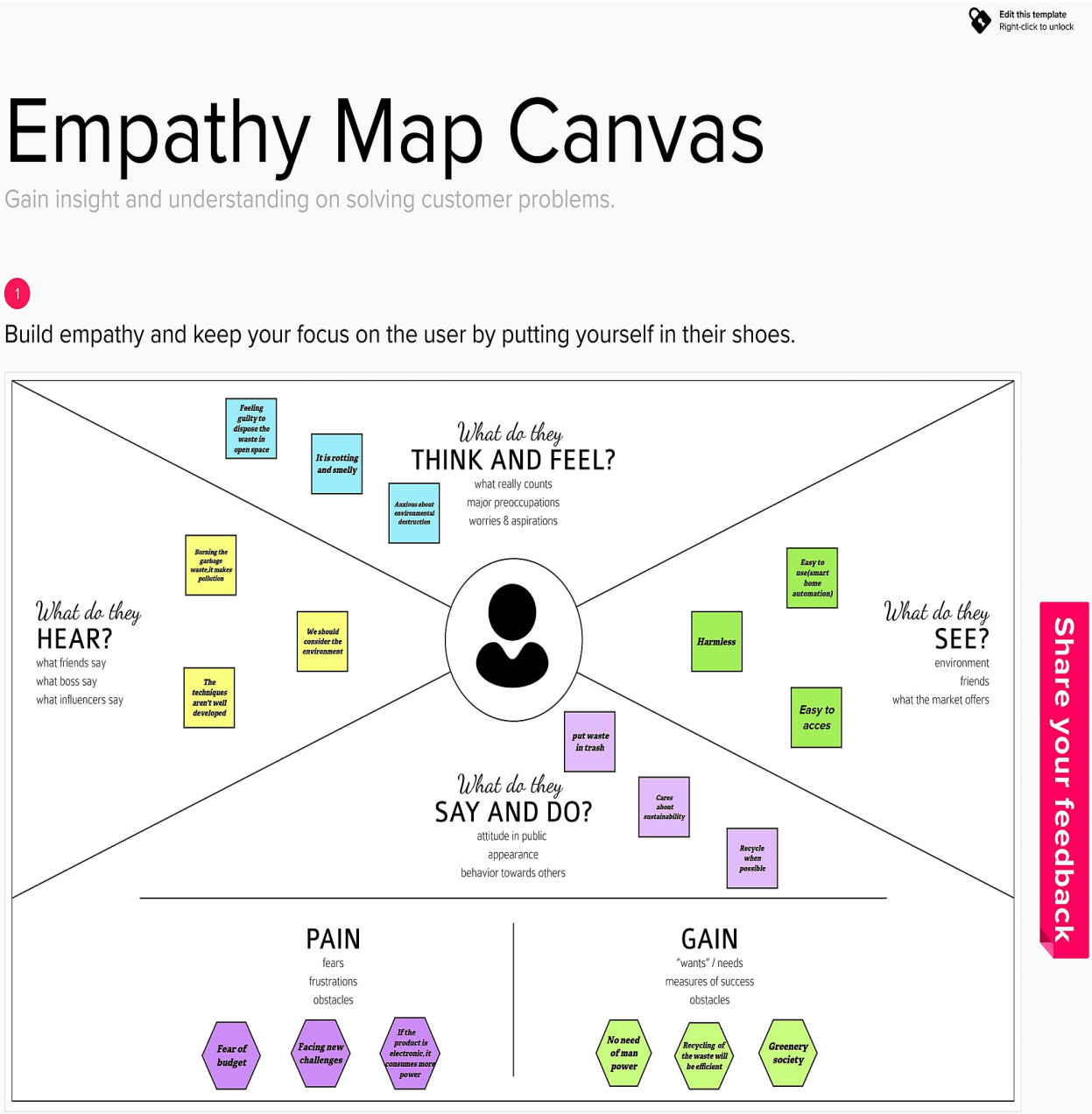
2.3 PROBLEM STATEMENT DEFINITION

Problem Statement (PS)	**Customer**	**I'm tryingto**	**But**	**Because**	**Which makes me feel**
PS-1	Social Activist	Keep my surroundings clean and green.	The bins aren't collected regularly.	There is no proper schedule or pattern for garbage collection.	Frustrated
PS-2	Housemaker	Proper maintenance of house	I can't dispose thewastes when thebins are full.	municipality hasn't taken any properaction	worried
PS-3	Employed Bachelor	Live by myself lonely and properly.	At the I leave my apartment there garabage trucks never arrives.	The time scheduled for the garbage trucks are always irregular.	Odd about my living cleanliness.
PS-4	College student livingalone as a dayscholar.	Make me Living betterand to excel inmy career.	My livingplace oftenlooks andsmells untidy.	The municipality workers never come on time and don't follow a regularity.	Feel distracted from my studies.
PS-5	A small wastegarbage collector.	Use the technology and data to create a more efficient garbage waste. Based on IOT & cloud.	Some drivers collect empty bins, predefined collection routes of the system cause waste of time, an increase in	The smart waste garbage collectoris a specially designed method to dispose the garbage in a smart way.	When it solvesthe social issues of hygiene in the country.

			fuel consumption, and excessive use of resources.		

3. IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



3.2 IDEATION AND BRAINSTORMING

3.3 PROPOSED SOLUTION

cMoreover, the system also shows the efficient path between the driver and the bin and provides navigation for fetching waste from the smart trash bins which are filled. The proposed garbage collection system is charged by solar energy. Fire detection also done by this system.

3.4 PROBLEM SOLUTION FIT

Trash bins with ultrasonic sensors are able to detect the fill level. A filled bin sends a notification to the drivers and user, which compiles that data to help plan collection routes that take into account only the full bins. Data's of the trash bin will be stored in cloud database. GPS module is used to find out the location . we power the system by the help of the most abundant source of energy, that is the solar energy. This energy can be used to charge the battery and inturn power the system.

4. **REQUIREMENT ANALYSIS**

4.1 FUNCTIONAL REQUIREMENTS

FR No.	Functional Requirement (Epic)	Sub Requirement (Story/ Sub-Task)
FR-1	User Guidance	Guides user to know complete information about the workflows performed by the smart bins, defines thefunctionality of the web apps, product feature, Focuson user requirement.

