SMART WASTE MANAGEMENT IN METROPOLITANS CITIES

PROJECT REPORT

Team ID	PNT2022TMID36338
Project Name	Smart Waste Management System For Metropolitan Cities

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1.INTRODUCTION:

1.1 Project Overview

The waste collection process is an important aspect for service providers. The traditional method of manually monitoring waste in bins is a complex and cumbersome process that requires more human effort, time and cost, and is incompatible with today's technology. Irregular disposal of waste, represented by household, industrial and environmental waste, is the root cause of many human problems, including pollution, disease and adversely affecting biological hygiene. To overcome all these problems, we propose an intelligent waste management system idea that supports automatic waste management without human intervention to maintain a clean environment.

1.2 Purpose:

Intelligent waste management is an idea that can be used to control many of the problems that disrupt society through pollution and disease. Waste disposal must be done immediately. Otherwise, it will lead to irregular management with detrimental effects on nature. Intelligent waste management is mostly compatible with smart city concepts. The main goals of the proposed system are:

• Oversight of waste management.
• Provide intelligent technology for waste systems. • Avoidance of human intervention.
• Reduce human time and effort
• The result is a healthy, lean environment.

2.LITERATURE SURVEY:

2.1 Existing problem:

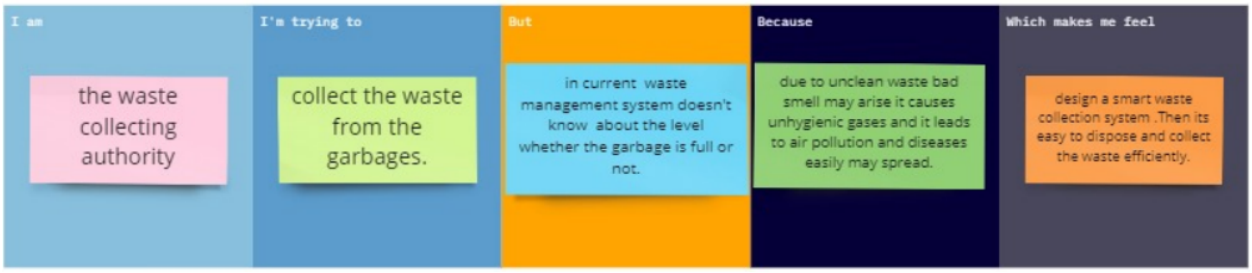
- **A manual system for employees to regularly clean out trash cans**
- **Lack of a systematic approach to recycle bin organization**
- **Unknown status for a particular site**
- **Employees do not recognize the need for specific locations**
- **Urban cleaning is very ineffective**

2.2 References:

S.NO	TITLE	AUTHOR & YEAR	DESCRIPTION
1	Smart Waste Management using WSN and IOT	Sivasankari, Bhanu Shri, Y. BevishJinila 2017	In this paper, they use Wireless Sensor Networks and IOT. The garbage bins are deployed with sensors and are networked together using WSN. The sensors deployed in the garbage bins collect the data for every determined interval. Once the threshold is reached, it raises a request to the GCA (garbage collector agent). This agent collects the requests of all the filled vehicles and communicates using the IoT framework.
2	Smart Waste Management System	Bindushree, Manasa, Sanjana Rao, Vidhya Shree, Gowra PS 2021	In this paper, they use sensors, which include an IR sensor for detecting the presence of any waste and a soil moisture sensor to detect whether the waste is dry or wet. The emphasis is primarily on waste segregation, followed by analysis via the website
3	Smart Waste Management System using IOT	Tejashree Kadus, PawankumarNirmal, Kartikee Kulkarni 2020	In this paper, they use an Arduino board interfaced with a load sensor, an IR sensor, and a Wi-Fi module instead of a PIR sensor and an ultrasonic sensor. In addition to electrical

