PROJECT REPORT

TEAM ID	**PNT2022TMID50056**
PROJECT NAME	**Smart Waste Management System for metropolitan cities**
TEAM LEADER	**R.George Denifer**
TEAM MEMBER 1	**B.Daniel**
TEAM MEMBER 2	**R.Suresh**
TEAM MEMBER 3	**M.Guru Prasath**

1. INTRODUCTION

The project is based on the concept of Automation used in waste management system under the domain of Cleanliness and Hygiene. Dumping garbage onto the streets and in public areas is a common synopsis found in all developing countries and this mainly end up affecting the environment and creating several unhygienic conditions. In order to deal with these problems Smart netbin is an ideology put forward which is a combination of hardware and software technologies i.e. connecting Wi-Fi system to the normal dustbin in order to provide free internet facilities to the user for a particular period of time. The technology awards the user for keeping the surrounding clean and thus work hand in hand for the proper waste management in a locality. Smart netbin uses multiple technologies firstly the technology for measuring the amount of trash dumped secondly the movement of the waste and lastly sending necessary signals and connecting the user to

the Wi- Fi system. The proposed system will function on client server model, a cause that will assure clean environment, good health, and pollution free society.

1.1 Project Overview

Our waste generation is constantly growing to form a global garbage crisis. Even though we indulge in creating a more sustainable and greener, we still fail to handle our waste generation and management. Combining technology support with a vision of social, economic and environmental sustainability is the best way out of this problem. It is done in the following manner. The smart bin system undergoes a thorough system check and battery level monitoring in order to function efficiently. If the battery level is found to be low, it has to be recharged immediately, else it can proceed to the next step. The threshold level levels of the bin are indicated my multiple sensors attached to bin. If the garbage exceeds the level, then an alert message is sent to the garbage collectors as well as to the municipality or area administration. The area in which garbage is found to overflow is allocated to respective garbage collectors in the form of messages through GSM system. Once the waste bin is emptied, an information update is sent to the municipality and server is updated. This is how the waste from bins can be efficiently handled and managed using technology which in turn keeps the environment clean and healthy.

1.2 Purpose

We amalgamate technology along with waste management in order to effectively create a safe and a hygienic environment. Smart waste management is about using technology and data to create a more efficient waste industry. Based on IoT (Internet of Things) technology, smart waste management aims to optimize resource allocation, reduce running costs, and increase the sustainability of waste services. This makes it possible to plan more efficient routes for the trash collectors who empty the bins, but also lowers the chance of any bin being full for over a week. A good level of

coordination exists between the garbage collectors and the information supplied via technology. This makes them well aware of the existing garbage level and instigate them whenever the bins reach the threshold level. They are sent with alert messages so that they can collect the garbage on time without littering the surrounding area. The fill patterns of specific containers can be identified by historical data and managed accordingly in the long term. In addition to hardware solutions, mobile applications are used to overcome the challenges in the regular waste management system, such as keeping track of the drivers while they are operating on the field. Thus, smart waste management provides us with the most optimal way of managing the waste in an efficient manner using technology.

2. LITERATURE SURVEY

This is not an original idea, IOT based dustbin was implemented and effectuated much before. Some authors presented systems where the sensors in the bin checked if the bin are filled up to the brim or not.If it was filled an automated message was sent to the server end of the system, through the Arduino SIM module, which used the application of the Arduino board. Once the server received the message it forwarded the message to the worker in charge, if the worker was available, he would notify his/her presence by accepting the work and would reach the required destination. If the worker was not available, the work would be transferred to another worker.system by using smart dustbins to check the filled level of dustbins whether they were filled. In this system the information of all smart dustbins can be accessed from anywhere and anytime by the concern person and he/she can take a decision accordingly. By implementing this proposed system, the cost reduction, resource optimization, effective usage of smart dustbins was carried out. This system indirectly reduced traffic in the city. In major cities the garbage collection vehicle visited the area's everyday twice or thrice