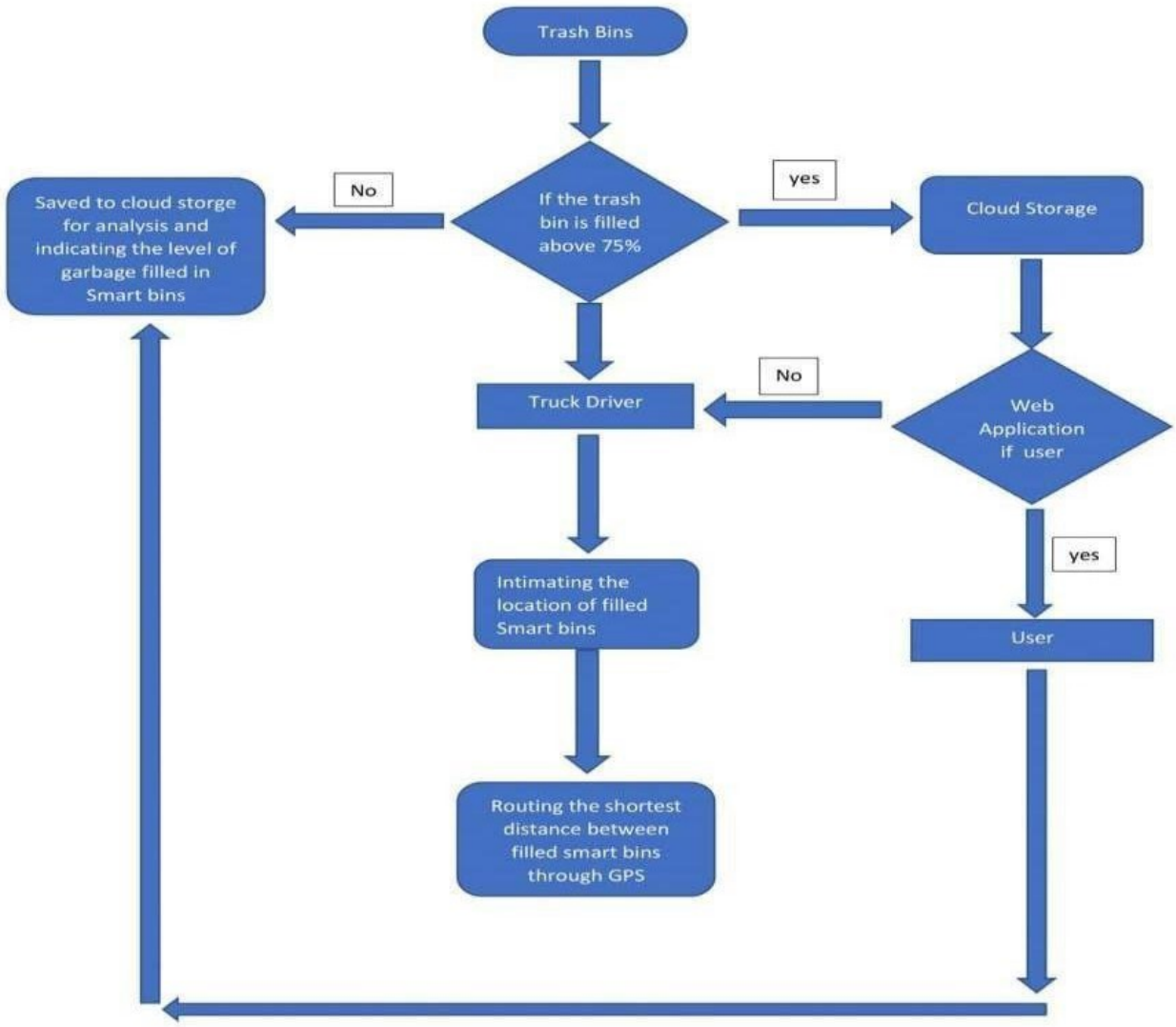
FR No.	Functional Requirement (Epic)	Sub Requirement (Story/ Sub-Task)
FR-2	User Registration	The registration contains three steps 1. 1.Identify user as a driver/citizen 2. 2.Initially sign in (first time registration) 3. 3.login.
FR-3	User confirmation	If they type in their username and password and clicksubmit the user's credentials are validated using mobile OTP through message and if it is correct, they are logged in and can access the web in case of forgetting password the can recover the account through their provided login credentials.
FR-4	User Subscription	The user can access the smart bins andapp bysubscribing our web services with any means.
FR-5	Product Review	a. User doubts can be clarified. b. With the help of productreview any malfunctioning insmart bin sensorscan be solved by userthemselves. c. So that you can track the location of your waste truckfleet or the location of your smart bins anytime you want.
FR-6	Product installation to theuser	a. This phase involves integration of smart bins inmetropolitan cities which mostly involves uninterrupted service between cloud and smartbins. b. GPS updation in maps is required for navigation purpose for driver's usage. c. Before installation involves API, testing andproduct testing involves.

4.2 NON-FUNCTIONAL REQUIREMENTS:

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	a. The user should go through the provideduser manual. b. web apps should be used more efficiently tomonitor and managewaste.
NFR-2	Security	Mobile number verification will be provided for better security if the user feels insecure about theweb UI.
NFR-3	Reliability	Minimum 2 to 3 years to which the system consistently performs the specified functions without failure.
NFR-4	Performance	a. The performance shouldbe more Accurate on GPS mapping and navigation. b. Performance of sensors in smart bins aremore reliable.
NFR-5	Availability	This product designed 24 hrs availability, that the user can access anywhere and all time during thetravel.
NFR-6	Scalability	Changes can be made with more features like alarm,and more sensors can be added to sense the unwanted situations suchas fire and flooding in smart bins

5. **PROJECT DESIGN**

5.1 DATA FLOW DIAGRAM



5.2 SOLUTION & ARCHITECTURE

5.3 USER STORIES

- ☆ As a user (Customer), they can register for the application by entering their mobile number, password and confirming their password. They will receive confirmation OTP for their mobile number through SMS, once they have registered for the application.
- ☆ As a user(Driver),they can register for the application with separate account to access

the mapping of smart bins. They can also locate the filled smart bins.

☆ As a web app user ,they can easily register, login and logout from the web app according to their convenience.

☆ As a customer care executive, they can clarify the doubts and solve the problems arises for the customer in operating application.