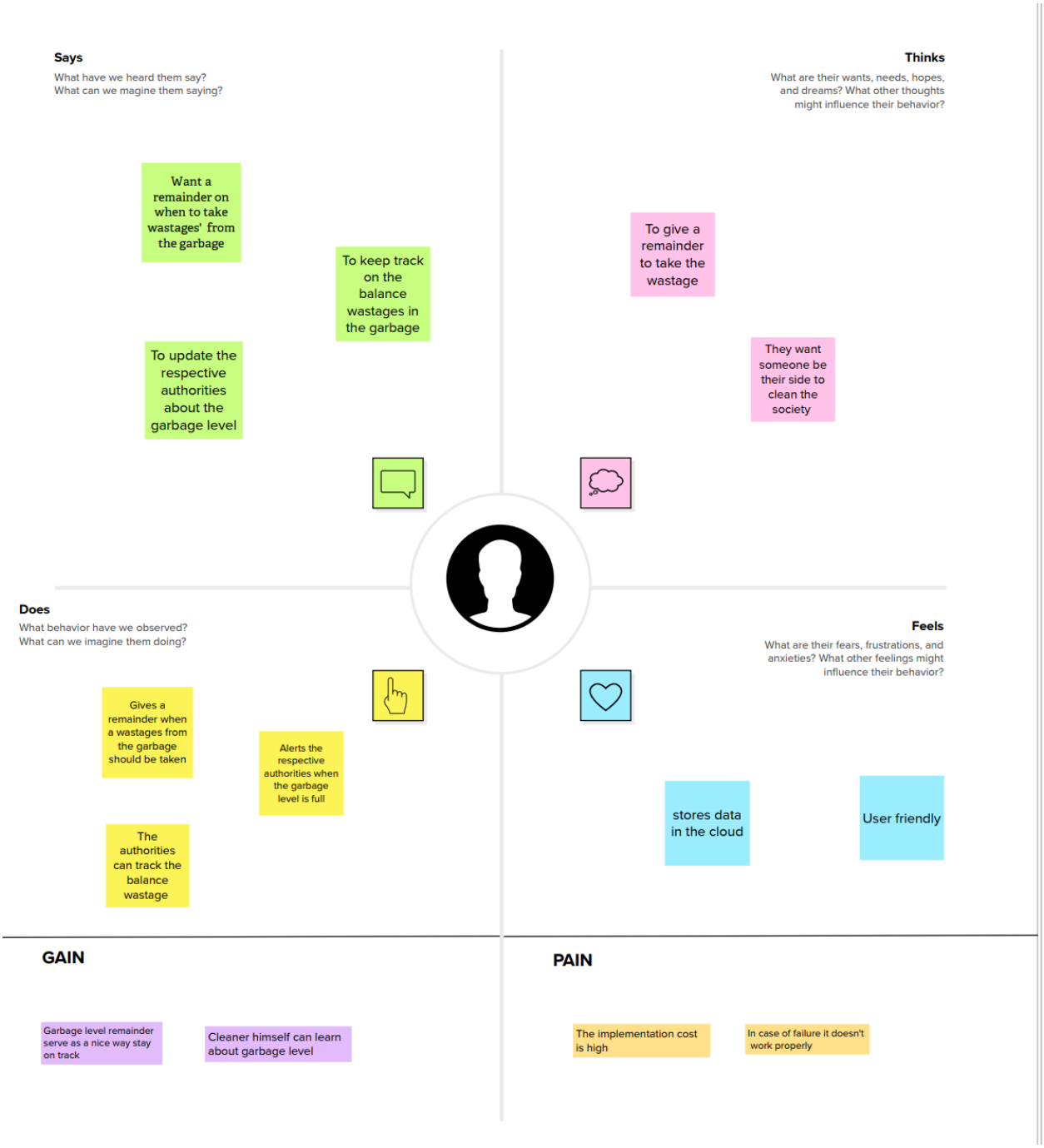
			components,they use mechanical components like the load sensing plate and shredder to crash the trash and then measure the load.