depending on the population of the particular area. The System informed the status of each and every dust bin in real time so that the concerned authority can send the garbage collection vehicle only when the dustbin is full.Some proposed smart garbage management system using IR sensor, microcontroller and Wi-Fi module.This system assured the cleaning of dustbins soon when the garbage level reached its maximum. If the dustbin was not cleaned in specific time, then the records were sent to the higher authority who took appropriate action against the concerned contractor. This system also helped to monitor the fake reports and hence helped to reduce the corruption in the overall management system. It ultimately helped to keep cleanliness in the society Progressively the Dustbin with Wi-Fi Router attached in it was also introduced. The Dustbin had a Passive Infrared Sensor. The Wi-Fi router was programmed to display the temporary connecting code. When the user throwed trash in the dustbin, the PIR sensor detected the trash and sent signals to the microcontroller. The microcontroller detected the signals and forwarded it to the router device. The router verified the signals and generated random codes and then forwarded it again to the microcontroller. The microcontroller scanned the signals and forwarded it to the LCD Display. The LCD Display displayed it. The user entered the random code generated by the router on the PHP interface which was hosted on the server. The server then responded to the request and displayed the Master Wi-Fi password to the user. The user then used the Master Wi-Fi password to connect to the internet. The user got the internet access for 10 minutes and automatically got disconnected.

2.1 Existing problem

The main problems of the existing solid waste collection process and management system are as follows:

- **More complications in the processing.**
- **many controlling units linked with each other**

2.2 References

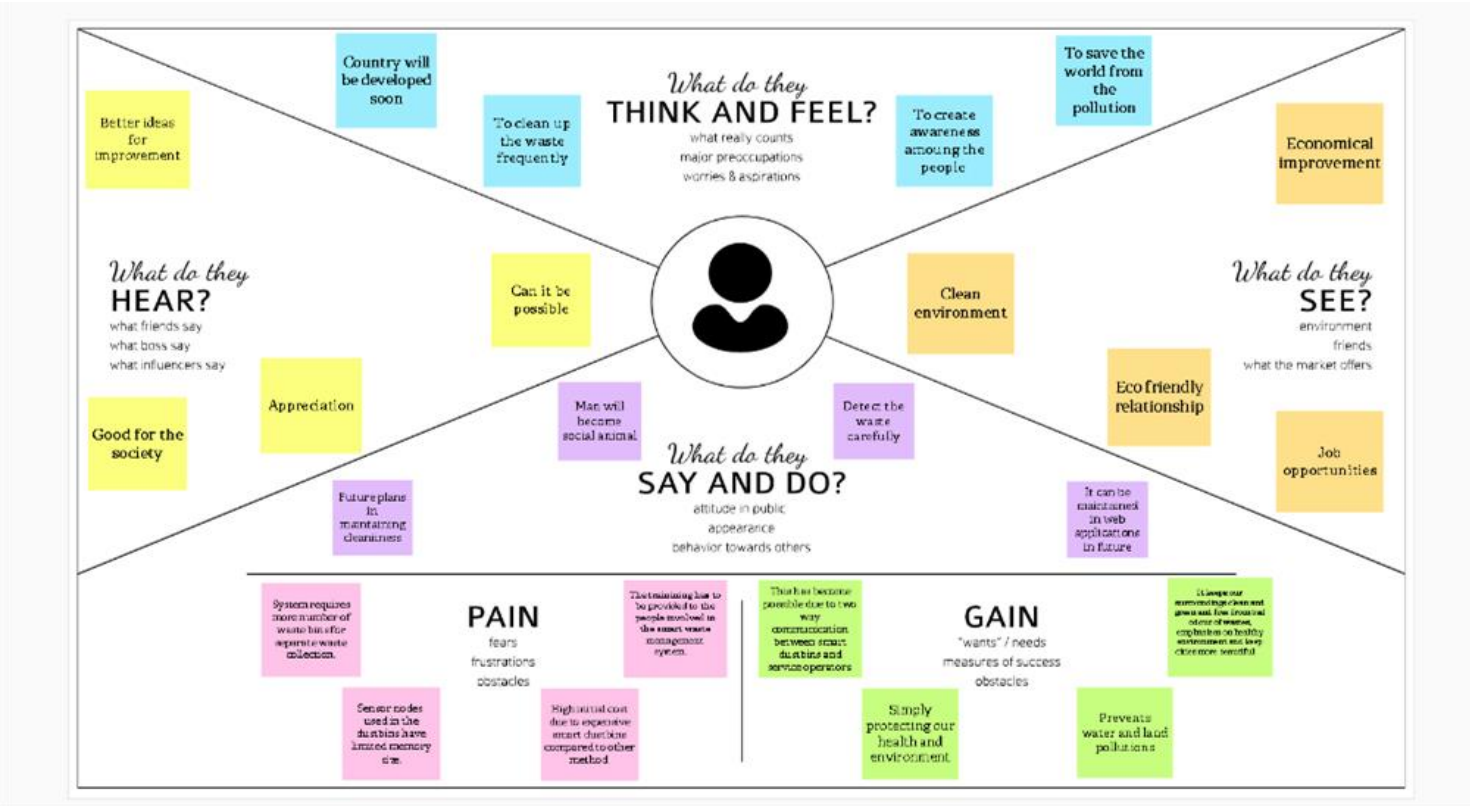
[1] P. Suresh, Vijay. Daniel, R.H. Aswathy, Dr. V. Parthasarathy, "A State-of-the-Art review on Internet of Things" International Conference on Science Engineering and Management Research (ICSEMR), IEEE, DOI: 10.1109/ICSEMR.2014.7043637 19 February 2015.
[2] Parkash, Prabu V "IoT Based Waste Management for Smart City" International Journal of Innovative Research in Computer and Communication Engineering, Vol. 4, Issue 2, DOI: 10.15680/IJIRCCE.2016. 0402029, February 2016.
[3] Evaluation on the Performance of Urban Domestic Sewage Treatment Plants in China - 2011 Dongmei Han; Guojun Song
[4] Teemu Nuortioa, Jari Kyto¨jokib, Harri Niskaa, Olli Bra¨ysyb "Improved route planning and scheduling of waste collection and transport", Expert Systems with Applications 30 (2006) 223–232,Elsevier
[5] M. Arebey, M. Hannan, H. Basri, and H. Abdullah, "Solid waste monitoring and management using RFID, GIS and GSM", The IEEE Student Conference on Research and Development (SCOReD), 16-18 November 2009, UPM Serdang, Malaysia, 2009.

