SMART WASTE MANAGEMENT SYSTEM

A PROJECT REPORT

Team ID PNT2022TMID12757

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1. INTRODUCTION

1.1 Project Overview

Waste management is all the activities and actions required to manage waste from its inception to its final disposal [1]. This includes collection, transportation, treatment and disposal of waste together with monitoring and regulation. Waste collection methods vary widely among different countries and regions. Domestic waste collection services are often provided by local government authorities.

Curbside collection is the most common method of disposal in most countries, in which waste is collected at regular intervals by specialised trucks. Waste collected is then transported to an appropriate disposal area.

Nowdays, cities with developing economies experience exhausted waste collection services, inadequately managed and uncontrolled dumpsites and the problems are worsening [2]. Waste collection method in such countries is an on-going challenge and many struggle due to weak institutions and rapid urbanization.

1.2 Purpose:

- By 2030, almost two-third of the world's population will be living in cities. This fact requires the development of sustainable solutions for urban life, managing waste is a key issue for the health.
- Efficient and energy-saving waste management, reducing CO_2,air pollution and vehicle exhaust emissions—these are just a few examples for the demands of future cities. In views of that, the efficient use and responsible handling of resources become more important.
- Effectively managing waste is important in developed countries. Waste management may swallow upto 50% of a city's budget, but only serve a small part of the population.
- Sometimes, upto 60%of waste is not being collected, it is often simply burned by the roadside. It can pollute drinking water, it can spread disease to people living nearby.
- Even with great route optimization, the worker must still physically go to the dustbin to check waste levels. Because of this, trucks often visit containers that do not need emptying, which wastes both time and fuel.
- Waste management prevents harm to human health and the environment by reducing the volume and hazardous character of residential and industrial waste.
- Improving proper waste management will reduce pollution, recycle useful materials and create more green energy.

2. LITERATURE SURVEY

2.1 Existing Problem

Seven reports were reviewed in detail for the literature review, with the majority of these providing some evidence to support the theory that the introduction of waste collections is associated with a reduction in waste arisings. The following text should be reviewed with consideration given to the fact that these studies were not specifically designed to assess the impact of waste collections on at source food waste reduction. Therefore, evidence is taken from these reports to be used in different context from that in which it was collected. For example, a common theme across all of the reports was the fact that where a reduction in food waste arisings had been observed, there was limited data to confirm how much food waste had simultaneously been diverted from the residual waste stream to home composting and how much was a result of at source waste prevention behaviour. A number of the reports considered the diversion of waste to home composting, as a contributor to waste reduction, as this reduced the food waste arisings collected at the kerbside. Overall the reports demonstrate that while there is some evidence to support the theory that implementing a waste collection can lead to an overall reduction in collected waste, there is currently no significant evidence to demonstrate to what extent this is due to prevention at source as opposed to diversion to home composting. A number of the reports support the need for further research in this area.

2.2 References

PAPER 1:

TITLE: IoT Based Waste Management for Smart City

AUTHOR NAME: Parkash Tambare, Prabu Venkatachalam

PUBLICATION YEAR: 2016

In the current situation, we frequently observe that the trash cans or dust cans that are located in public spaces in cities are overflowing due to an increase in the amount of waste produced each day. We are planning to construct “IoT Based Waste Management for Smart Cities” to prevent this from happening because it makes living conditions for people unsanitary and causes unpleasant odours in the surrounding area. There are numerous trash cans scattered throughout the city or on the campus that are part of the proposed system.Each trash can is equipped with a low-cost embedded device that tracks the level of the trash cans and an individual ID that will enable it to be tracked and identified.

PAPER 2:

AUTHOR NAME: Mohammad Aazam, Marc St-Hilaire,Chung-Horng Lung, Ioannis Lambadaris

PUBLICATION YEAR: 2016

Each bin in the Cloud SWAM system that Mohammad Aazam et al suggested has sensors that can detect the amount of waste inside. There are separate bins for organic, plastic/paper/bottle/glass, and metal waste. This way, each form of waste is already divided, and it is known how much and what kind of waste is collected thanks to the status. Different entities and stakeholders may benefit from the accessibility of cloud-stored data in different ways. Analysis and planning can begin as soon as garbage is collected and continue through recycling and import/export-related activities. Timely garbage collection is provided via the Cloud SWAM system. A timely and effective method of waste collection improves health, hygiene, and disposal.

PAPER 3:

AUTHOR NAME: K. Suresh, S. Bhuvanesh and B. Krishna Devan

PUBLICATION YEAR: 2019

In this paper, a technique for cleaning up our surroundings and environment is described. The Indian government just began work on a smart city initiative, and in order for these towns to be smarter than they already are, the garbage collection and disposal system must be improved upon. Self-Monitoring Automated Route Trash (SMART) dustbins are intended for use in smart buildings such as colleges, hospitals, and bus stops, among other places. In this study, we have employed the PIR and Ultrasonic sensors to detect human presence, the Servomotor to open the dustbin lid, and the Ultrasonic sensor to detect the level of rubbish. Signals between two trash cans are transmitted using a communication module, and the GSM module sends the message to the operator.

PAPER 4:

AUTHOR NAME: Mohd Helmy Abd Wahab, Aeslina Abdul Kadir,Mohd Razali Tomari and Mohamad Hairol Jabbar

PUBLICATION YEAR: 2014

Proposed a smart recycle bin that can handle the recycling of plastic, glass, paper, and aluminium cans. It generates a 3R card after automatically determining the value of the trash thrown away. The recycle system makes it possible to accumulate points for placing waste into designated recycle bins. By allowing the points to be redeemed for goods or services, such a system promotes recycling activities. The system keeps track of information on disposal procedures, materials disposed of, user identification, and points accrued by the user. To use the recycle bin, the user must tap his card to the designated RFID reader. Doors to recycling bins are opened, and rubbish is placed one by one.

PAPER 5:

AUTHOR NAME: Dr. Raveesh Agarwal, Mona Chaudhary and Jayveer Singh

PUBLICATION YEAR: 2015

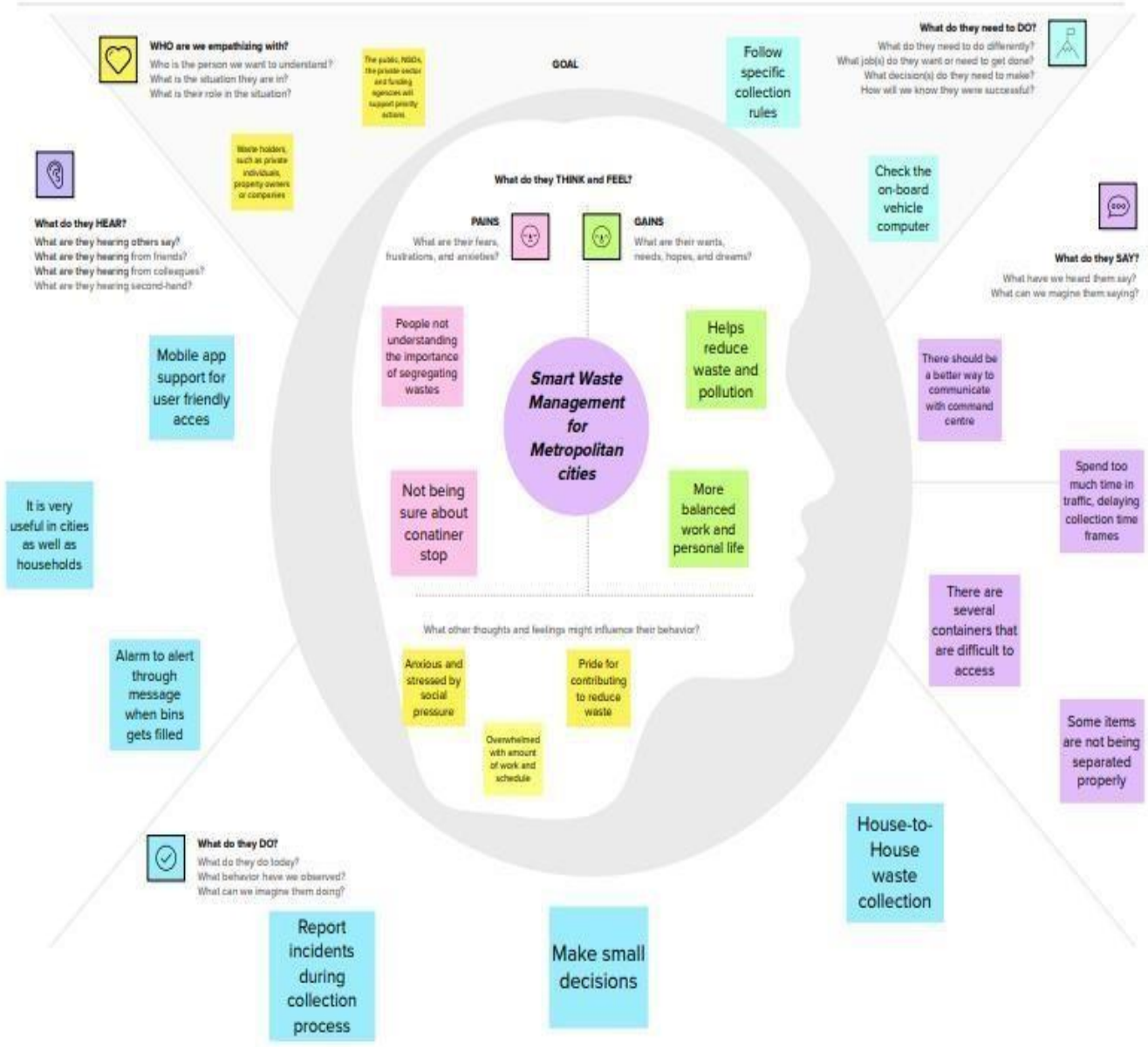
The objective of this paper is to examine the present methods used in India for the welfare of its people in different waste management efforts. The other goal is to offer advice on how to make Indian municipalities' trash disposal procedures better. On secondary research, this essay is founded. The system is improved by looking at the reports that have already been written about waste management and the suggestions made for improvement by planners, NGOs, consultants, government accountability organisations, and important business leaders. It provides in-depth understanding of the various waste management programmes in India and identifies areas where waste management might be improved for societal benefit. The essay makes an effort to comprehend the crucial part that our nation's official waste management sector plays in the waste management process.

2.3 Problem Statement Definition:

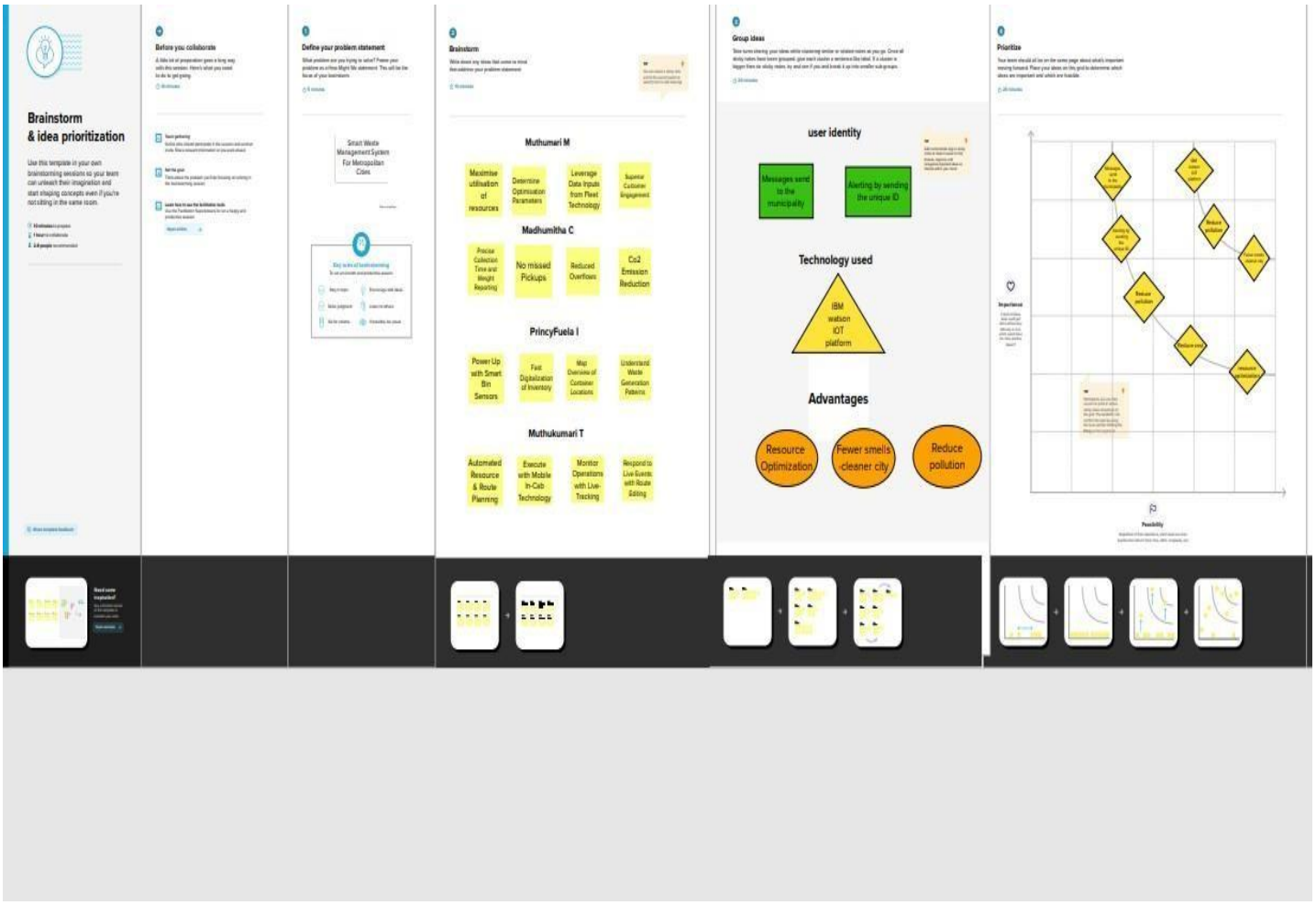
Problem Statement (PS)	I am (Customer)	I am trying to	But	Because	Which makes me feel
PS-1	Council	Monitor the waste in my city	I have not much effective system for monitoring	Because of high cost	unhygienic
PS-2	Council	Manage the waste in my city	I have not much effective system for managing	Because of more time consuming	unsafe

