PROJECT REPORT

Team ID	**PNT2022TMID07841**
Project Name	**Smart Waste Management System For Metropolitan Cities**
Team Lead	**RANI J**
Team Member 1	**TAMIL SELVAN R**
Team Member 2	**SRIDHAR T**
Team Member 3	**CHANDRU P**
Team Member 4	**SUGANESHWARAN E**

1. INTRODUCTION

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 generationand management. Combining technology support with a vision of social, economic andenvironmental 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 howthe 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 beingfull 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 garbagelevel and instigate them whenever the bins reach the threshold level. They are sent with alertmessages 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 providesus with the most optimal way of managing the waste in an efficient manner using technology

2. LITERATURE SURVEY:

2.1 Existing problem:

Waste management has become an alarming challenge in local towns and cities across the world. Often the local area bins are overflowing and the municipalities are not aware of it. This affects the residents of that particular area in numerous ways starting from bad odour to unhygienic and unsafe surroundings. Poor waste management - ranging from non-existing collection systems to ineffective disposal -causes air pollution, water and soil contamination. Open and unsanitary areas contribute to contamination of drinking water and can cause infection and transmit diseases. Toxic components such as Persistent Organic Pollutants (POPs) pose particularly significant risks to human health and the environment as theyaccumulate through the food chain. Animals eating contaminated plants have higher doses ofcontaminants than if they were directly exposed. Precipitation or surface water seeping through waste will absorb hazardous components from landfills, agricultural areas, feedlots, etc. and carry them into surface and groundwater. Contaminated groundwater also poses a great health risk, as it is often used for drinking, bathing and recreation, as well as in agricultural and industrial activities. Landfills and waste transfer stations can attract various pests (insects, rodents, gulls, etc.) that look for food from waste. These pests can spread diseases through viruses and bacteria (i.e., salmonella and e-coli), which are a risk to human health.

2.2 References:

PAPER 1:

TITLE: IoT Based Waste Management for Smart City

AUTHOR NAME: Parkash Tambare, Prabu

Venkatachalam**PUBLICATION YEAR:** 2016

DESCRIPTION:

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 trashcans 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 **DESCRIPTION:**

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:

TITLE: Arduino Microcontroller Based Smart Dustbins for Smart Cities**AUTHOR NAME:** K. Suresh, S. Bhuvanesh and B. Krishna Devan **PUBLICATION YEAR:** 2019 **DESCRIPTION:**

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 areintended 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 levelof 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

DESCRIPTION:

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 usethe 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:

TITLE: Waste Management Initiatives in India For Human Wellbeing

AUTHOR NAME: Dr. Raveesh Agarwal, Mona Chaudhary and Jayveer Singh**PUBLICATION YEAR:** 2015 **DESCRIPTION:**

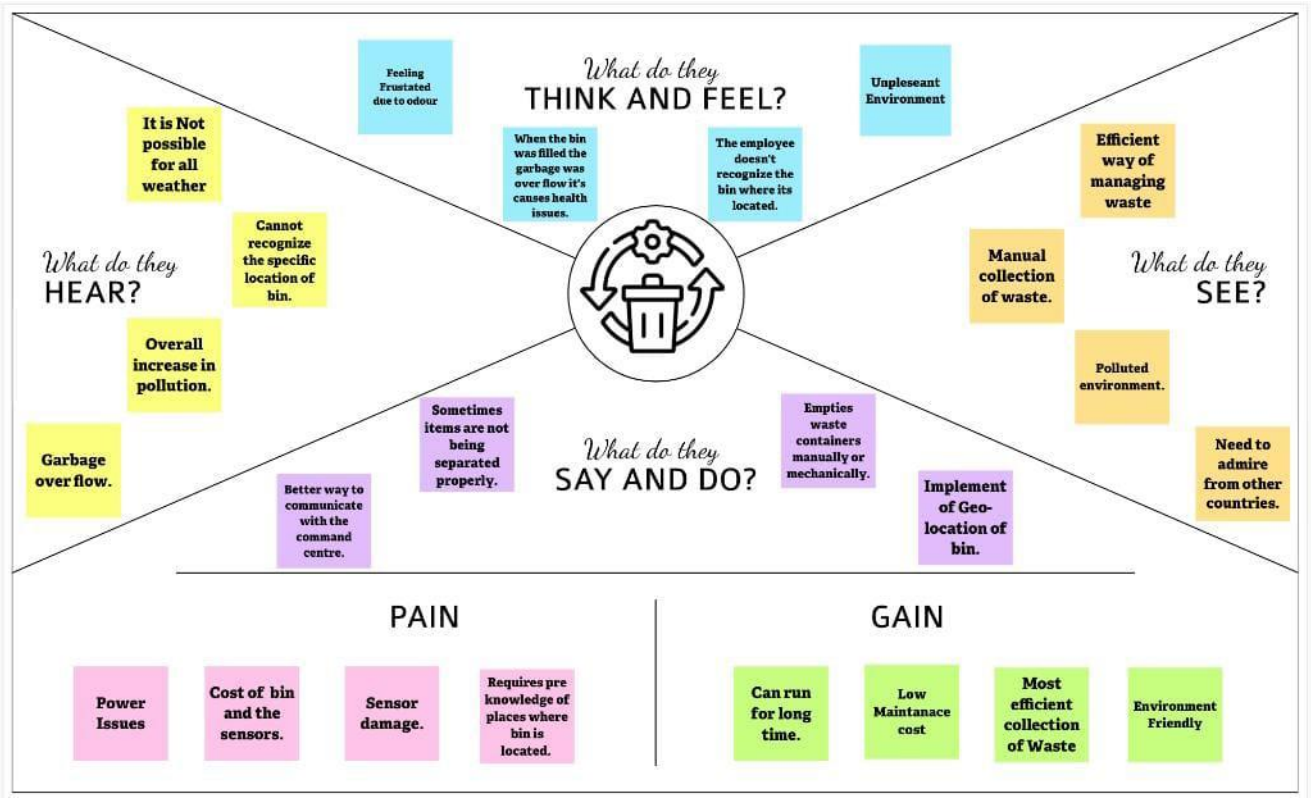
The objective of this paper is to examine the present methods used in India for the welfare of its people in different waste management efforts. The other goal is to offer advice on how to make Indian municipalities' trash disposal procedures better. On secondary research, this essay is founded. The 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:

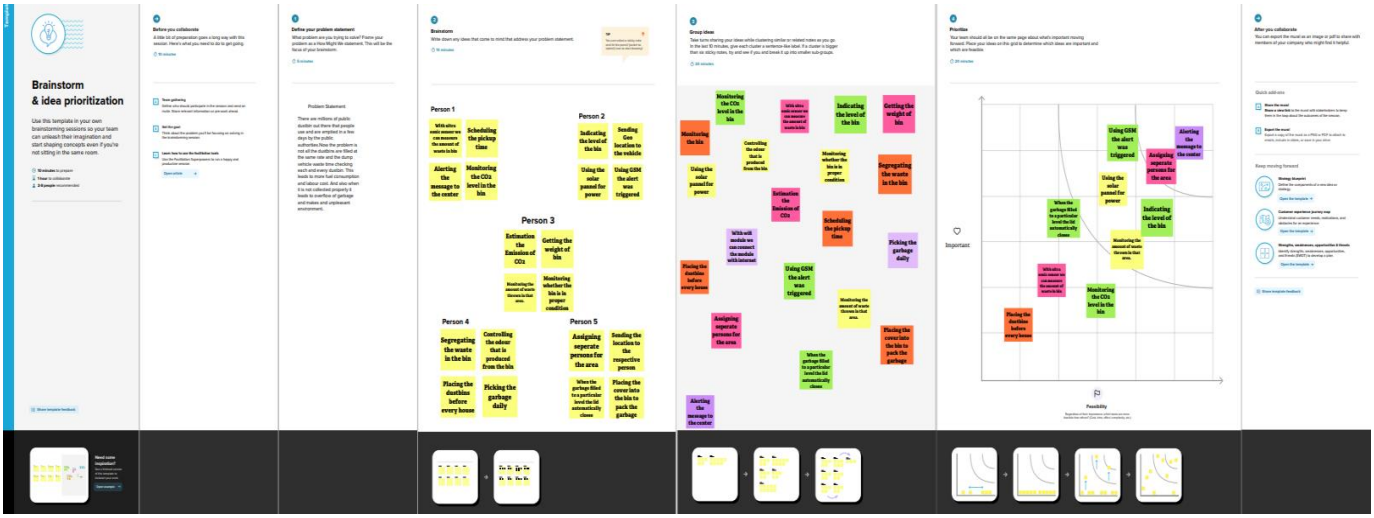
Problem Statement (PS)	**I am (Customer)**	**I am tryingto**	**But**	**Because**	**Which makes me feel**
PS-1	Council	Monitor the waste in my city	I have not much effective system for monitoring.	Because of high cost	unhygienic
PS-2	Council	Manage the waste in my city	I have not much effective system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

3.IDEATION & PROPOSED SOLUTION:

3.1 Empathy map canvas:



3.2 Ideation & Brainstorming:



3.3 Proposed Solution:

SI 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 technologieswhich if properly used in the establishment of this project helps to detect the garbage level and intimating about it to the authorityand 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 IoTand 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:

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Now a days waste materials were widely increased in the Electronic, Food and Medical areas. So, our Primary Customer Segments are Hospitals, Electronic Industries and Hotels.

6. CUSTOMER

We Have used Latest Geo location module that work with solar power and helps to identify and track the waste in the bin and collect it by periodically. The co2 sensor will measure the pollution level caused by the waste.

5. AVAILABLE SOLUTIONS AS

The manual Checking and Collecting of Waste is not possible this leads to overflow of waste and cause several problems. The Major reason is finding the dustbins in the areas.

All dustbins are not filled at the same rate and the dump vehicles waste time checking each dustbin. This leads to more fuel usage and labor cost.