2.3 Problem Statement Definition

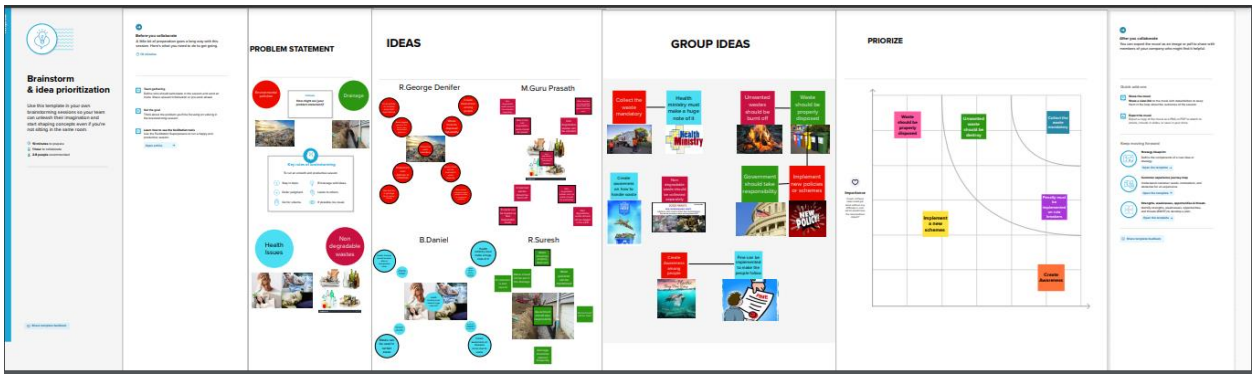
Waste Generation Solid waste generation rates estimate the amount of waste created by residences or businesses over a certain amount of time (day, year, etc.). Waste generation includes all materials discarded, whether or not they are later recycled or disposed in a landfill. Waste generation rates fore sidential and commercial activities can be used to estimate the impact of new developments on the local waste stream. As a consequence, if solid waste management is to be accomplished in an efficient and orderlymanner , the fundamental aspects and relationship involved must be identify, adjusted foruniformity of data, and understood clearly Indiscriminate dumping of solid waste and failure of the collection system in a populated community would soon causes health problems.