☆ As a admin ,they can gather data from the customer and provide their needs .They can also analyse the data for its betterment

6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story / Task	Story points	Team Members
Sprint-1	Administrator	As an Admin, I need to give access tothe web app for the users,drivers and every othermunicipal worker.	2	Arunajeyalakshmi, Sivaranjani.
Sprint-1	Co-Administrator	As a Co-admin, I can monitor the smartbins using ultrasonic and acoustic sensors.	5	Gomal RajyaShri, Sivaranjani.
Sprint-1	User Registration	As a user, I can register for the application byentering my email ormobile number, password and confirming my password.	5	Arunajeyalakshi, Gomal RajyaShri.
Sprint-1	login	As a User,I can login to the applicationbyentering email & password.	8	Sivaranjani, Guhan
Sprint-2	User confirmation	As a user,I can confirm my login using the OTP sent to my mobile number	3	Gomal Rajya Shri, Guhan.

Sprint	Functional Requiremet (Epic)	User Story / Task	Story Points	Team Members
Sprint-2	Data Sync	The smartbins send their data to thecloud inthe real time which is in turn updates to the web app and the administrator's dashboard.	2	Arunajeyalakshmi, Sivaranjani.
Sprint2		As a User,I can access information about the smart bins level and the number of bins filled in my area.	13	Gomal Rajya Shri, Sivaranjani.
Sprint-2		As a Driver, I can access the map provided by the web app to get the shortest distance between two filled smart bins.	2	Guhan, Arunajeyalakshmi
Sprint-3	Notification	As a User, I can receive message in the form of visual notification.	5	Arunajeyalakshmi, Sivaranjani. Gomal Rajya Shri.
Sprint-3	SMS Notification	As a user, I can receive SMS notificationwhen the smart binsare filled over 75%.	1	Gomal Rajya Shri, Guhan.
Sprint-3	Alert Notification	As a User, I can get the alert message if any smart bins caught fire or any kindof unusual things happened to the smart bins .	13	Guhan, Sivaranjani.
Sprint-3	Maintenance	As an executive, I manage a team of representatives offer in customer support.	1	Arunajeylakshmi, Gomal Rajya Shri.

Sprint	Functional Requiremet (Epic)	User Story / Task	Story Points	Team Members
Sprint-4	Admin Dashboard	As an Admin, I can receive information about the situation and can alert the concerned authorities.	2	Guhan, Arunajeyalakshmi
Sprint-4	User Dashboard	As a user, I can acknowledge information about smart bins on my dashboard.	13	Arunajeyalakshmi, Sivaranjani
Sprint-4	Municipality	As a Municipal Corporation, I can check whether the work is happening efficiently or not.	5	Guhan,Gomal Rajya Shri.