3. IDEATION & PROPOSED SOLUTION:

3.1 Empathy map canvas:


WHO are we empathizing with?
Who is the person we want to understand?
What is the situation they are in?
What is their role in the situation?
The public, NGOs, the private sector and funding agencies will support priority actions
GOAL
Follow specific collection rules
What do they need to DO?
What do they need to do differently?
What job(s) do they want or need to get done?
What decision(s) do they need to make?
How will we know they were successful?
Waste holders, such as private individuals, property owners or companies
Check the on-board vehicle computer
What do they HEAR?
What are they hearing others say?
What are they hearing from friends?
What are they hearing from colleagues?
What are they hearing second-hand?
What do they THINK and FEEL?
PAINS
What are their fears, frustrations, and anxieties?
GAINS
What are their wants, needs, hopes, and dreams?
What do they SAY?
What have we heard them say?
What can we imagine them saying?
People not understanding the importance of segregating wastes
Helps reduce waste and pollution
Mobile app support for user friendly acces
Smart Waste Management for Metropolitan cities
There should be a better way to communicate with command centre
Not being sure about conatiner stop
More balanced work and personal life
Spend too much time in traffic, delaying collection time frames
It is very useful in cities as well as households
What other thoughts and feelings might influence their behavior?
There are several containers that are difficult to access
Alarm to alert through message when bins gets filled
Anxious and stressed by social pressure
Pride for contributing to reduce waste
Overwhelmed with amount of work and schedule
Some items are not being separated properly
House-to-House waste collection
What do they DO?
What do they do today?
What behavior have we observed?
What can we imagine them doing?
Report incidents during collection process
Make small decisions

3.2 Ideation & Brainstorming:



3.3 Proposed Solution:

Sl No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Detecting the level of garbage and informing the garbage collectors through a proper communication channel about the garbage level and alerts them to collect it at a specified time efficiently.
2.	Idea / Solution description	By using fill level sensors we can detect the garbage level. Improving the communication channel using proper technology like WiMAX. Using GPS for tracking the location of bin and sorting out the short routes. Using cloud service for the storage purpose.
3.	Novelty / Uniqueness	By using IoT, GPS and GSM like technologies which if properly used in the establishment of this project helps to detect the garbage level and intimating about it to the authority and initiating them to collect the garbage on time.
4.	Social Impact / Customer Satisfaction	It keeps our surroundings clean and green and free from bad odour of wastes, emphasizes on healthy environment. Reduces air pollution
5.	Business Model (Revenue Model)	Smart waste management system is an innovative and effective step to analyze the production of waste annually and it helps to find the ways to reduce the factors which increases the waste produced.

6.	Scalability of the Solution	Smart waste management can attain its scalability by still more advancement in IoT and using many sensors to detect its accurate level accurately. Its implementation can be enhanced by using 5G type of technology for faster communication. AI recycling robots can be used in the nearer future.

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.	The Dashboard shows statistics on the amount of fill in bins as it is being tracked by smart sensors. The application also forecasts when the bin will fill up based on past data in addition to the percentage of fill level, which is one of the features that even the finest waste management software lacks. As picks are also recognized by the sensors, you can determine when the bin was last emptied. You can get rid of the overflowing bins and cease collecting half-empty ones using real-time data and forecasts.
FR-2	Eliminate inefficient picks.	Get rid of the collection of half-empty trash cans. Picks are recognized by sensors. We can demonstrate to you how full the bins you collect are using real-time data on fill-levels and pick recognition.
FR-3	Plan waste collection routes.	Route planning for rubbish pickup is semiautomated using the tool. You are prepared to act and arrange for garbage collection based on the levels of bin fill that are now present and forecasts of approaching capacity. To find any discrepancies, compare the planned and actual paths.

FR-4	Adjust bin distribution.	Ensure the best possible bin distribution. Determine which regions have a dense or sparse distribution of bins. Ensure that each form of waste has a representative stand. You can make any required adjustments to bin position or capacity based on past data.
FR-5	Expensive bins.	We assist you in locating containers that increase collection prices. The tool determines a collection cost rating for each bin. The tool takes local average depo-bin discharge into account. The tool determines the distance from depo-bin discharge and rates bins (1–10).
FR-6	Detailed bin inventory.	On the map, you can see every monitored bin and stand, and you can use Google Street View at any time to visit them. On the map, bins or stands appear as green, orange, or red circles. The Dashboard displays information about each bin, including its capacity, trash kind, most recent measurement, GPS position, and pick-up schedule.

1. **Non-Functional requirements:**

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability is a unique and significant perspective to examine user needs, which may further enhance the design quality according to IoT devices. Analysing how well people interact with a product may help designers better understand customers' prospective demands for waste management, behaviour, and experience in the design process when user experience is at the Centre.
NFR-2	**Security**	Utilize recyclable bottles. Utilize reusable shopping bags. Spend responsibly and recycle Eat and drink in limited-use containers.
NFR-3	**Reliability**	Creating improved working conditions for garbage collectors and drivers is another aspect of smart waste management. Waste collectors will use their time more effectively by attending to bins that require service rather than travelling the same collection routes and servicing empty bins.
NFR-4	**Performance**	The Smart Sensors assess the fill levels in bins (along with other data) numerous times each day using ultrasonic technology. The sensors feed data to Senone's Smart Waste Management Software System, a robust cloud-based platform with data- driven daily operations and a waste management app, using a variety of IoT networks (NB-IoT, GPRS). As a consequence, customers receive data-driven decision-making services, and garbage collection routes, frequency, and truck loads are optimized, resulting in at least a 30% decrease in route length.

NF R-5	**Availability**	By creating and implementing robust hardware and gorgeous software, we enable cities, companies, and nations to manage garbage more intelligently.
NF R-6	**Scalability**	Using smart trash bins allows us to scale up and monitor the rubbish more efficiently while also reducing the number of bins needed in towns and cities.