3. IDEATION & PROPOSED SOLUTION;

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

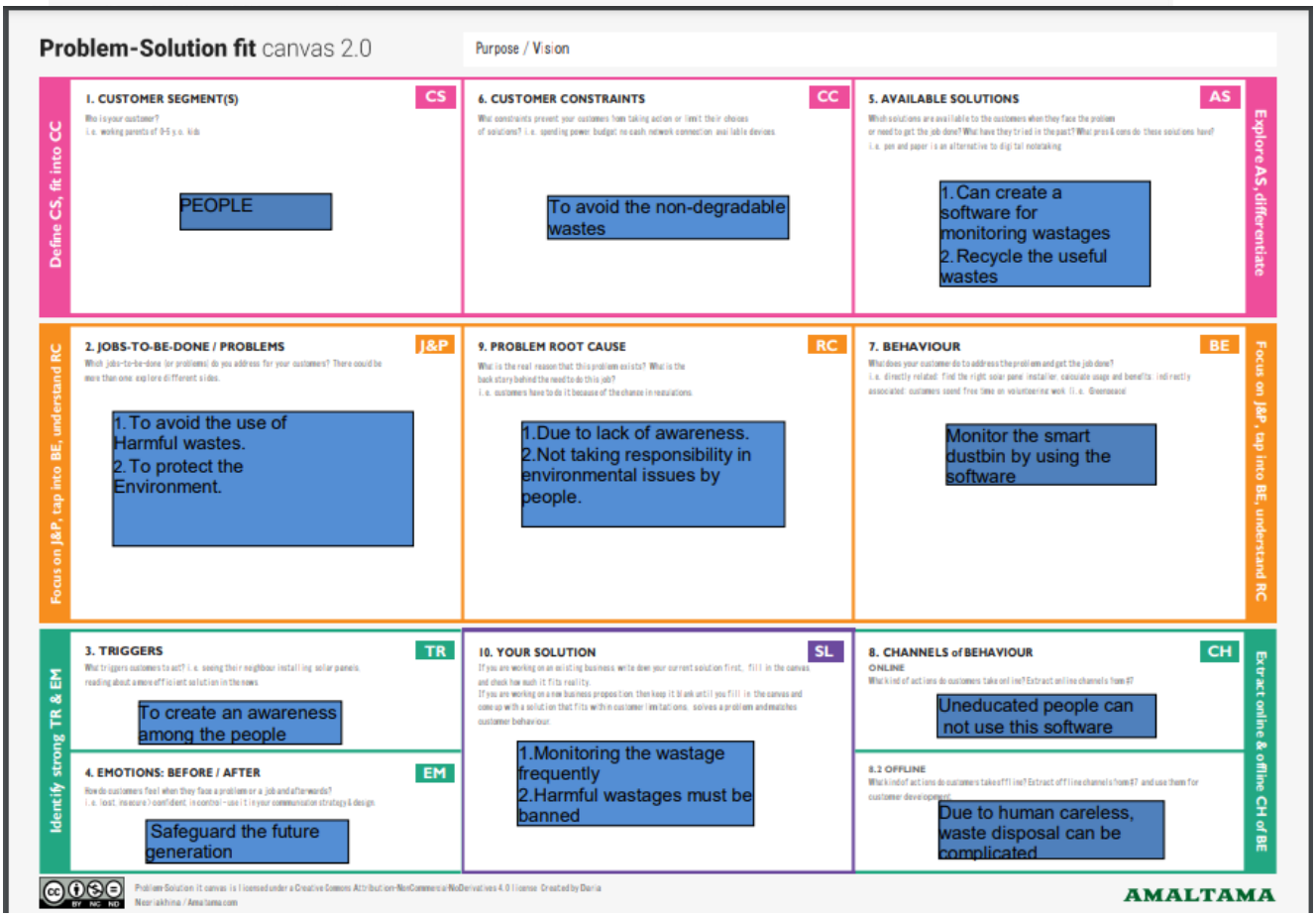


3.3 Proposed Solution

S.No.	Parameter	Description
1	Problem Statement (Problem to be solved)	To maintain waste in the metropolitan cities and to maintain the clean

		environment which is polluted by the wastes and to dispose wastes.
2	**Idea / Solution description**	**-Software can be implemented** **-Fine can be implemented** **-Create awareness**
3	**Novelty / Uniqueness**	**This system provides awareness among the people and safeguard the environment with the help of people.**
4	**Social Impact / Customer Satisfaction**	**Clean cities Healthy environment Peaceful life**
5	**Business Model (Revenue Model)**	**-Offering software as a service model to government.** **-Making use of useful wastes and making it us money.**
6	**Scalability of the Solution**	**To help government to maintain clean environment.**