2.3 Problem Statement Definition:

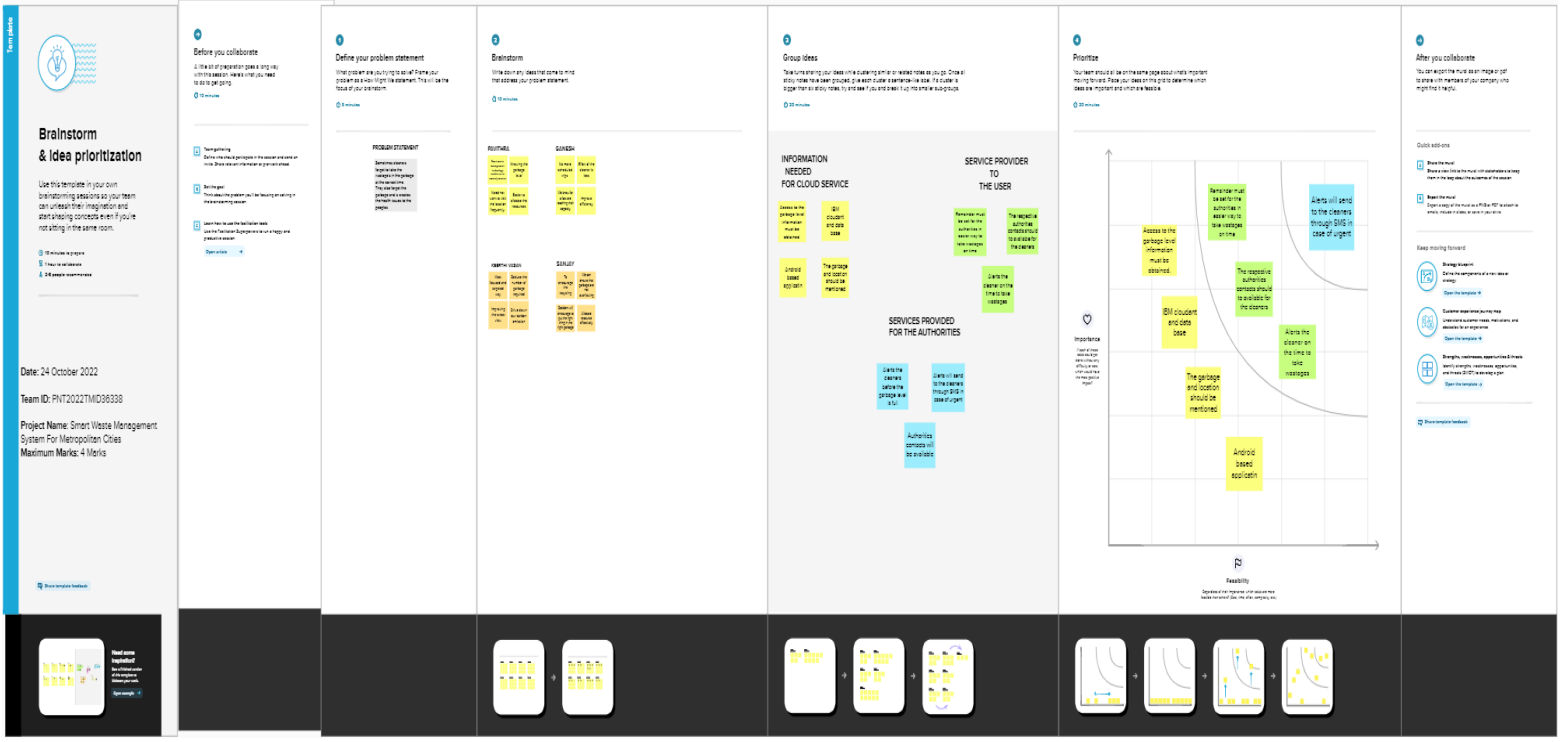


3.IDEATION & PROPOSED SOLUTION :

3.1 Empathy Map Canvas:



3.2 Ideation & Brainstorming:



3.3 Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The biggest issues affecting smart waste management are unscientific treatment ,Improper collection of waste and ethical problems .Therefore we need to protect waste management.
2.	Idea / Solution description	It can be protected by creating an interactive dashboard by IOT .By doing this we can predict the upcoming programs .
3.	Novelty / Uniqueness	It can give correct and accurate information .
4.	Social Impact / Customer Satisfaction	In terms of social impact , it has a great interactive dashboard for predicting the wastages.
5.	Business Model (Revenue Model)	It has more revenue when it comes to the market.
6.	Scalability of the Solution	It has easy manupulation of data .

3.4 Problem Solution fit:

4.REQUIREMENT ANALYSIS:

4.1 Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Real time bin monitoring	In the dashboard itself display the level of bins which is monitor by sensor
FR-2	Distribution and bin adjust	Based on the areas, you can adjust bin capacity or location where necessary.
FR-3	Eliminate inefficient picks	The sensors recognize picks.Eliminate the collection of half empty bins. The data shows how full the bin was when picked. You immediately see any inefficient picks below 80% full.
FR-4	Planning the routes	In view of current Bin fill-levels furthermore, forecasts of arriving at full limit, you are prepared to collecting the waste assortment.