6.2 SPRINT DELIVERY SCHEDULE

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

6.3 REPORTS FROM JIRA

7. CODING & SOLUTIONING

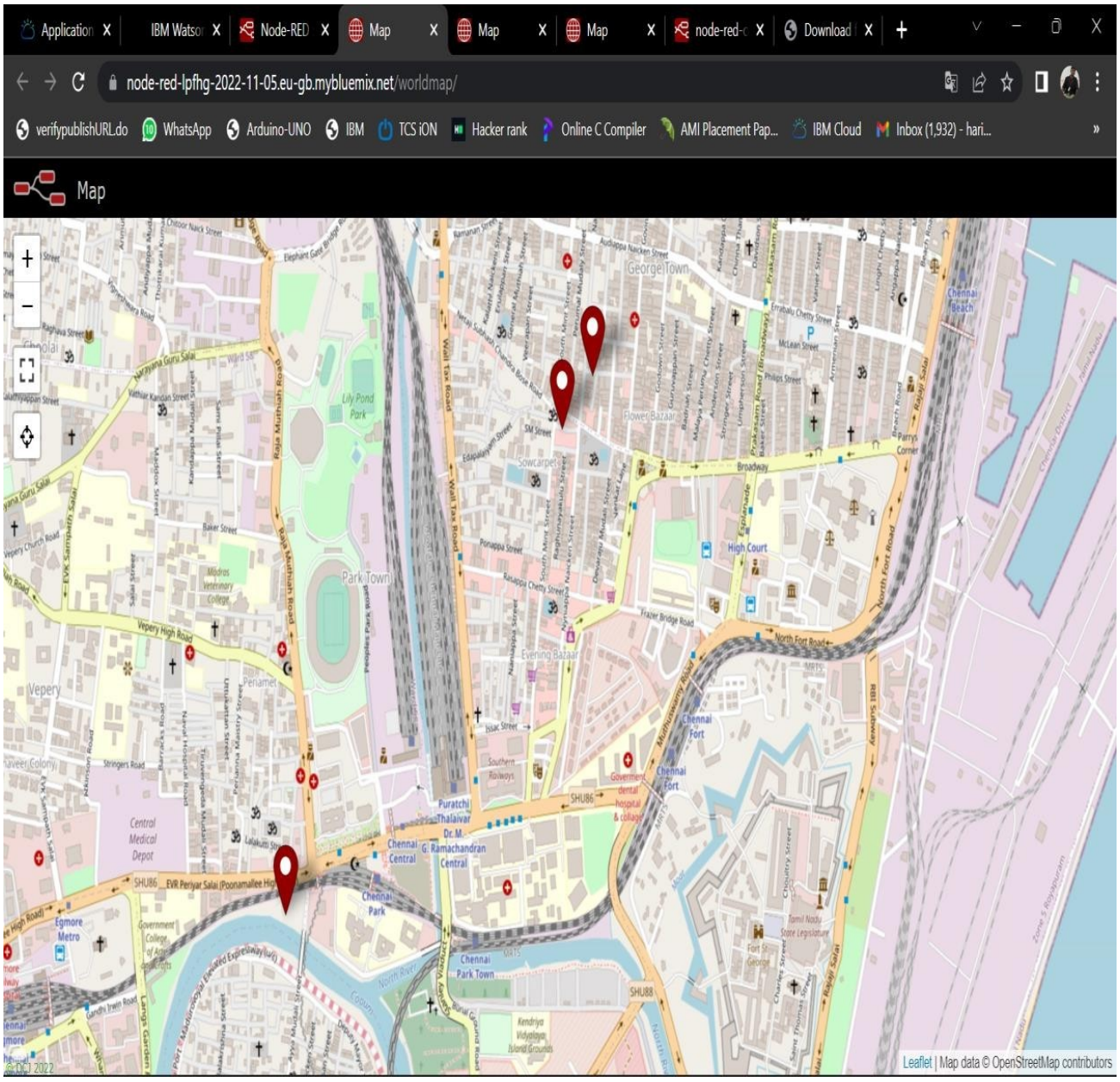
7.1 FEATURE 1 - GPS

The system also shows the efficient path between the driver and the bin and provides navigation for fetching waste from the smart trash bins which are filled by using the GPS.

```
import wiotp.sdk.device
import time
import random
myConfig = {
    "identity":{"orgId":"
        udgvx5",
        "typeId":"Python",
        "deviceId":"Test1"
     },
     "auth":{
         "token":"IBM_TEAM@123"
    }
}
def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" %
    cmd.data['command'])m=cmd.data['command']
client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)client.connect()
def pub(data):
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None)
    print("Published data Successfully: %s", myData)
while True:
    myData={'name':'Bin1','lat': 13.08005,'lon': 80.27009}
    pub(myData)
```

```
    time.sleep(3)
    myData={'name':'Bin1','lat': 13.09005,'lon': 80.28009}
    pub(myData)
    time.sleep(3)
    myData={'name':'Bin1','lat': 13.08905,'lon': 80.27909}
    pub(myData)
    time.sleep(3)
    client.commandCallback = myCommandCallback
client.disconnect()
```

OUTPUT



7.2 Feature 2 - ULTRASONIC SENSOR

Ultrasonic sensor is added to this system for finding the level of trash bin.