3.4 Proposed Solution Fit



4.Requirements Analysis;

4.1 Functional Requirements

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	Web Application	Node-Red sevice
FR-4	Configure to Device	IBM Watson IoT Platform
FR-5	Database	MYSQL ,NOSQL
FR-6	Python Srcipt	IBM IoT Platform

4.2 Non Functional Requirements

FR No	Non-Functional Requirement	Description

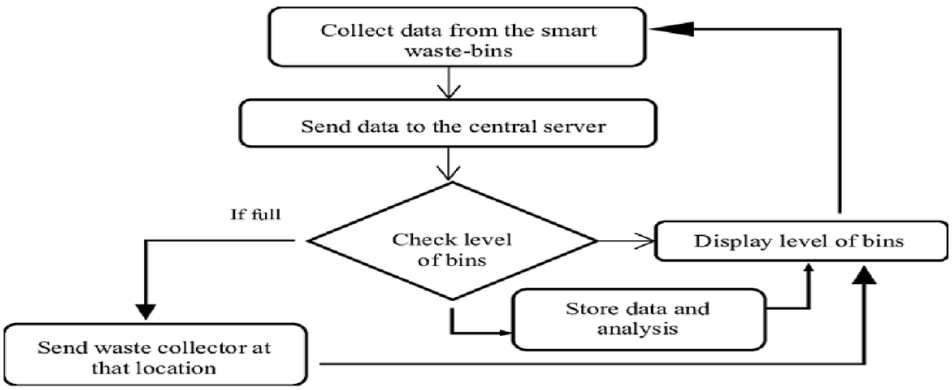
NFR-1	**Usability**	**Help to locate and monitor the waste continuously**
NFR-2	**Security**	**Information is secured**
NFR-3	**Reliability**	**More Consistency and Dependability**
NFR-4	**Performance**	**Easy to monitor & dispose the waste**
NFR-5	**Availability**	**Available anytime and anywhere**
NFR-6	**Scalability**	**To exceed future demand**