There are several projects is there for tracking and collecting but all those are not connected well and there is no information of the waste amount and the pollution of the area.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE / PROBLEMS J&P

- The rapid growth of population and the Industrialization growth are the major cause of increase in garbage.
- Due to uncollected waste or Overflow of garbage can cause malodorous, Health issues and disturbance to the people.

9. PROBLEM ROOT CAUSE RC

Overpopulation, urbanization, and the growing technology are among the few reasons for solid waste pollution. The food waste from the kitchen Solid waste items including carton boxes, paper, tins, metal cans, aluminum in the forms of foils, batteries are a few of the solid waste that can be recycled. Hazardous waste includes chemicals, paints, fertilizers, light bulbs, and batteries that pollute the environment. The waste coming from hospitals and drug companies are also hazardous.

7. BEHAVIOUR BE

The problems were get posted to the website and the problem will be rectified Asap. The bin health is also monitored continuously.

The Records were Continuously monitored and in case of Emergency an alert message sent to the office.

Focus on J&P, tap into BE, understand RC

3. TRIGGERS TR

With the use of Geolocation, it's possible to locate and collect the waste on time.

4. EMOTIONS: BEFORE / AFTER EM

Before	->	After
Frustrated		Fulfilled
Unpleasant Environment		Pleasant Environment
Unhealthy		Healthy
Polluted		Controlled

10. YOUR SOLUTION SL

Our Solution that comes under Smart City. In this in every area and every street we will place a smart dust bin which contain an Arduino board with Co2 sensor, Gps, Ultrasonic sensor which will connect with the app and indicates the level of garbage and the Pollution level of the area. It works in the solar power and it stores the power in the backup battery for the emergency situation.

8.CHANNELS of BEHAVIOUR CH

8.1 ONLINE

Customers can complain, report and give their feedback.

8.2 OFFLINE

In offline customers can report about the garbage to the local staff of the nearby area to clear them.

4. REQUIREMENT ANALYSIS

4.1 Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Bin inventory.	All monitored bins and stands can be seen on the map. You can see bin capacity, GPS location andcollection schedule or pick recognition.
FR-2	Real time bin monitoring.	The level of bins are monitored by smart sensors. Sensors recognize picks as well; so you can check whenthe bin was last collected. With real-time data and predictions, you can eliminatethe overflowing bins and stop collecting half-empty ones.
FR-3	Bins.	We help you identify bins that drive up your collectioncosts. The tool calculates a rating for each bin in termsof collection costs.
FR-4	Bin distribution.	Ensure the optimal distribution of bins. Identify areas with either dense or sparse bindistribution. Based on the historical data, you can adjust bin capacity or location if necessary.
FR-5	Eliminate unefficient picks.	Eliminate the collection of half-empty bins. By using real-time data on fill-levels and pick recognition, we can show you how full the bins youcollect are.

4.2 Non-Functional requirements:

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	IoT device verifies that usability is a special and important perspective to analyze user requirements,which can further improve the design quality. The analysis of users product usability can help designersto understand users potential needs in waste management, behavior and experience.
NFR-2	**Security**	Use a reusable bottlesand grocery bags. Avoid single use food and drink containers.
NFR-3	**Reliability**	Smart waste management is also about creating better working. Instead of driving the same collectionroutes and servicing empty bins, waste collectors willspend their time more efficiently, taking care of bins that need servicing.
NFR-4	**Performance**	The Smart Sensors use ultrasound technology to measure the fill levels in bins several times a day. Using a variety of IoT networks the sensors send thedata .Customers are hence provided data-driven decision making, and optimization of waste collection routes, frequencies, and vehicle loads resulting in route reduction.
NFR-5	**Availability**	By developing & deploying the hardware and software we empower the country to manage waste smarter and easier.
NFR-6	**Scalability**	Using smart waste bins we can be able to monitor thegarbage more cost effectively .