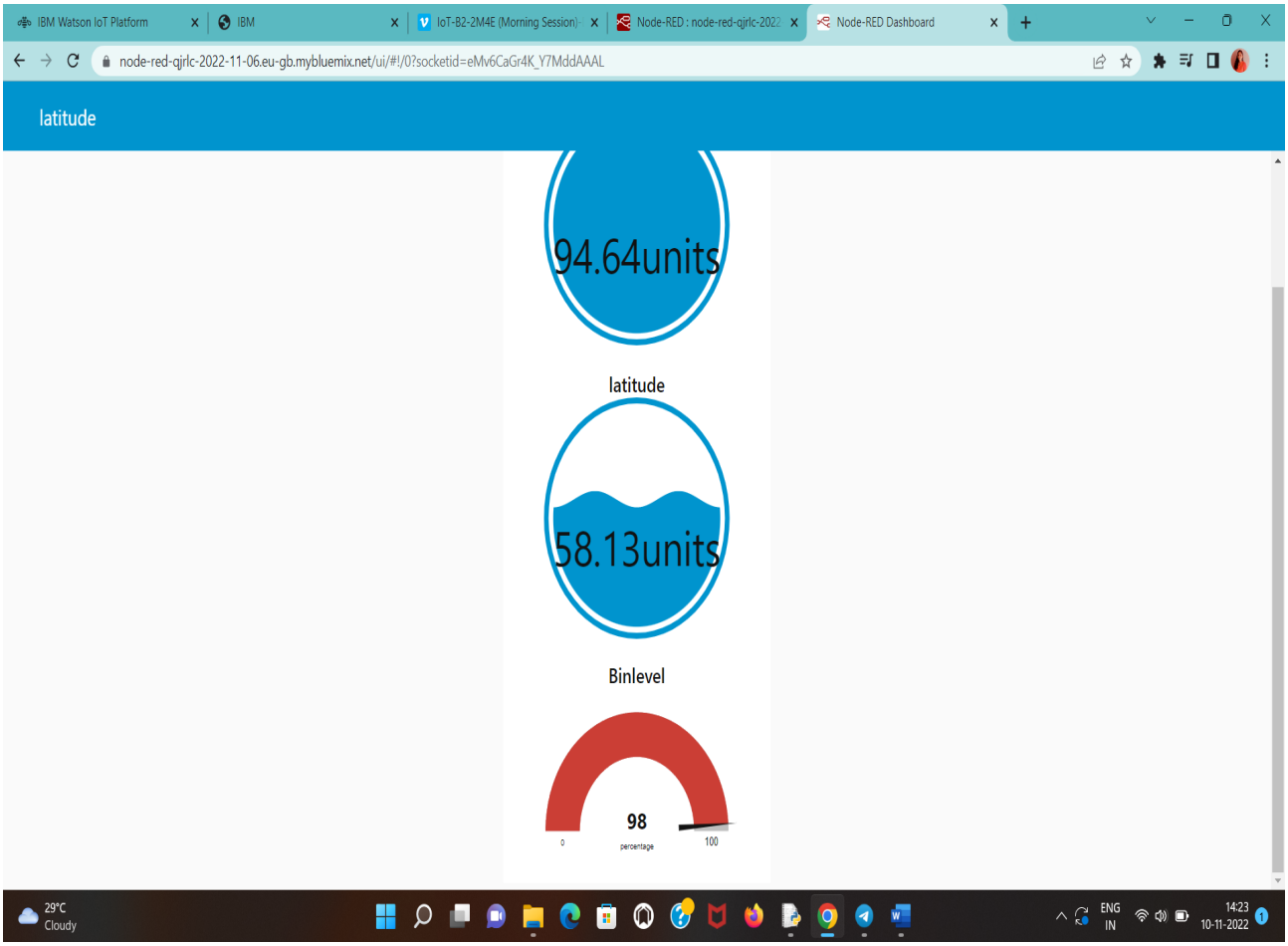
CODE:

```
import time
import wiotp.sdk.device
import sys import ibmiotf.application
import ibmiotf.device
import random
import sys
#Provide your IBM Watson Device Credentials organization = "udgvx5" deviceType = "GPS"
deviceId = "1"
authMethod = "token"
authToken = "12345678"
myConfig = {
"identity":{
"orgId":"udgvx5",
"typeId":"GPS",
"deviceId":"1" },
"auth":{ "token":"12345678"
 }
 }
def myCommandCallback2(cmd):
print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
m=cmd.data['command']
# Initialize GPIO
def myCommandCallback(cmd):
 print("Command received: %s" % cmd.data['command'])
status=cmd.data['command']
if status =="lighton":
 print("led in on")
 else : print ("led is off")
 try: deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-
method":authMethod, "auth-token": authToken}
deviceCli = ibmiotf.device.Client(deviceOptions)
```

```
#.....................................
 except Exception as e:
print("Caught exception connecting device: %s" % str(e))
 sys.exit()
client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()
 deviceCli.connect()
def pub(data):
client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None) print("Published data Successfully: %s", myData)
 while True:
 time.sleep(2)
 ult_son=random.randint(0,80)
weight=random.randint(0,100)
 lat = round(random.uniform(12.03, 13.50), 6)
lon = round(random.uniform(80.80, 85.90), 6)
data = {'Ultrasonic' : ult_son, 'Weight' : weight , 'lat' : lat,'lon':lon}
 #print data
def myOnPublishCallback():
print ("Published Ultrasonic :%s Cm" %ult_son, "Weight:%s kg " %weight, "lat: %s" %lat,"lon:
%s" %lon)
 success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
 if not success:5
 time.sleep(1)
deviceCli.commandCallback = myCommandCallback
myData={'name':'Bin1','lat': 13.08005,'lon': 80.27009}
 pub(myData)
 time.sleep(3)
 myData={'name':'Bin1','lat': 13.09005,'lon': 80.28009}
 pub(myData)
time.sleep(3)
 myData={'name':'Bin1','lat': 13.08905,'lon': 80.27909}
pub(myData)
 time.sleep(3)
 client.commandCallback = myCommandCallback2
# Disconnect the device and application from the cloud
```