5. PROJECT DESIGN;

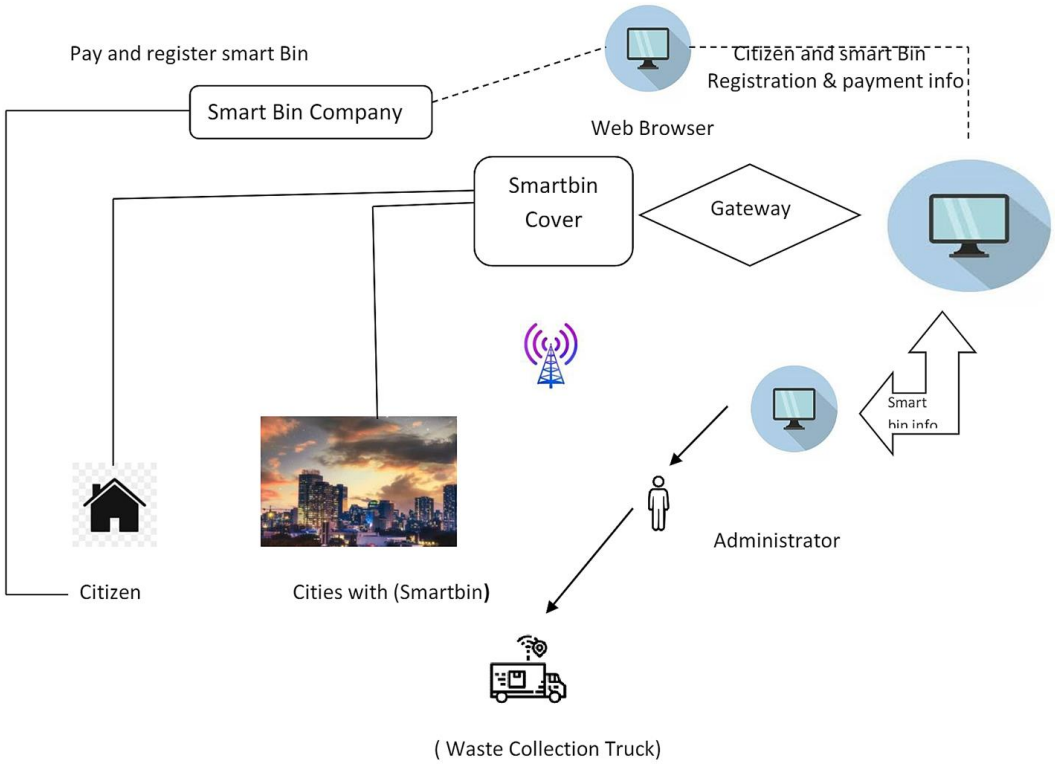
5.1 Data Flow Diagrams

Project Design Phase-II
Data Flow Diagram & User Stories

Date	16 October 2022
Team ID	PNT2022TMID50056
Project Name	Smart Waste System Management for Metropolitan Cities
Maximum Marks	4 Marks



5.2 Solution & Technical Architecture



5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer	Registration	USN - 1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint - 1
		USN - 2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint - 1
		USN - 3	As a user, I can register for the application through Gmail	I can access my account through Gmail	Medium	Sprint - 1
	Login	USN - 4	As a user, I can log into the application	I can reach the dashboard	High	Sprint - 1

			by entering email & password			
		USN - 5	**AS a user, I need to clear my queries regarding the problems**	**I have a option to ask my queries**	**Medium**	**Sprint - 2**
	Dashboard					

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

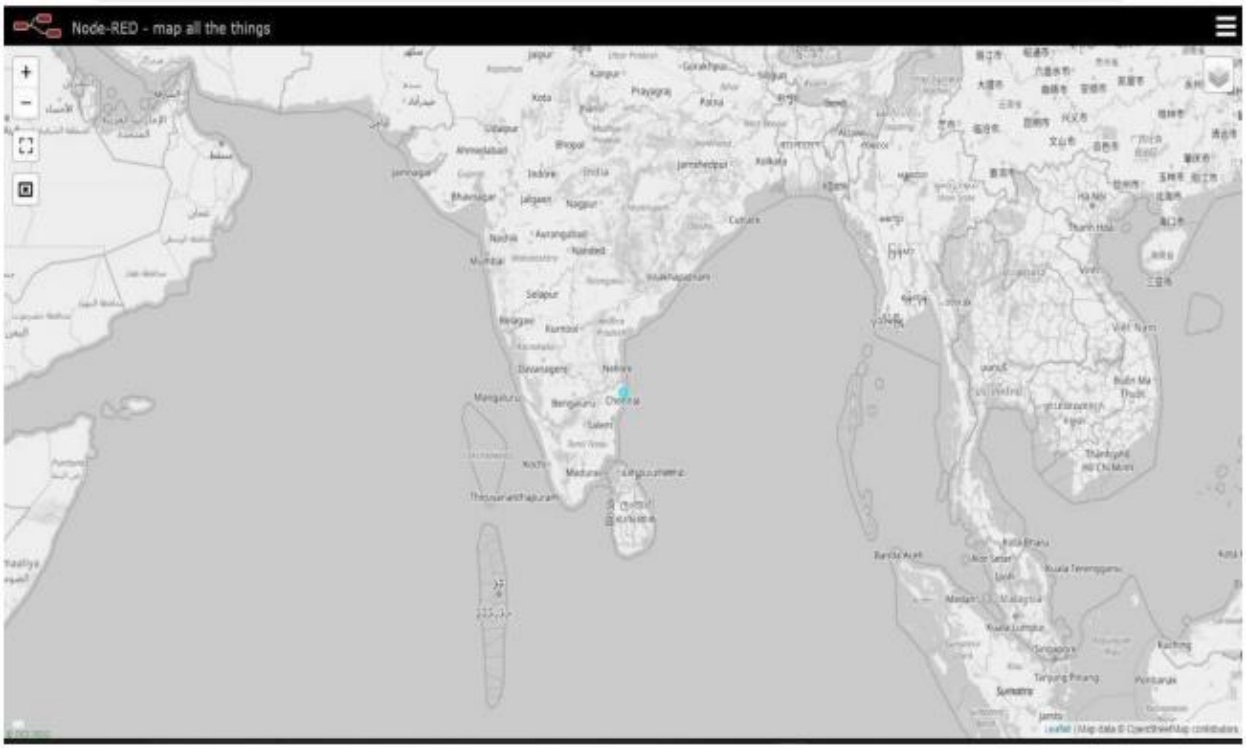
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	**Login**	**USN-1, USN-2**	**As an Administrator, I need to give user id andpassword for every workers over there in the municipality and also as a Co-Admin, I'll control the waste level by monitoring them by real time web portal. Once the filling happens,I'll notify trash truck with.**	**20**	**High**	**R.George Denifer**
Sprint-2	**Dashboard**	**USN-3**	**As a Truck Driver, I'll follow Co-Admin's Instruction to reach the filling bin in short roots and save time**	**20**	**Low**	**R,Suresh**
Sprint-3	**Dashboard**	**USN-4**	**As a Local Garbage Collector, I'II gather all the waste from the garbage, load it onto a garbage truck, and deliver it to Landfills**	**20**	**Medium**	**M.Guru Prasath**
Sprint-4	**Dashboard**	**USN-5**	**As a Municipality officer, I'll make sure everything is proceeding as planned and without any problems**	**20**	**High**	**B.Daniel**