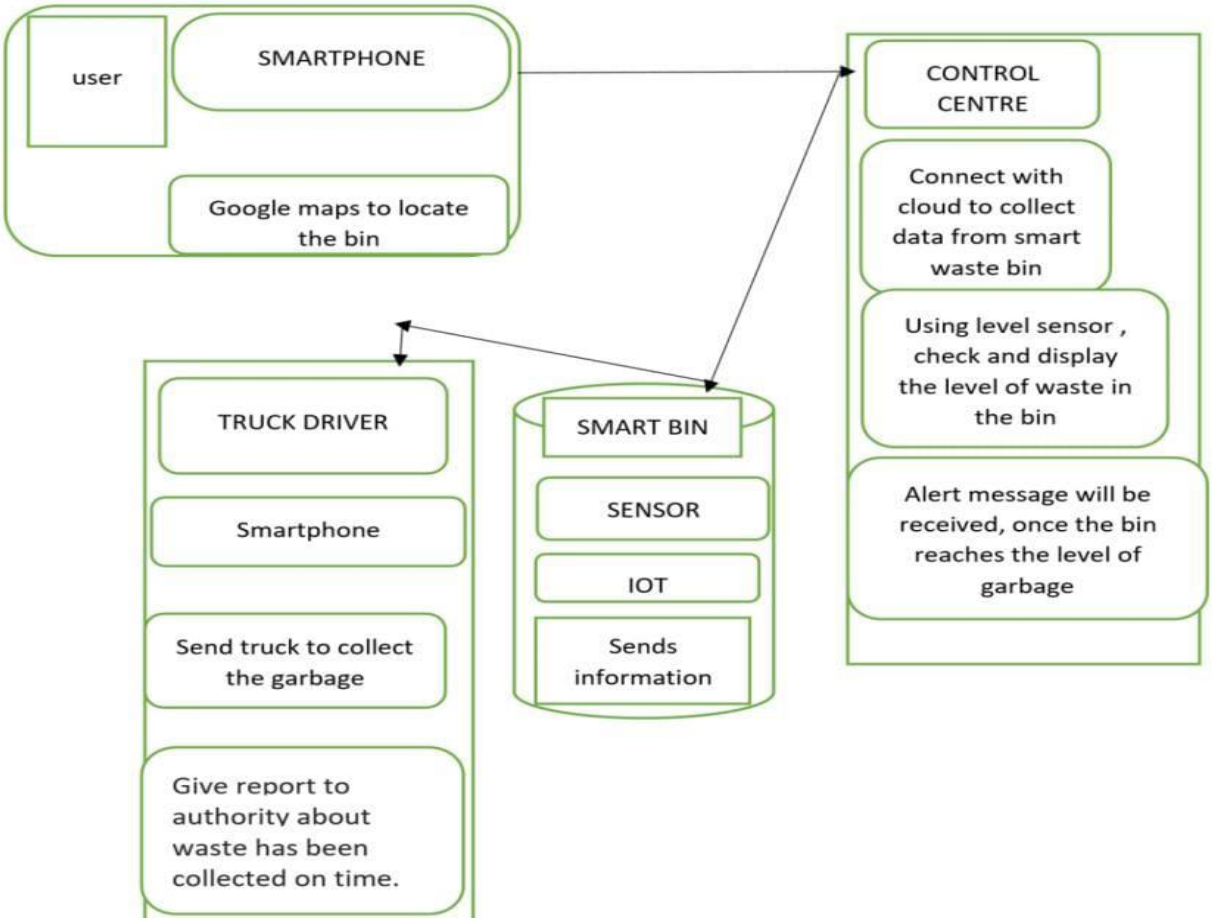
5.PROJECT DESIGN:

5.1 Data Flow Diagrams:

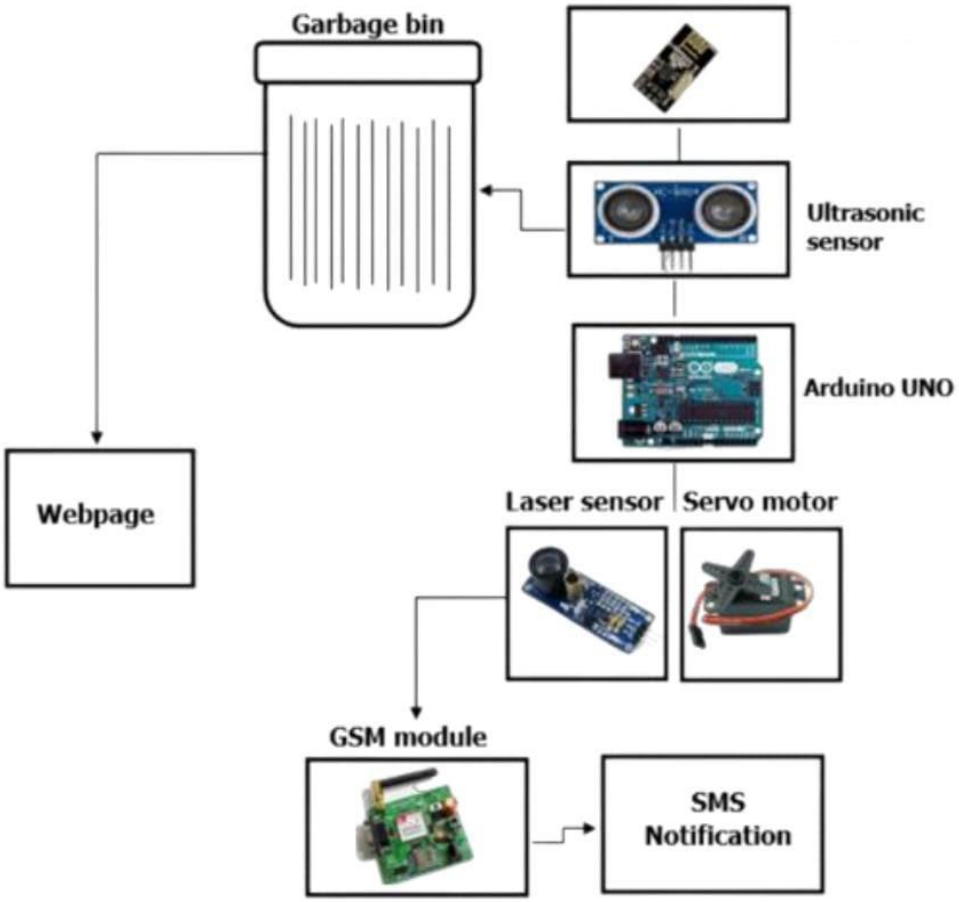
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored A smart 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	Login	USN-1	As an Admin, I gave user id and password forever workers and manage them.	I can manage the webAccount.	Medium	Sprint-2
Co Admin	Login	USN-2	As a Co Admin, I'll manage the garbage level if garbage got filled the alert of the location and garbage id will be sent to the trash truck.	I can manage the garbage Monitoring.	High	Sprint-1
Truck Driver	Login	USN-3	As Truck Driver, I will follow the route send bythe Co Admin to reach the filled garbage.	I can drive to the garbage filled route in the shortest route.	Medium	Sprint-2
Local Garbage Collector	Login	USN-4	As a Waste Collector, I will collect all the trash from garbage and load into the garbage truck and send them to landfill	I can collect trach andpulled to truck.	Medium	Sprint-2
Municipality	Login	USN-5	As a Municipality, I'll check the process that are happening in order without any issues.	I can manage all theseProcess.	High	Sprint-1