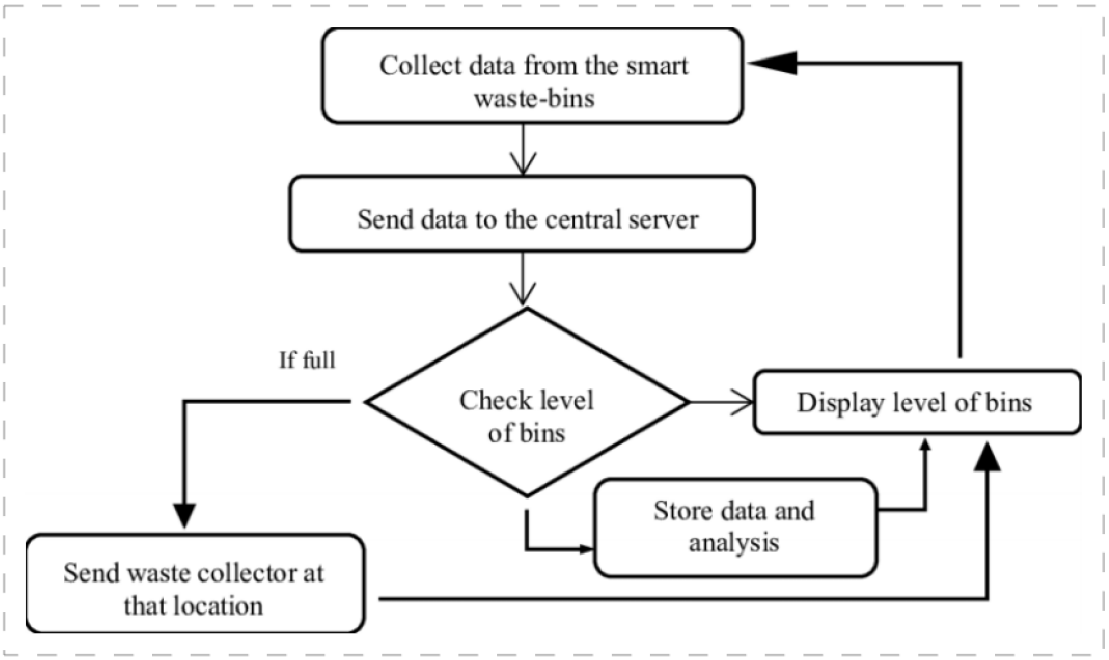
Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	IoT gadget confirms that ease of use is an exceptional and significant point of view to break down client prerequisites, which can additionally work on the plan quality. In the plan cycle with client experience as the center, the examination of clients' item ease of use can without a doubt help originators better get it clients' expected requirements in squander the board, conduct What's more, insight.
NFR-2	**Security**	Utilize a reusable containers Utilize reusable staple sacks
NFR-3	**Reliability**	Smart waste management provides better working conditions for cleaners and drivers.Instead of driving the same collection routes and servicing empty bins, collectors will spend their time more efficiently, taking care of bins that need servicing .
NFR-4	**Performance**	Management Software System, a powerful cloud -based platform, for data driven daily operations, available also as a waste management app. Using a variety of IoT networks (NB -IoT,GPRS), the sensors send the data to Sensono's Smart Waste
NFR-5	**Availability**	By creating and deploying versatile equipment, we empower cities, businesses, and countries to manage waste smarter.
NFR-6	**Scalability**	It can be monitored at any time for more cost effect and scalability when we moves to smarter.