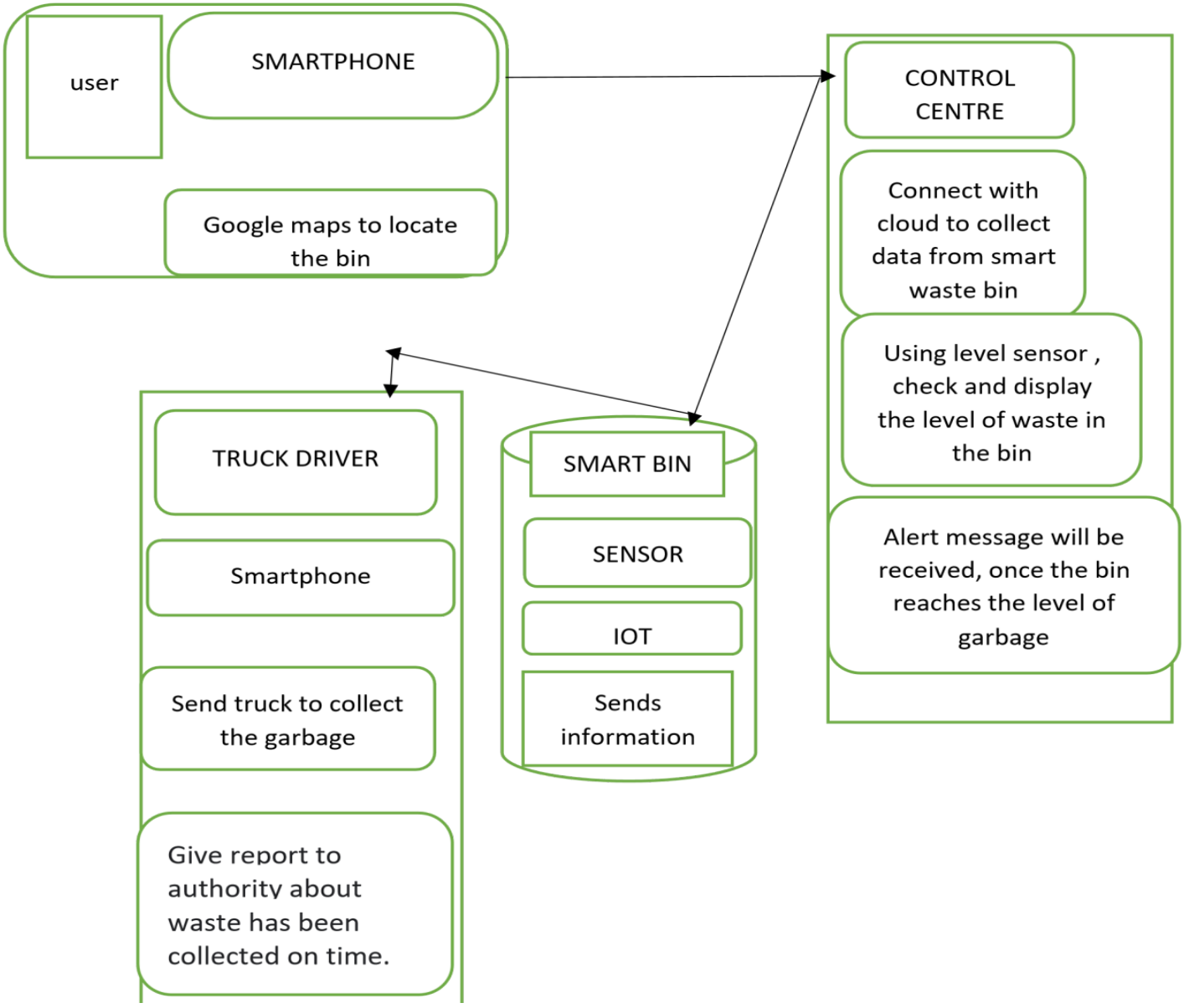
5 .PROJECT DESIGN:

5.1 Data Flow Diagrams

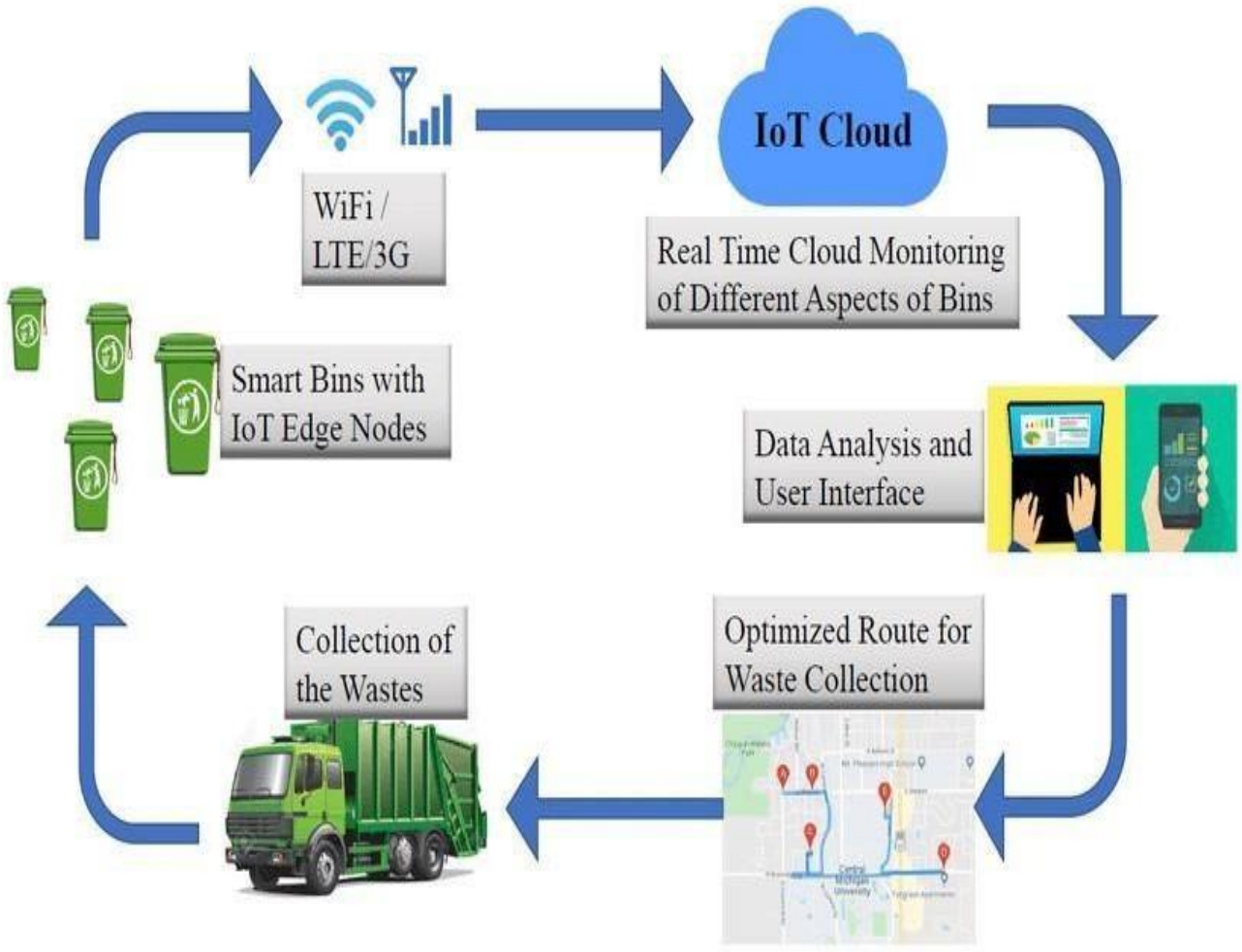
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored A smart waste management platform uses analytics to translate the data gather in your **bins into actionable insights to help you improve your waste services.** You can receive data on metric such as:

- The first test conducted is the situation where the garbage bin is empty or its garbage level is very low
- Then, the bin is filled with more garbage until its level has surpassed the first threshold **value, which is set to 80% then the first warning SMS is being sent, as depicted**
- The first notification SMS sent by the system, once the waste reaches the level of 85% full
- The second notification SMS sent by the system, indicating that bin is at least 95% full and **the garbage needs to be collected immediately**
- Locations prone to overflow
- The number of bins needed to avoid overflowing waste
- The number of collection services that could be saved
- The amount of fuel that could be saved
- The driving distance that could be saved

Data flow diagram:



5.2 Solution & Technical Architecture:



5.3 User stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Admin(who manages server)	Web server login	USN-1	As a admin, I can able to track the truck driver name,id, contact number, location, and also the location of the dustbin.	I can Manage and direct workers through web server	High	Sprint-1
Co-Admin	Login	USN-2	As a co-admin I'll monitor the workers, whether the work has been done properly, checking the availability of workers and also monitor the waste collected by the truck driver within the scheduled time	I can monitor the garbage bin activity	High	Sprint-1

Customer (Web user)	User	USN-3	As a user , I can able to raise queries to higher authorities about the maintenance and disposal of waste	I can raise queries	Medium	Sprint-2
Customer Care Executive	Worker	USN-4	As a customer care executive I will try to rectify the queries from customers by contacting coadmin. In case of emergency situation query can be reported to Admin.	I can attend calls and respond people and solve their problems	High	Sprint-1

Truck driver	Worker	USN-5	The truck driver is a worker who has been assigned to collect the garbage and he have to report to admin about when and where and also the timings the garbage has been picked up according the daily schedule.	I will do the work properly and report the data at the scheduled time	High	Sprint1

6. PROJECT PLANNING & SCHEDULING:

6.1 Sprint Planning & Estimation:

PHASE	TITLE	DESCRIPTION
Ideation Phase	Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc.
	Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements
	Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.

Phase-1	Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.
	Problem Solution Fit	Prepare problem - solution fit document.
	Solution Architecture	Prepare solution architecture document.
Phase-2	Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit).
	Functional Requirement	Prepare the functional and Nonfunctional requirement document.

	Data Flow Diagrams	Draw the data flow diagrams and submit for review.
	Technology Architecture	Prepare the technology architecture diagram.
Project planning phase	Prepare Milestone & Activity List	Prepare the milestones & activity list of the project.
Project development phase	Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developed code by testing it.

6.2 Sprint Delivery Schedule:

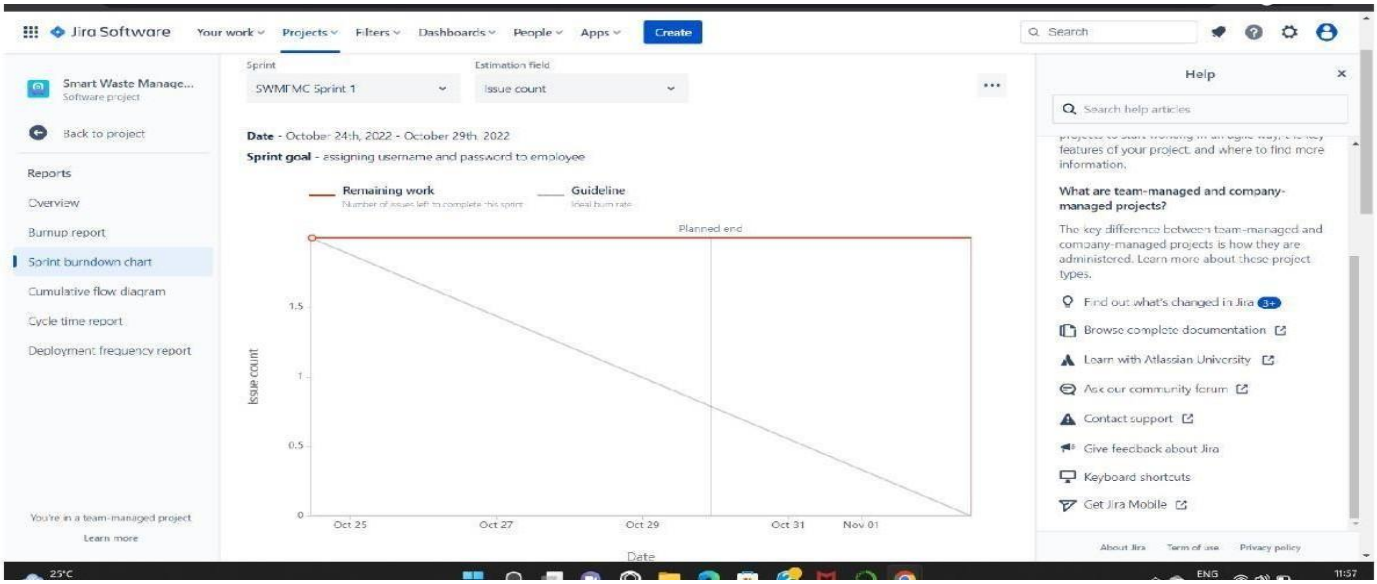
Sprint	Functional Requirement (Epic)	Task	Story Points	Priority	Team Members
Sprint- 1	Registration	As a team lead, I can enrolled for the project by entering my email, password and within that I can enter my team members name and their email.	2	High	Muthumari
print- 1		As a team lead, I will receive confirmation email once, I have enrolled for the project with team id and along with team members name.	2	High	Muthumari
print- 2	Login	As a team member, I can login to the IBM portal by entering email & password	1	Medium	Madhumitha
Sprint- 2		As a team member, I can login to the IBM portal by entering email & password	1	Medium	Princy fuela
Sprint- 2		As a team member, I can login to the IBM portal by entering email & password	1	Medium	Muthukumari
Sprint- 2		As a team member, I can login to the IBM portal by entering email & password	1	Medium	Madhumitha

Project Tracker, Velocity & Burndown Chart:

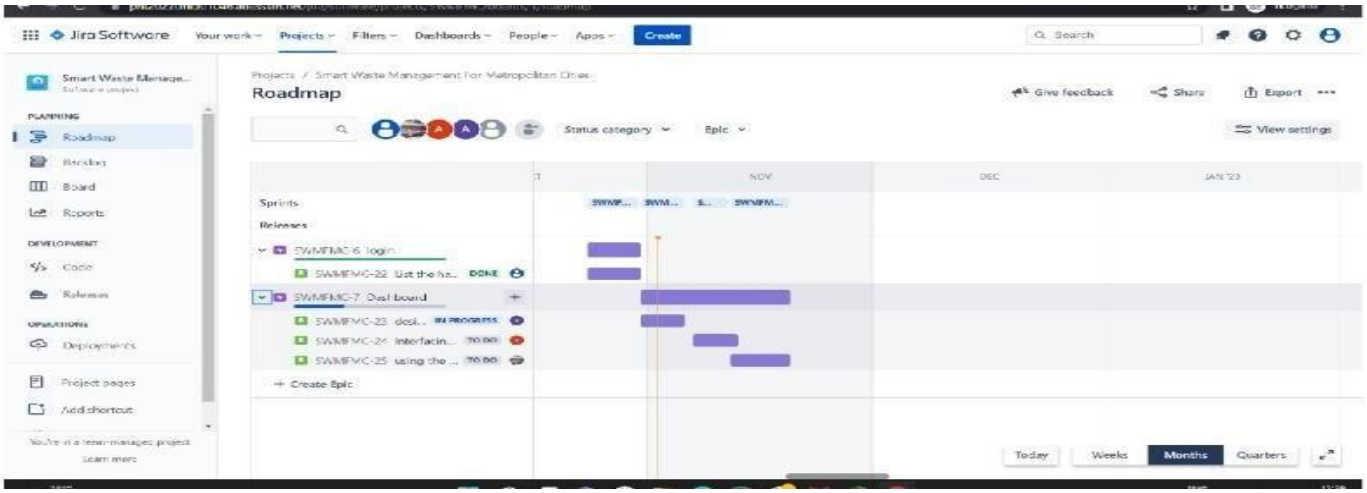
Sprint	Total Story Points	Duration	Sprint Start Date	SprintEnd Date(Planned)	Story Points Completed (Planned End Date)	print Release Date (Actual)
Sprint-1	20	6 Days	05 Nov 2022	12 Nov 2022	20	18 Nov 2022
Sprint-2	20	6 Days	07 Nov 2022	14 Nov 2022	30	18 Nov 2022
Sprint-3	20	6 Days	10 Nov 2022	17 Nov 2022	49	18 Nov 2022
Sprint-4	20	6 Days	05 Nov 2022	12 Nov 2022	50	18 Nov 2022

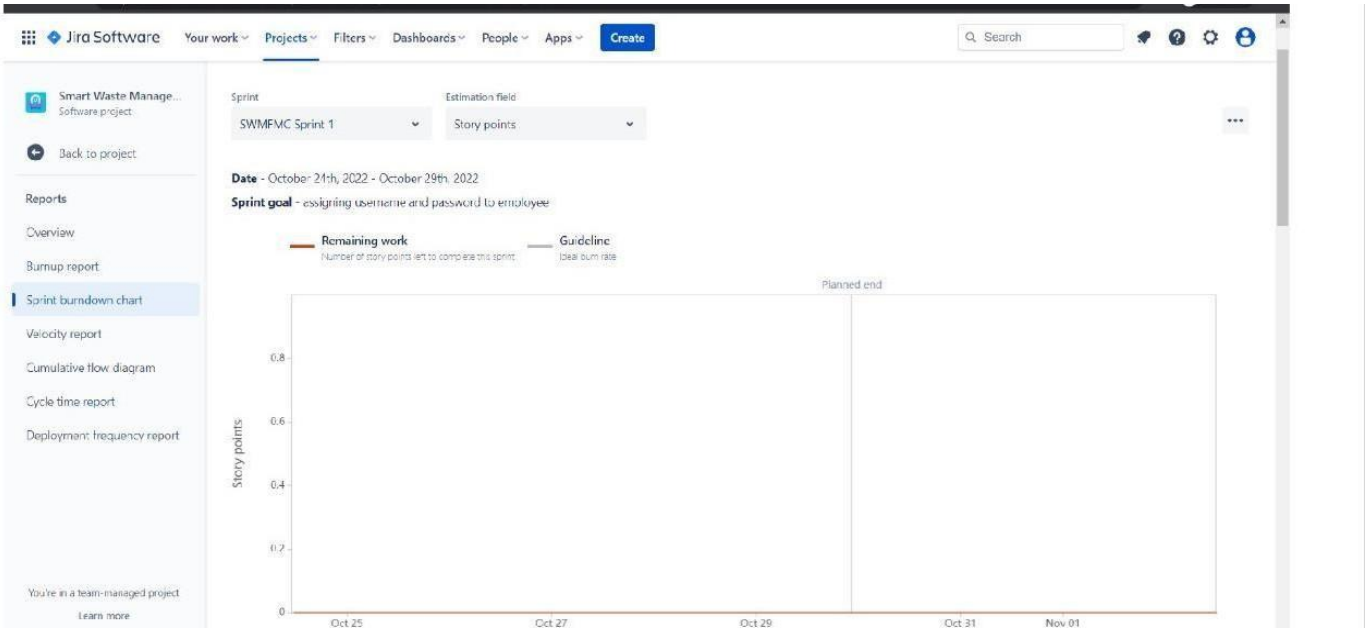
6.3 Reports from JIRA:

Burnout Chart:



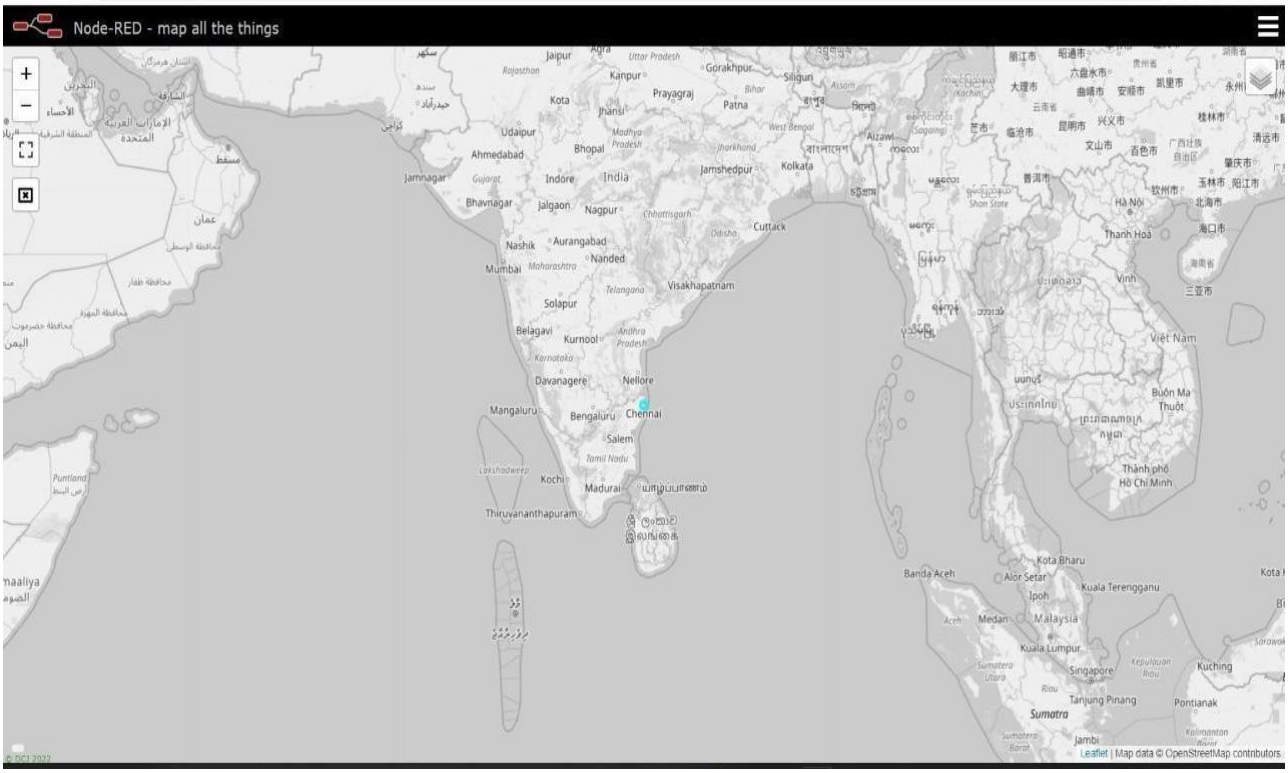
Road map:


Jira Software
Your work
Projects
Filters
Dashboards
People
Apps
Create
Search
Smart Waste Manage...
Software project
PLANNING
Roadmap
Backlog
Board
Reports
DEVELOPMENT
Code
Releases
OPERATIONS
Deployments
Project pages
Add shortcut
You're in a team-managed project
Learn more
Projects / Smart Waste Management For Metropolitan Cities
Roadmap
Give feedback
Share
Export
Status category
Epic
View settings
NOW
DEC
JAN '23
Sprints
Releases
SWMFMC-6 login
SWMFMC-22 List the ha...
DONE
SWMFMC-7 Dashboard
SWMFMC-23 desi...
IN PROGRESS
SWMFMC-24 Interfacin...
TO DO
SWMFMC-25 using the ...
TO DO
Create Epic
Today
Weeks
Months
Quarters


Jira Software
Your work
Projects
Filters
Dashboards
People
Apps
Create
Search
Smart Waste Manage...
Software project
Back to project
Reports
Overview
Burnup report
Sprint burndown chart
Velocity report
Cumulative flow diagram
Cycle time report
Deployment frequency report
You're in a team-managed project
Learn more
Sprint
SWMFMC Sprint 1
Estimation field
Story points
Date - October 24th, 2022 - October 29th, 2022
Sprint goal - assigning username and password to employee
Remaining work
Number of story points left to complete this sprint
Guideline
Ideal burn rate
Planned end
Story points
0.8
0.6
0.4
0.2
0
Oct 25
Oct 27
Oct 29
Oct 31
Nov 01

7. CODING & SOLUTIONING:

7.1 Feature 1- LOCATION TRACKER:

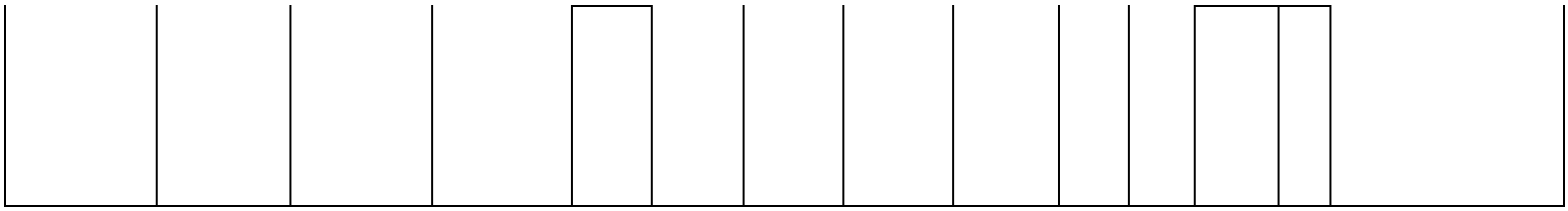


7.2 Feature 2- LIVE UPDATE ON COLLECTED DATA:

TESTING :

8.1 Testcases:

ID	FEATURE TYPE	COMPONENT	TEST SCENARIO	PREREQUISITE	STEPS TO EXECUTE	TEST DATA	EXPECTED RESULT	ACTUAL RESULT	STATUS	COMMENTS	TC FOR AUTOMATION(Y/N)	BUG ID	EXECUTED BY
LOGIN page_tc001	FUNCTIONAL	HOME PAGE	Verify the user is able to see the LOGIN/SIGN UP WHEN USER Click on my account		1.ENTER URL And Click Go 2.Verify Login/SiGN UP	https://169.51.204.219.30106	Login Page visi	Working gas expected	PASS	**SUCCESSUL**			Bhuvan



LOGIN PAGE_ TC _002	UI	H OM E PA GE	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SI G N UP WEN USER CLICK ON MY ACCOU NT BUTTON		1.E NT ER URL AND CLICK GO 2.VER IFY LOGI N/SI GN UP Ele me nts a.ID te xt b o x B . pas sw ord text box c..lo gi n butto n D.ne w user E.alre ady have an accou nt	https: // 1 69.51.2 0 4.219.3 0 106	Applic at ion should show below UI elem en t	Workin g as expec te d	PA SS	Su cc ess full			**PRINCY FUELA l**

LOGIN PAGE_ TC _003	FUNC TI ONA L	LOGI N PA GE	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SI G N UP WEN USER CLICK ON MY ACCOU NT BUTTON		1.enter url and click go 2.click on my account 3.Enter valid ID 4.Enter valid password 5.click on login	Id:1111 password:5678	User should navigat e your home page.	Working as expecte d	PA SS	Su cc ess ful			**PRINCY FUELA I**
					but to n								
LOGIN	FUNC TI ONA	LO GI	VERIFY		1.e nt er	Id:11	Confi	Work	PA	Su cc			BHUVAN

		N			url	11	rm	in	SS	ess			

PAGE_TC_ 004	L	PAGE	THE USER IS ABLE TO SEE THE LOGIN/SIG N UP WEN USER CLICK ON MY ACCOUNT BUTTON		and click go 2.click on my account 3.Enter valid ID 4.Enter valid password 5.click on login butvton	password: 5678	ation message sent	g as expecte d		ful			
LOGIN PAGE_TC_ 005	UI	LOG IN PAGE	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SIG N UP WEN USER CLICK ON MY ACCOUNT BUTTON		1.enter url and click go 2.click on my account 3.Enter valid ID 4.Enter valid password 5.click on login button	Id :1111 password: 5678	Confirm ation message sent	Work in g as expecte d	PASS	Success ful			**MUTHUMARI** M

LOGIN PAGE_TC_ 006	FUNCTIONA L	LOGIN PAGE FOR ADMIN	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SIG N UP WEN USER CLICK ON MY		1.enter url and click go 2.click on my account 3.Enter valid ID 4.Enter valid passwo	Id :1111 password: 5678	Customer database is visible	Work in g as expecte d	PASS	Success ful			BHUVAN