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:

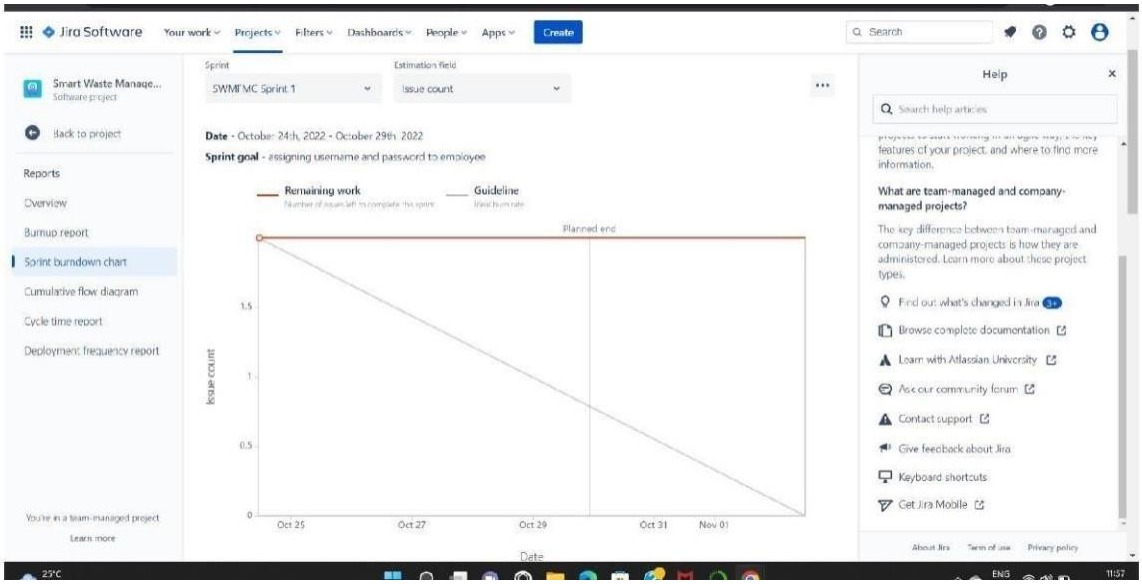
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Member
Sprint-1	Login	USN-1	As a Co-Admin, I'll control the waste level by monitoring them via real time web portal. Once the filling happens, I'll notify trash truck with location of bin with bin ID	10	High	Rani J, Tamilselvan R
Sprint-2	Dashboard	USN-2	As a Truck Driver, I'll follow Co-Admin's Instruction to reach the filling bin in short roots and save time	20	Low	Suganeshwaran E
Sprint-3	Dashboard	USN-3	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	Chandru P
Sprint-4	Dashboard	USN-4	As a Municipality officer, I'll make sure everything is proceeding as planned and without any problems	20	High	Sridhar T

Project Tracker, Velocity & Burndown Chart:

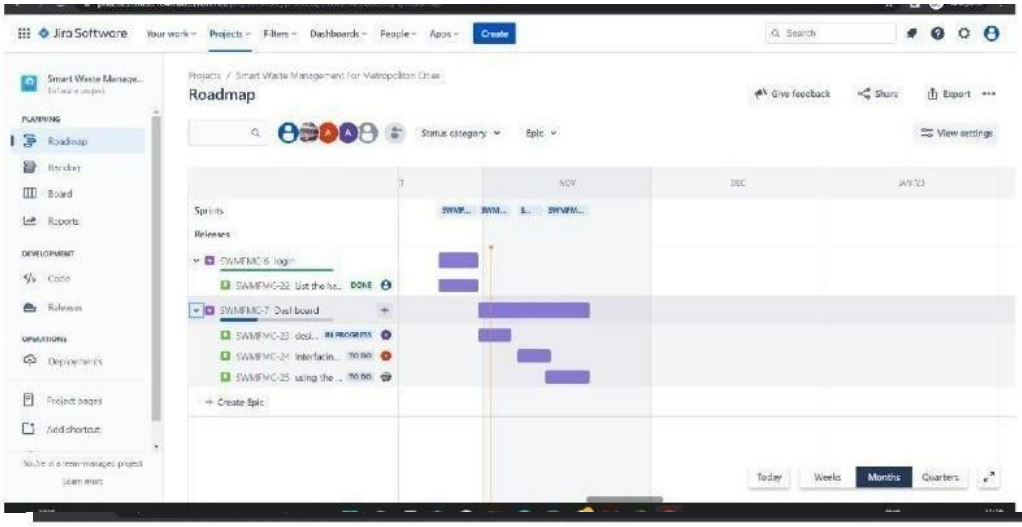
Sprint	Total Story Points	Duration	Sprint StartDate	Sprint End Date (Planned)	Story Points Completed (Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	30	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	49	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	50	19 Nov 2022

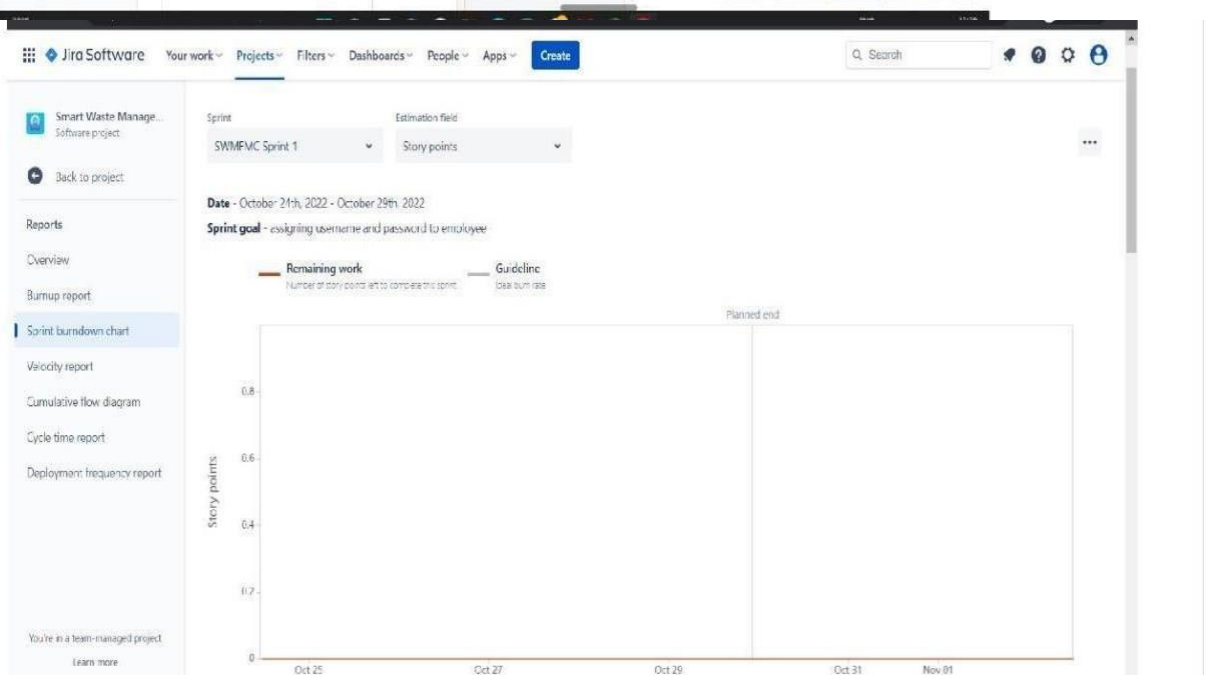
6.3 Reports from JIRA:

Burnout Chart:



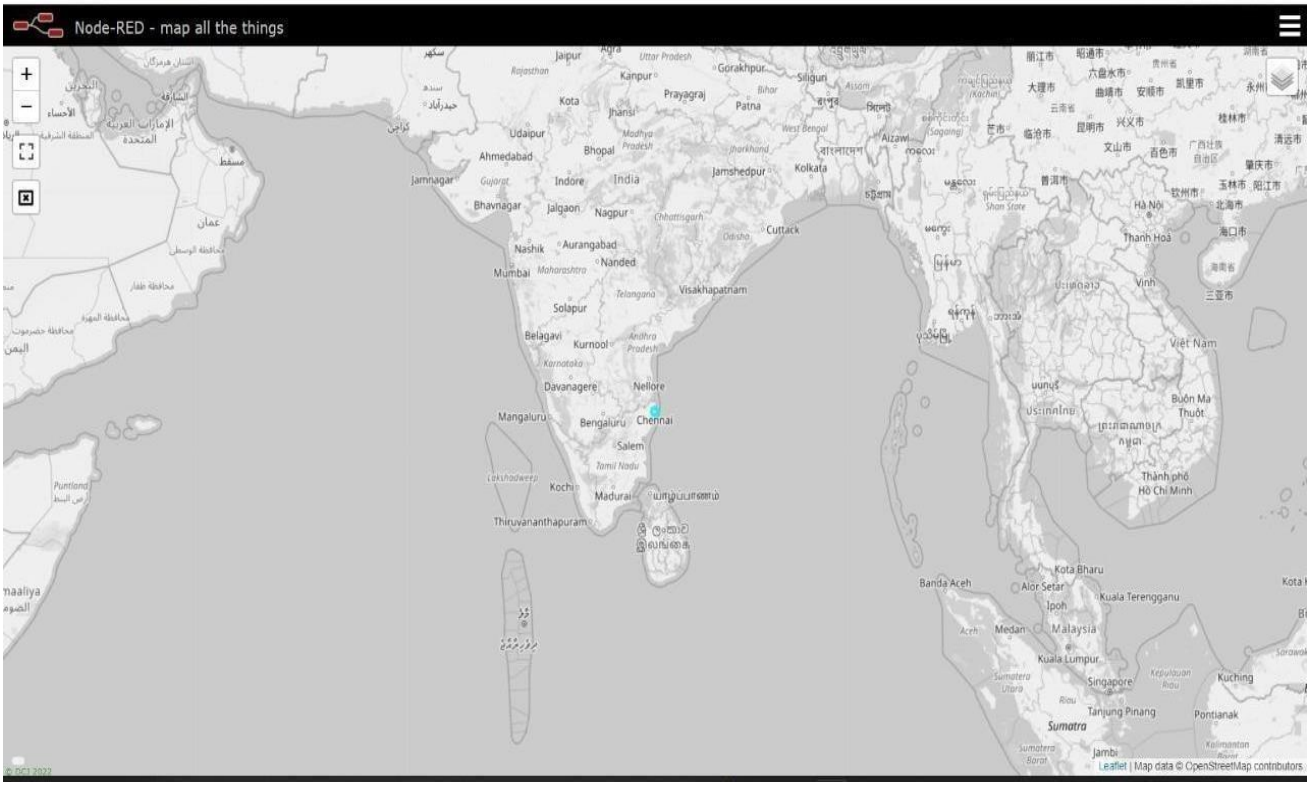
Road map:


Jira Software
Your work
Projects
Filters
Dashboards
People
Apps
Create
Search
Roadmap
Give feedback
Share
Export
Status category
Epic
View settings
Sprints
Releases
Create Epic
Today
Weeks
Months
Quarters

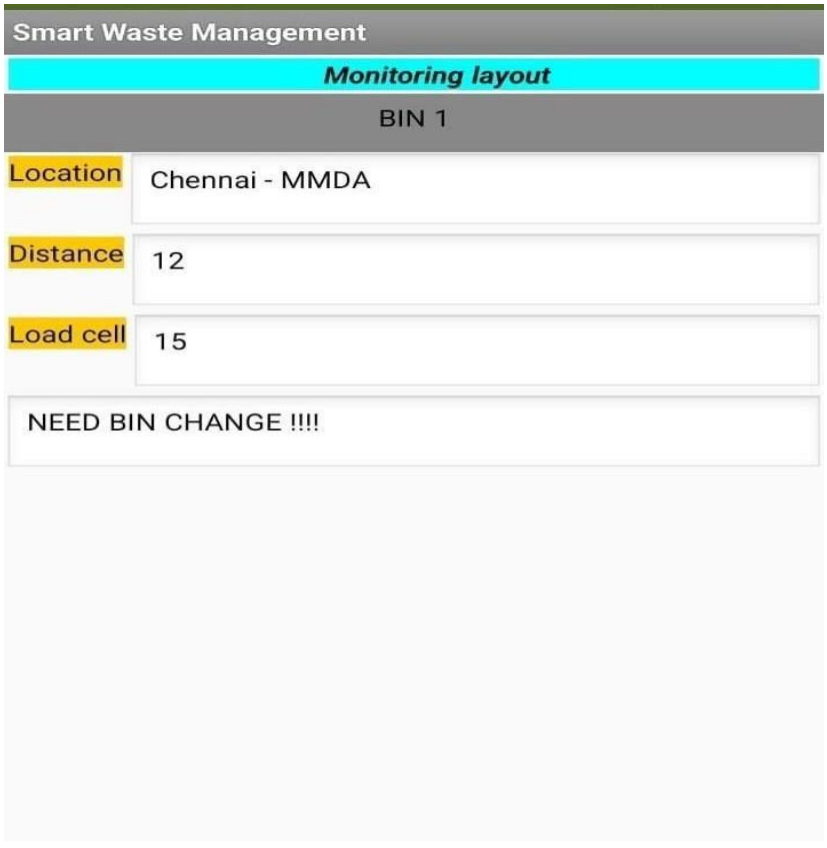

Jira Software
Your work
Projects
Filters
Dashboards
People
Apps
Create
Search
Smart Waste Manage...
Software project
Back to project
Reports
Overview
Burnup report
Sprint burndown chart
Velocity report
Cumulative flow diagram
Cycle time report
Deployment frequency report
You're in a team-managed project
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
Guideline
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 of – Location Tracking