5. PROJECT DESIGN:

5.1 Data flow diagram:

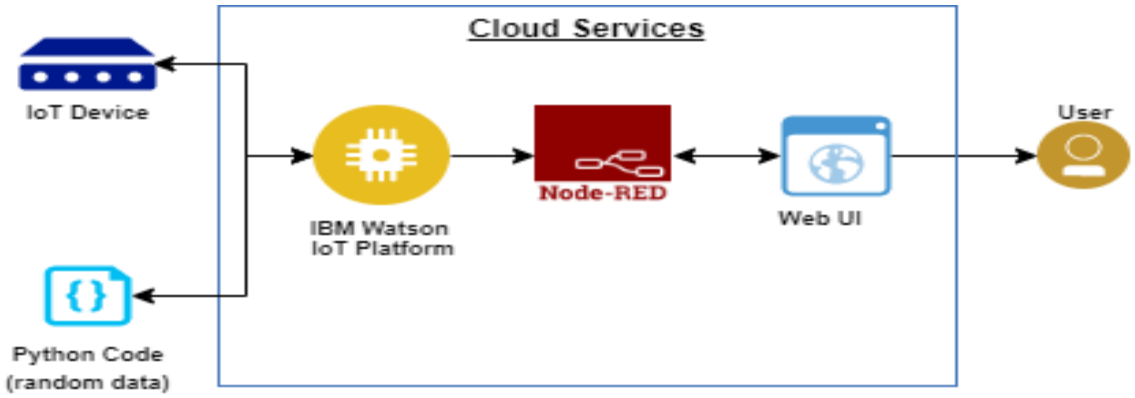


5.2 Solution & Technical Architecture:

S.No	Component	Description	Technology
1.	User Interface	Web Portal	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	To compute the distance of rubbish and show the continuous level in online interface ,data getting through ultrasonic sensor and the alarm message initiate with python content to the online interface.	Python /Ultrasonic sensor
3.	Application Logic-2	To ascertain the weight of the trash and show the constant weight in a web-based interface, this data gets by means of burden cell and the alarm message actuated with python to the online interface.	Load cell /Python
4.	Application Logic-3	Getting area of the Trash.	GSM/GPS
5.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
6.	File Storage	File storage requirements	GitHub, Local file System.
7.	External API-1	Firebase is a set of hosting services for any type of applicationIt offers NoSQL and real-time hosting of databases, content, social authentication, and notifications, or services, such as a real time communication server.	Fire box
8.	Ultrasonic sensor	To toss a ready message at the point when trash is getting full.Distance Acknowledgment Model.	Distance Acknowledgment Model.
9.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: localhost Cloud Server Configuration: localhost, Firebox	Local host, web portal

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	NodeRed,Python,IBM Simulator.	Internet Of Things (IOT)
2.	Security Implementations	For example used to broadcast live data, further security measures are recommended and use the UFW(uncomplicated Firewall).	Internet Of Things (IOT)
3.	Availability	These garbage bins use sensors like ultrasonic and load cell to send ready message about the rubbish level acknowledgment innovation, and counterfeit knowledge, empowering them to consequently sort and arrange reusing litter into one of its more modest receptacle	Internet Of Things (IOT)
4.	Performance	Number of request:RPI manages to execute 129 -139 read requests per second.Use of Cache:512mb Use of CDN's:Real time	IOT/ web portal



6.PROJECT PLANNING AND SCHEDULING:

6.1 Sprint Planning and Scheduling:

SPRINT	FUNCTIONAL REQUIREMENT (EPIC)	USER STORY NUMBER	USER STORY/TASK	STORY POINTS	PRIORITY	TEAM MEMBERS
sprint-1	IBM Watson IoT Platform	USN-1	Creating devices and board and generating data	1	Medium	1.Ganesh.P 2.Keerthivasan.S 3.Sanjay.S 4.Pavithra.P
sprint-2	Story Data Using Mode Red	USN-2	Storing data in IBM Cloudant DB through node-red functions	2	High	1.Ganesh.P 2.Keerthivasan.S 3.Sanjay.S 4.Pavithra.P
sprint-3	IoT Device /Microcontroller Board	USN-4	The board connect with the cloud and retrieve the information and remain the peoples	2	Low	1.Ganesh.P 2.Keerthivasan.S 3.Sanjay.S 4.Pavithra.P
sprint-4	Reminder(TTS)	USN-5	Getting The Speech Remainder to users to take their tablet	1	High	1.Ganesh.P 2.Keerthivasan.S 3.Sanjay.S 4.Pavithra.P