6.2 Sprint Planning & Estimation

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

7. CODE & SOLUTION;

7.1 Feature 1-LOCATION TRACKER:



7.2 Feature 2

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
LOGIN PAGE_ TC _001	FUNCTIONAL	HOME PAGE	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SIGN	1.ENTER URL AND CLICK GO 2.VERIFY LOGIN/SI	1.ENTER URL AND CLICK GO 2.VERIFY LOGIN/SI	L0gin page is visible	Working as expecte d	PASS		Sucessful			R.Goerge Denifer

			UP WEN USER CLICK ON MY ACCOUNT BUTTON	**GN UP**	**GN UP**								
LOGIN PAGE_ TC _002	**UI**	**HOME PAGE**	**VERIFY THE USER IS ABLE TO SEE THE LOGIN/SI GN UP WEN USER CLICK ON MY ACCOUNT BUTTON**		**1.ENTER URL AND CLICK GO 2.VERIFY LOGIN/SIGN UP Elemen ts a.ID text b o x B . password text box c..log i n butto n D.new user E.alre**	**https:// 169.51.2 04.219.3 0106**	**Application should show below UI elemen t**	**Working as expecte d**	**PASS**	**Success full**			**R.Suresh**

					ady have an accou nt								
LOGIN PAGE_ TC _003	FUNCTIONA L	LOGIN PAGE	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SIGN UP WEN USER CLICK ON MY ACCOUNT BUTTON		1.enter url and click go 2.click on my accou nt 3.Ent er valid ID 4.Ent er valid passw ord 5.click on login button	Id:1111 passwo rd:5678	User should navigat e your home page.	Working as expecte d	PASS	Successful			M.Guru Prasath