7.2 Feature 2- LIVE UPDATE ON COLLECTED DATA:



8.Testing:

8.1 Testcases:

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/SIG N UP WEN USER CLICK ON MY ACCOUNT BUTTON		1.ENTER URL AND CLICK GO 2.VERIFY LOGIN/SIGN UP	https://169.51.20 4.219.30 106	Login page is visible	Working as expected	PASS	Successful			Tamil Selvan.R

LOGIN PAGE_TC_002	UI	HOME 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.VERIFY LOGIN/SIGN UP Elements a.ID text b ox B. password text box c..login button D.new user E.already have an account	https://169.51.20 4.219.30 106	Application should show below UI element	Working as expected	PASS	Success full			Sridhar.T

LOGIN PAGE_TC_003	FUNCTIONA L	LOGIN PAGE	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SIG N UP WEN USER CLICK ON MY ACCOUNT BUTTON		1.ent er url and click go 2.click on my account 3.Ent er valid ID 4.Ent er valid passw ord 5.click on login button	Id:1111 passwor d:5678	User should navigat e your home page.	Workin g as expected	PASS	Succ ess ful			Rani.J
LOGIN	FUNCTIONA	LOGIN	VERIFY		1.enter url	Id:1111	Confirm	Workin	PASS	Succ ess			Sridhar T

PAGE_TC_004	L	PAGE	THE USER IS ABLETO SEE THE LOGIN/SIGN 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	pass word:5678	ation message sent	g as expected		ful			
LOGIN PAGE_TC_005	UI	LOGIN PAGE	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SIGN UP WEN USER CLICK ON MY ACCOUNT BUTTON		1.enter urland clickgo 2.click on my account 3.Enter valid ID 4.Enter valid password 5.click on login button	Id:1111 password:5678	Confirmation message sent	Working as expected	PASS	Successful			**Suganeshwaran E**
LOGIN PAGE_TC_006	FUNCTIONAL	LOGIN PAGE FOR ADMIN	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SIGN UP WEN USER CLICK ON MY ACCOUNT BUTTON		1.enter urland clickgo 2.click on my account 3.Enter valid ID 4.Enter valid password 5.click on login button	Id:1111 password:5678	Customer database is visible	Working as expected	PASS	Successful			**Chandru P**

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	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
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	Fai l	Pas s
Print Engine	7	0	0	7

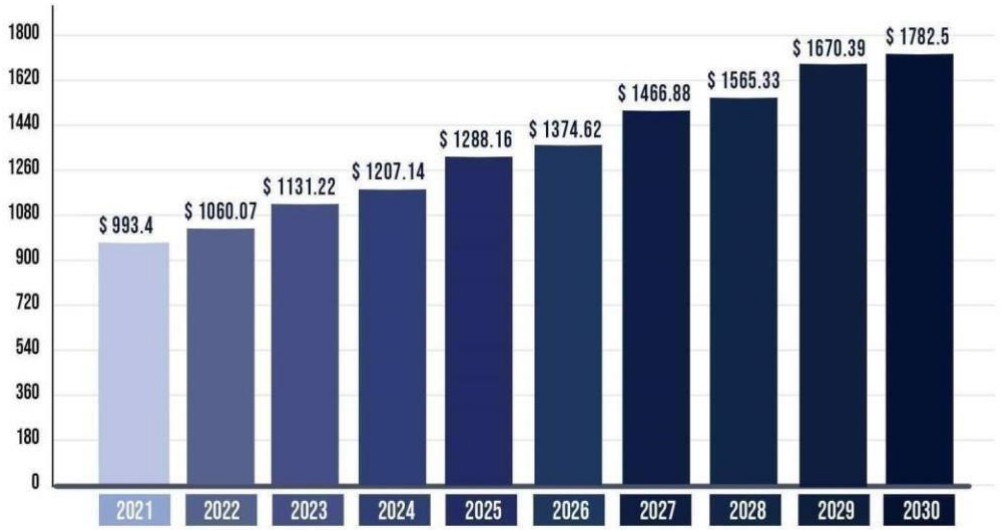
Client Application	51	0	0	51
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

9.RESULTS:

9.1 Performance Metrics:

PRECEDENCE RESEARCH

WASTE MANAGEMENT MARKET SIZE, 2021 TO 2030 (USD BILLION)



Source: www.precedenceresearch.com

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 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.

11. CONCLUSION:

A Smart Waste Management system that is more effective than the one in use nowis 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 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

13. Appendix:

```
    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 :' 'Risk Warning: Dumpster poundage getting high,
Time to collect :)'                    elif
load == "60 %" or distance == "60 %":
                          warn = 'alert :'
          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)
```

```
    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(10)




    deviceCli.commandCallback=myCommandCallback
#disconnect the device
deviceCli.disconnect()
```

GitHub Link:

https://github.com/IBM-EPBL/IBM-Project-29824-1660130827