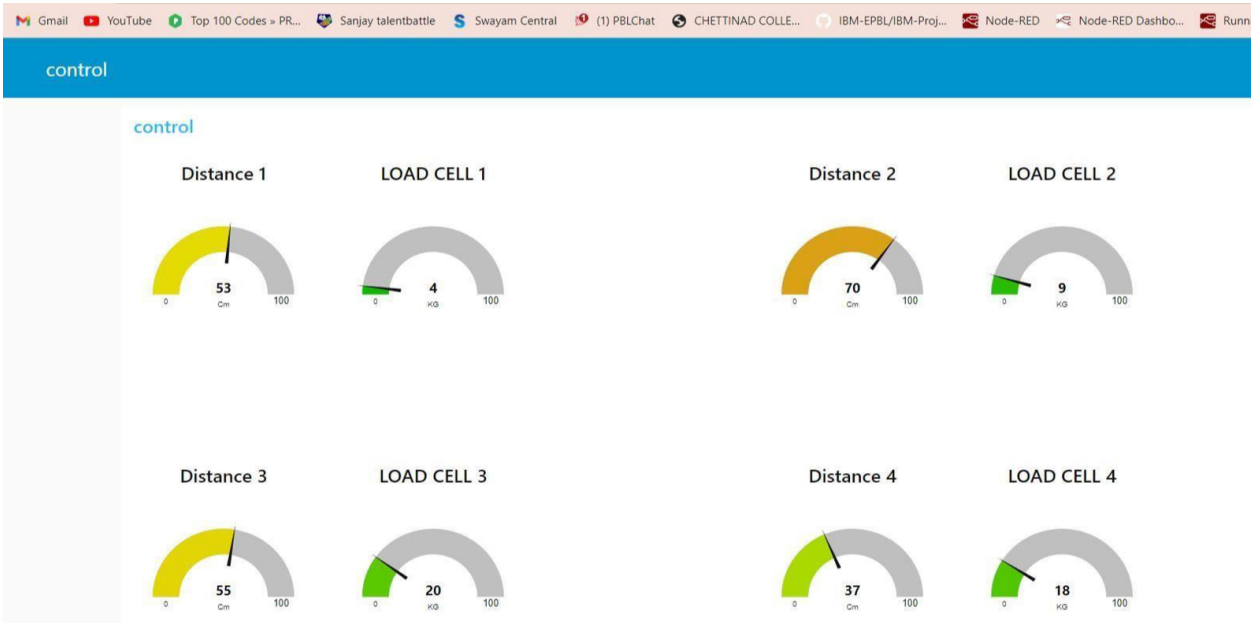
sprint-1	IBM Watson IoT Platform	USN-1	Creating devices and board and generating data	1	Medium	1.Ganesh.P 2.Keerthivasan.S 3.Sanjay.S 4.Pavithra.P
sprint-4	Reminder(TTS)	USN-5	Getting The Speech Remainder to users to take their tablet	1	High	1.Ganesh.P 2.Keerthivasan.S 3.Sanjay.S 4.Pavithra.P

PROJECT TRACKER, VELOCITY & BURNDOWN CHART:(4 MARKS)

SPRINT	TOTAL STORY POINTS	DURATION	SPRINT START DATE	SPRINT END DATE (PLANNED)	STORY POINTS COMPLETED (AS ON PLANNED END DATE)	SPRINT RELEASE DATE (ACTUAL)
SPRINT-1	20	6 DAYS	16 NOV 2022	18 NOV 2022	20	18 NOV 2022
SPRINT-2	20	6DAYS	20 NOV 2022	22 NOV 2022	20	22 NOV 2022
SPRINT-3	20	6 DAYS	22 NOV 2022	24 NOV 2022	20	24 NOV 2022
SPRINT-4	20	6 DAYS	24 NOV 2022	26 NOV 2022	20	26 NOV 2022