			ACCOUNT BUTTON		rd 5.click on login button								

8.2 User acceptance Testing:

1.Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

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

Resolution	everity 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	2	37

				0	

Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	7

1. Test Case Analysis:

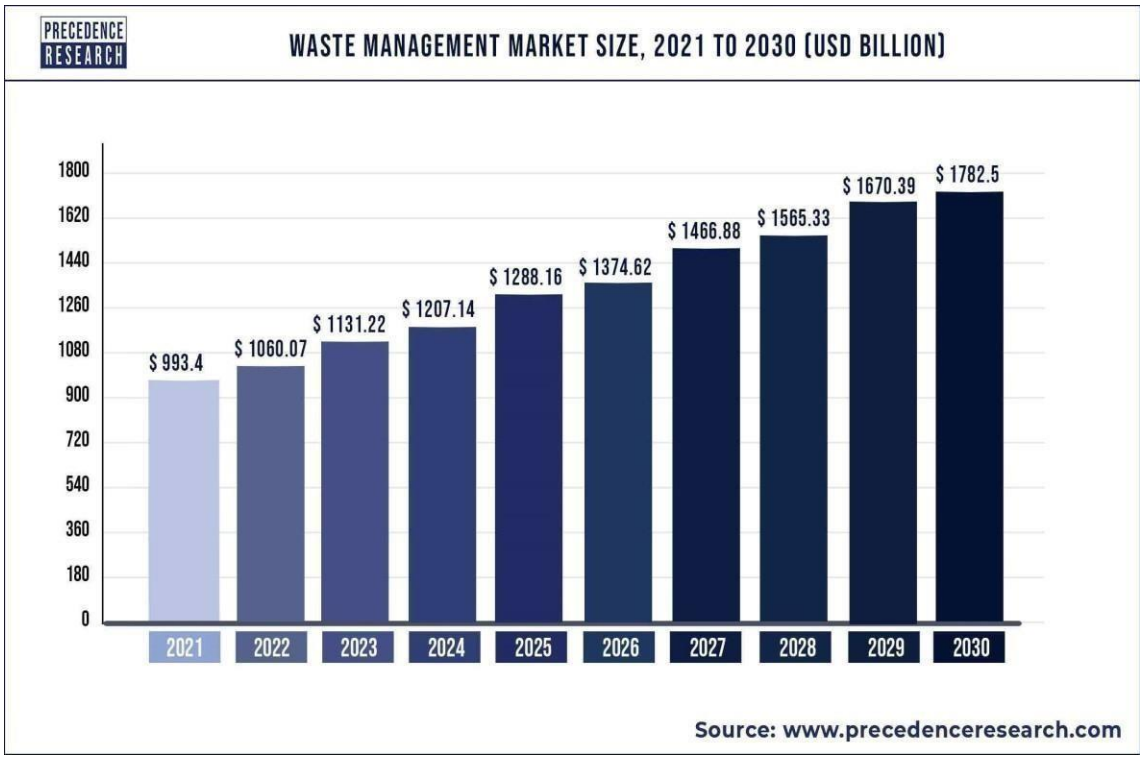
This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	51	0	0	51
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4

Version Control	2	0	0	2

9. RESULTS:

9.1 Performance Metrics:



9. 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 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:

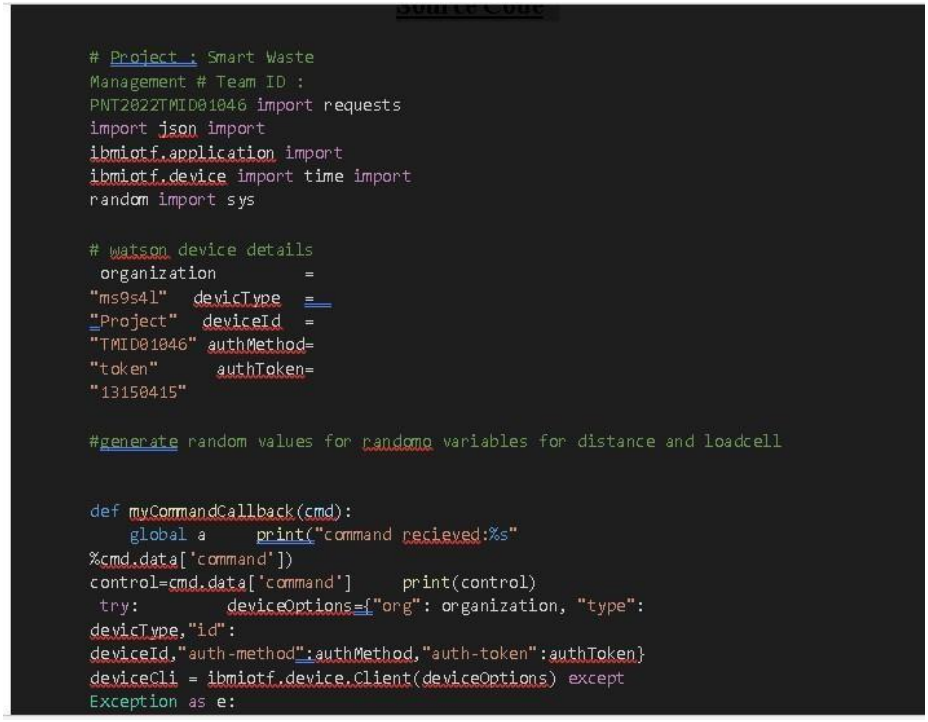
A Smart Waste Management system that is more effective than the one in use now is achievable by using sensors to monitor the filling of bins. Our conception of a "smart waste management system" focuses on monitoring waste management, offering intelligent technology for waste systems, eliminating human 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.

11. 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 in protecting 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 waste management efforts, thus fulfilling the idea of Swachh Bharath.
3. Having case study or data analytics on the type and times waste is collected on different days or seasons, making bin filling predictable and removing the reliance on electronic components, and fixing the coordinates.
4. Improving the Server's and Android's graphical interfaces

11. Apendix



```
# Project : Smart Waste
Management # Team ID :
PNT2022TMID01046 import requests
import json import
ibmiotf.application import
ibmiotf.device import time import
random import sys

# watson device details
 organization         =
"ms9s4l"   devicType   =
"Project"   deviceId   =
"TMID01046" authMethod=
"token"      authToken=
"13150415"

#generate random values for randomo variables for distance and loadcell


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,"auth-token":authToken}
deviceCli = ibmiotf.device.Client(deviceOptions) except
Exception as e:
```

```
deviceCli = ibmiotf.device.Client(deviceOptions) except
Exception as e:
        print("caught exception connecting device %s" %str(e))
sys.exit()

#connect and send a datapoint "distance and loadcell" 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)
```

```
          warn  = 'alert :' 'Risk Warning: 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 '
if distance <20:
        warn={'alert':'NEED BIN CHANGE!!!!!!'}
         def
myOnPublishCallback(lat=10.939091,long=78.135731):
        print("Chennai")        print("published distance = %s
" %distance,"loadcell:%s "
%loadcell,"lon = %s " %long,"lat = %s"
%lat)       print(load)
print(dist)         print(warn)
```

12 GITHUB:

https://github.com/IBM-EPBL/IBM-Project-27802-1660066303