deviceCli.disconnect()
client.disconnect()

OUTPUT



8. TESTING

8.1 Test Cases

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	steps To Execute	test data	Expected Result	Actual Result	Status	comments	TC for Automation(Y/N)	Bug ID	Executed by
LoginPage_TC_OO1	UI	Home Page	Verify whether user is able to access and notify	Notification	https://node-red-lpfhg-2022-11-05.eu-gb.mybluemix.net/red/#flow/cbdb6defa35a206a	Url	No notification received	Failed to notify	Fail	Wrong browser selected	NO	103	Sivaranjani V
LoginPage_TC_OO2	UI	Home Page	Verify whether user is able to access and notify	Notification	https://node-red-lpfhg-2022-11-05.eu-gb.mybluemix.net/red/#flow/cbdb6defa35a206a	Url	Notification received	notified	pass	Able to access in selected browser	YES	No Bugs	Arunajeyalakshmip
CloudStorage_TC_OO3	Functional	CLOUD	Verify the bin level and weight for efficient management of waste	CLOUD	As an user, We can access the information about	Smart bin level and weight in percentage	Garbage levels and range of visibility displayed dynamically	Does not change dynamically	Fail	Not Connected	NO	105	Gomal Rajya Shri P

					the smart bin level and the number of bins are filled in the area								
CloudStorage_TC_OO4	Functional	CLOUD	Verify the bin level and weight for efficient management of waste	CLOUD	1.Check whether the bins are empty or full 2.Displayed as per situation - Choose the shortest route to collect the garbage	Smart bin level and weight in percentage	Garbage levels and range of visibility displayed dynamically	Does not displayed proper instructions	pass	Connected	YES	No Bugs	Guhan G
Response_TC_OO5	Functional	IOT device	Check for the bin level and notify them	IOT Device	1.Check whether the bins are empty or full 2.Displayed as per situation - Choose the shortest route to collect the garbage	If the bin is full Indicate - "BIN IS FULL !!" Or else "BIN IS IN NORMAL LEVEL"	Displayed Instructions	Does not displayed proper instructions	Fail	verify the inputs	NO	106	Arunajeyalakshmi p
Response_TC_OO6	Functional	IOT device	Check for the bin level and notify them	IOT Device	1.Take the location data 2. Find the shortest route for the truck to	If the bin is full Indicate - "BIN IS FULL !!" Or else	Displayed Instructions	Now displayed proper instructions to users	pass	Now verified	YES	No Bugs	Gomal Rajya Shri P