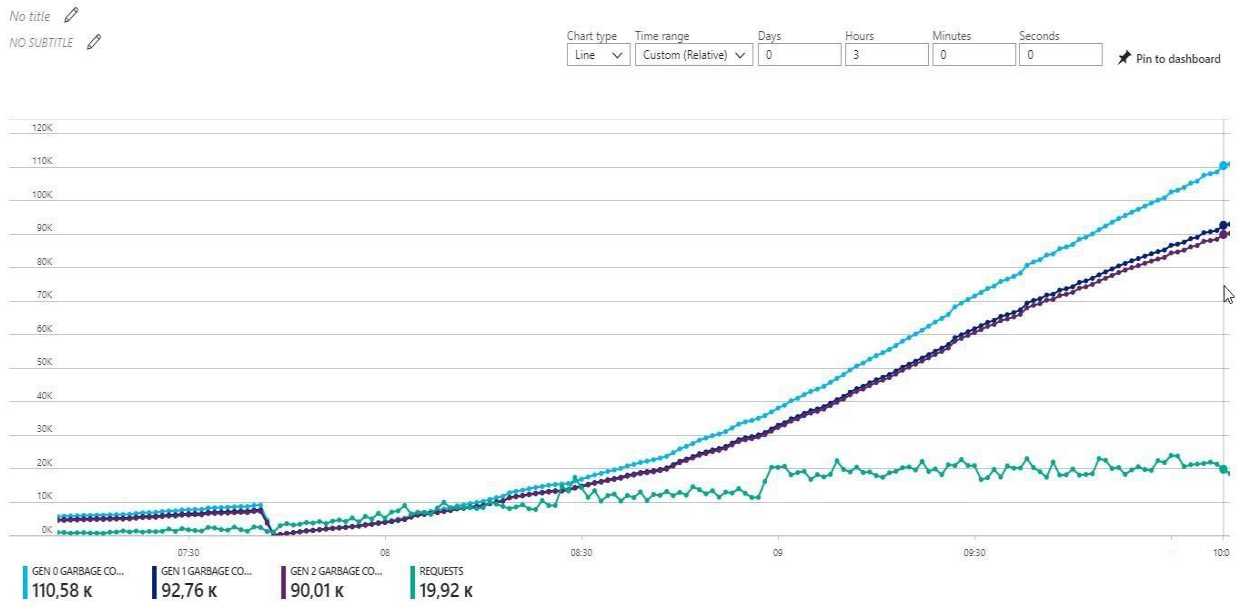
7. CODING AND SOLUTIONING:

7.1 Feature 1: Web UI showing Level and Load of bin



8.RESULTS:

8.1 Performance Metrics:



9. ADVANTAGES & DISADVANTAGES:

ADVANTAGES:

• Displays the location, bin level, and load in real time.
• A decrease in the gas CO2
• Maintains a clean environment by preventing waste overflow.

DISADVANTAGSE:

• System requires a greater 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 compare to other methods.
• Sensor nodes used in the dustbins have limited memory size.

10. CONCLUSION:

Through the use of sensors, it is possible to create a system that is more effective than the one that is currently in place.Our concept of a "smart waste management system" focuses primarily on monitoring waste management, providing a smart technology for the waste system, avoiding human intervention, reducing human time and effort, and creating an environment that is both clean and free of waste.The concept that has been proposed could be implemented in smart cities where residents would be too busy with their busy schedules to devote sufficient time to

waste management.If desired, the bins can be installed in a city with a large bin that can hold enough solid waste for a single apartment.The residents could split the cost, resulting in lower prices for services.

11. FUTURE SCOPE:

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

• We can create separate dustbins for dry and wet waste in the event that there are additional bins.

• The proposed remedy is adaptable.and decoupled from the algorithm that determines the best route for vehicles or the optimal number of bins and vehicles.

APPENDIX:

Source code:

```
import requests import
json import
ibmiotf.application import
ibmiotf.device import time
import random import sys
# watson device details
organization =
"4yi0vc" devicType =
"BIN1" deviceId =
"BIN1ID" authMethod=
"token" authToken=
"23232323"
#generate random values for randomo variables (temperature&humidity)
 def
myCommandCallback(cmd):
 global a print("command recieved:%s"
%cmd.data['command'])
control=cmd.data['command'] print(control)
try:
 deviceOptions={"org": organization, "type": devicType,"id":
deviceId,"authmethod":authMethod,"authtoken":authToken} deviceCli =
ibmiotf.device.Client(deviceOptions) except
Exception as e:
 print("caught exception connecting device %s" %str(e))
sys.exit()
#connect and send a datapoint "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:' 'Dumpster poundage getting high, Time to collect :) 90 %'
 elif
distance < 40 and distance >16:
 dist = 'Risk warning:' 'dumpster 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 :' ' Dumpster poundage getting high, Time to collect :)'
 elif load == "60 %" or
distance == "60 %":
 warn = 'alert :'
'dumpster is above 60%' else :
 warn = 'alert :' 'No need to collect right now '
def myOnPublishCallback(lat=10.678991,long=78.177731):
 print("Gandigramam, Karur") 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
```

GitHub Link:

https://github.com/IBM-EPBL/IBM-Project-53775-1661494976

Video Demo Link:

https://drive.google.com/file/d/1lyRpgysfFr87KssVJSkrbSCIQFnFGZ5A/view?usp=sharing