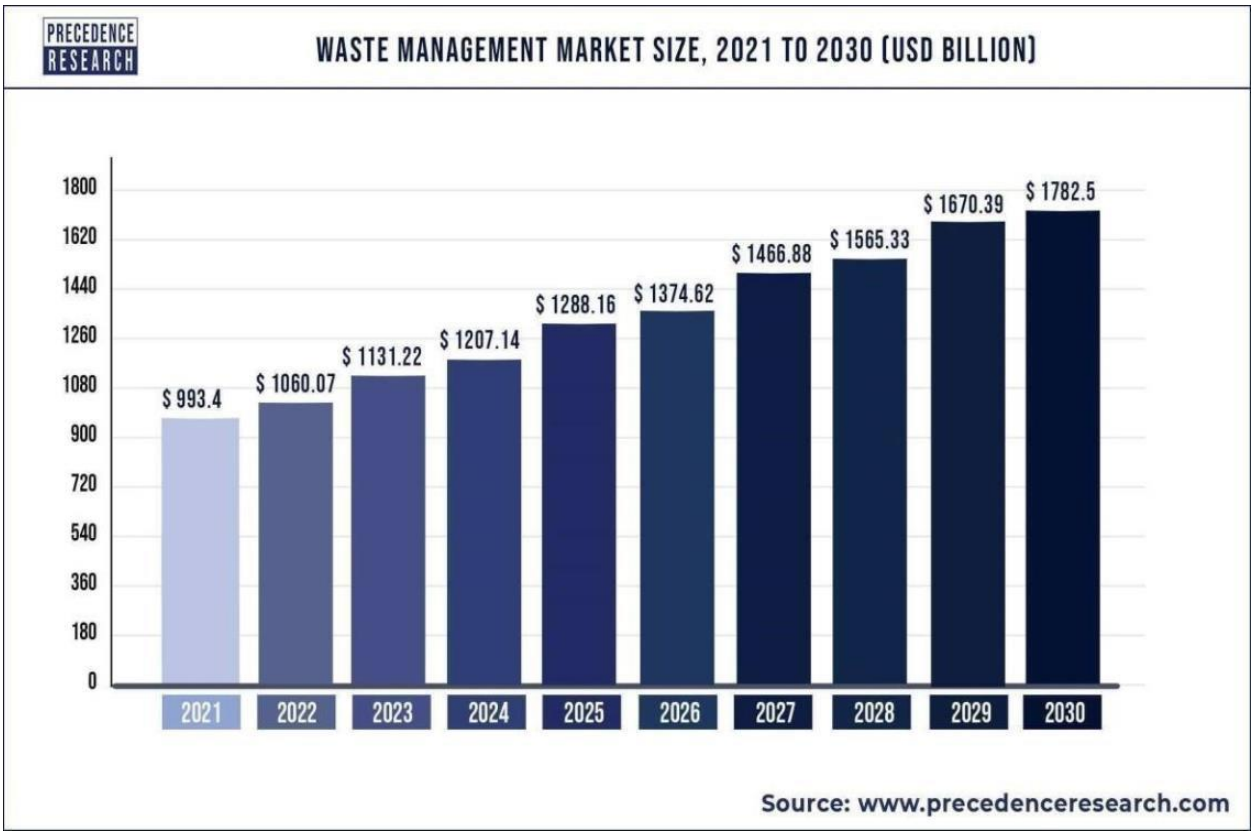
8.2 User Acceptance Testing

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

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37

9.RESULTS:

9.1 Performance Metrics:



10.ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- **Reduction in Collection Cost**
- **No Missed Pickups**
- **Reduced Overflows**
- **Waste Generation Analysis**
- **CO2 Emission Reduction**

DISADVANTAGES

- **System requires a greater number of waste bins for separate waste collection as perpopulation in the city.**
- **This results into high initial cost due to expensive smart dustbins compare to othermethods. Sensor nodes used in the dustbins have limited memory size.**

11. CONCLUSION

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

12.FUTURE SCOPE

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

1.Change the system of user authentication and atomic lock of bins, which would aid inprotecting the bin from damage or theft.

2.The concept of green points would encourage the involvement of residents or end users,making the idea successful and aiding in the

achievement of collaborative wastemanagement efforts, thus fulfilling the idea of Swachh Bharath.
3.Having case study or data analytics on the type and times waste is collected on differentdays or seasons, making bin filling predictable and removing the reliance on electroniccomponents, and fixing the coordinates.
4.Improving the Server's and Android's graphical interfaces

13. APPENDIX

Source Code

Python script

```
import requests
 importjson
 importibmiotf.application
import ibmiotf.device
 import time import random
import sys
# watson device details
organization "4yi0vc"
devicType = "BIN1"
 deviceId = "BIN1ID"
authMethod= "token"
authToken= "123456789"
#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,"auth- method":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 :)'
```

GitHub Link:
https://github.com/IBM-EPBL/IBM-Project-38511-1660381912

Project Demo Link:

https://drive.google.com/file/d/1soMnZkdclNE5noWi7lJ0lvMzQ2hSdbaj/view?usp=share_link