					collect the garbage	"BIN IS IN NORMAL LEVEL"							
Output_TC_007	Functional	CLOUD	Verify the location and indicates if any bins are full	CLOUD	1.Take the location data 2. Find the shortest route for the truck to collect the garbage	Garbage bin's location data	Indication for collecting the garbage as per pinned location	Does not included the location data	Fail	Smart bin - Garbage level should be below 50 cm Bin Weight - Weight should be below 75 kg	NO	106	Guhan G
Output_TC_008	Functional	CLOUD	Verify the location and indicates if any bins are full	CLOUD	1.Take the location data 2. Find the shortest route for the truck to collect the garbage	Garbage bin's location data	Indication for collecting the garbage as per pinned location	Location data included	pass	Smart bin - Garbage level should be below 50 cm Bin Weight - Weight should be below 75 kg	YES	No Bugs	Sivaranjani V
TTS-TC_009	Functional	IOT device	Indicate the message as per the factors	IOT Device and TTS	Take data's from all require factors and showed response in display	Displayed instructions as per the situation	Showed message for precautionary responses	Message displayed as per situations	pass	Indication message displayed	YES	No Bugs	Sivaranjani V,Arunajeyalakshmi p
Final Output_TC_010	Functional	IOT device	Verify all the responses are showed and dynamically changed in the	IOT Device and TTS	Take all the data's retrieved from cloud and Showed responses in	Displayed all the type of instructions showed in a same	Showing the indications and messages in a display and changes dynamically	Indications and messages showed and dynamically changed	pass	All factors showed in the display	YES	No Bugs	Guhan G,Gomal Rajya Shri P

			single display		display as per the data factors	displ ay	according to the situation						

8.2 User Acceptance Testing

Resolution	Severit y 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	9	5	1	6	21
Duplicate	2	0	1	0	3
External	1	2	2	0	5
Fixed	12	2	5	19	38
Not Reproduced	0	1	0	0	1
Skipped	0	0	1	0	1
Won't Fix	0	3	2	0	5
Totals	24	13	12	25	74

Test Case Analysis

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	40	0	0	40
Security	3	0	0	3
Outsource Shipping	2	0	0	2
Exception Reporting	5	0	0	5

Final ReportOutput	3	0	0	3
Version Control	2	0	0	2

9 **RESULTS**

9.1 PERFORMANCE METRICS

NFT - Risk Assessment

Project Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes	Risk Score	Justification
Smart Waste Management System in Metropolitan cities	Existing	Moderate	Moderate	Low	Loss of users and delay in run time	>10 to 30%	ORANGE	Since there are moderate changes in function and hardware, it may add setup time in the long run

NFT - Detailed Test Plan

Project Overview	NFT Test approach	Assumptions/Dependencies/Risks	Approvals/SignOff
Managing the collection of trash in busy cities	LOAD, STRESS	May request advanced versions in software Requires speed test	Approval

End Of Test Report

Project Overview	NFT Test approach	NFR - Met	Test Outcome	GO/NO-GO decision	Recommendations	Identified Defects (Detected/Closed/Open)	Approvals/SignOff
Managing the collection of waste by using smart bins which alerts the garbage collector when it is full	LOAD, STRESS	MET	Opertates efficiently when the number of users is increased	GO	Recommended to have advanced browsers that enable gps tracking	Closed	Approval

10. **ADVANTAGES & DISADVANTAGES**

ADVANTAGES :

- It saves time and money by using smart waste collection bins and system equipped with fill level sensors.
- It keeps our surroundings clean and green and free from bad odours of wastes
- Applying smart waste management process to the cities optimize management, resource and costs which makes it a “smart city”.
- It helps governance to generate extra revenue by ad on smart devices.

DISADVANTAGES

- System requires more number of waste bins for separate waste collection as per population in the city. This results into high initial cost due to expensive smart dustbins compared to other methods.
- Sensors node used in the dustbins have limited memory size.
- What ever may be the waste notification will not sent untill reaches threshold value

- Sometimes It will show wrong location to drivers.

11. CONCLUSION

Waste management provides and cities can benefit from IoT powered smart waste management solution. Using the applied science, waste management companies can increase their functional efficiency, cut cost, and enhance customer satisfaction by make sure no dumpster overflows.we here by conclude that smart waste management system will reduce waste spreading on roads and helps people to be hygienic.

12. FUTURE SCOPE

The ultimate goal of IoT in waste management is producing leaner operations and present higher quality service to citizens. A growing collection of interlinked sovereign systems are managing routine urban functioning and improving both citizen undergo and our carbon footprint. finally, however, we need deeper coordinates between public sectors through a mix of ordinance and incentives and private sectors through a willingness to engage with regional, state, and federal agencies to use IoT in waste management to build a better and more sustainable future.

13. APPENDIX

https://github.com/IBM-EPBL/IBM-Project-1735-1658411105

https://node-red-lpfhg-2022-11-05.eu-gb.mybluemix.net/red/#fl

https://youtu.be/JBZDCsEeJyw