PROJECT REPORT:

Team ID	PNT2022TMID52032
Project Name	Smart waste management system for metropolitan cities
Team Lead	SUDHESHWARI N
Team Member 1	AKSHARA S S
Team Member 2	MUTHU KANNAN N
Team Member 3	PRIYA LAKSHMI M

CONTENT

1. INTRODUCTION

Internet and its applications have become an integral part of today's human lifestyle. It has become an essential tool in every aspect. The world is in a process of updation, and there is one stinking problem we have to deal with. Garbage! In our daily life, we see the pictures of garbage bins being overfull and all the garbage spills out. This leads to the number of diseases and insects and mosquitoes breed on it. A big challenge in the cities is solid waste management not only in India but for most of the countries in the world. Hence, such a system has to be build which can eradicate this problem which reduces the minimum level.

The waste collection process is a critical aspect for the service providers. In order to overcome all these problems, we are proposing the idea of a waste management system in metropolitan cities which helps in the management of waste with the least human interaction in order to maintain a clean environment. IoT Garbage Monitoring System monitors the garbage bins and informs about the level of garbage collected in the garbage bins via LED. We are making use of various sensors to scan type of garbage and then categorize them to different bins by automatically opening the door. It also uses ultrasonic sensors placed over the bins to detect the garbage level. It will stop overflowing of dustbins along roadsides and localities as smart bins are managed at real time. The filling and cleaning time of smart bin will also be reduced thus making empty and clean dustbins available to the people when its needed.

1.1 PROJECT OVERVIEW:

In developing countries like India where a rapid increase in population has been observed in past decades , solid waste management has become a critical issue. This issue arises mainly due to the improper segregation of waste. Waste management and dumping of solid wastes in India have been researched and findings show that municipal solid wastes are mostly composed of biodegradable and non biodegradable materials .Organic and Inorganic waste are treated in the same way and are not collected on time . This leads to loss of potential energy generated using organic wastes. The main problem of the existing solid waste process is the lack of information about collecting time and source available, also there will be lack of productivity due to inefficient utilization and unauthorized use of vehicles. As of now to overcome this disadvantage , household garbage can be converted into biogas and can be utilized for cooking purposes in home as well as it can be collected and thrown in the trash bin instead of making the environment unhygiene. This will reduce amount of waste generated by each families which helps in planned and organized waste management solution . This step will serve as a huge step in formation of smart cities.

1.2.PURPOSE:

- ➢ The main purpose of smart waste management is
- ➢ To keep the area clean
- ➢ To avoid damage to human beings
- ➢ To collect the waste from the required area regularly

2. LITERATURE SURVEY:

For our project we have analaysed many research papers related to our concept, and the information obtained from those survey are listed as follows:

2.1. EXISTING PROBLEMS:

The main existing problem is that due to lack of dustbins there is a major cause to human beings. For example, if the waste is not collected on time by using the truck there will be major cause in that particular area where the waste will be dumped for days so that there will be an overflow form the dustbin and the area will be suffering from nasty smell. Because today's generation the people are not even trying to put waste in the particular dustbins allotted for their respected area. Also the existing system uses an LCD in each bins to indicate to the workers to notify them whether the bins has been filled.

2.2. REFERENCE:

1. A Survey on Garbage Collection and Monitoring system for Smart cities using IoT - Neha shinde, Varsha Devkule.

2. Waste Management Improvement in Cities using IoT - Ashwin Kumar Patil, Adithya Gandh.

3. Smart Waste Segregation and Monitoring system using IoT - - V.Sowndharya, P.Savitha, S.Hebziba Jeba Rani

4. IRJET-Smart City Waste Management System using IOT SERVER - Vaibhav.S Ballal , Sandhesh.S.Patil , Namdev.P.Dange

5. Arduino Microcontroller Based Smart Dustbins for Smart Cities - K. Suresh, S. Bhuvanesh and B. Krishna Devan

2.3. PROBLEM STATEMENT DEFINITION:

In developing countries like India where a rapid increase in population has been observed in past decades, solid waste management has become a critical issue. This issue arises mainly due to the improper segregation of waste. Waste management and dumping of solid wastes in India have been researched and findings show that municipal solid wastes are mostly composed of biodegradable and non-biodegradable materials .Organic and Inorganic waste are treated in the same way and are not collected on time. This leads to loss of potential energy generated using organic wastes. As of now to overcome this disadvantage, household garbage can be converted into biogas and can be utilized for cooking purposes in home as well as it can be collected and thrown in the trash bin instead of making the environment unhygiene. This will reduce amount of waste generated by each family which helps in planned and organized waste management solution. This step will serve as a huge step in formation of smart cities.

3. IDEATION AND PROPOSED SOLUTION:

The ideation and proposed solution is given below :

3.1. Empathy Map Canvas:

An Empathy map is a useful tool to helps teams and better understand the users. To create an effective solution requires understanding the true problem and the person who is experiencing it. The main advantages of the empathy map is simple and easy to capture the knowledge about users behaviours and attitudes.

3.2. Ideation & Brainstorming:

Brainstorming provides a free and open environment that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and helping each other to develop a rich amount of creative solutions. In this idea prioritization we all

discuss the idea and the best idea was set in the first priority as the graph shown.

3.3.PROPOSED SOLUTION:

We are the project team was filled the following information in this proposed solution. As the problem statement is the project enables the organization to meet their needs of smart garbage management systems.

The idea/solution description is the proposed system would be able to automate the solid waste monitoring process and management of the overall collection process using IOT; The Novelty/Uniqueness of this project is our team has planned to build a wrist band to the workers that indicate the blinking of light .The main use of the wrist band is alertness of

workers. Then the Social impact/Customer Satisfaction are from the public perception as worst impacts of present solid waste disposal practices are seen direct social impacts such as neighbourhood of landfills to communities, breeding of pests, nasty areas and in property values. The business model are Waste Management organizes its operations into two reportable business segments: Solid Waste, comprising the Company's waste collection, transfer, recycling and resource recovery, and disposal services, which are operated and managed locally by the Company's various subsidiaries, which focus on distinct geographic areas; and Corporate and Other, comprising the Company's other activities, including its development and operation of landfill gas -to energy facilities in the INDIA, and its recycling brokerage services, as well as various corporate function.

Finally, the scalability of the solution is the proposed system uses sensor and communication technologies where waste data is collected from the smart bin, in real-time, and then transmitted to an online platform where citizens can access and check the availability of the compartments scattered around a city.

3.4. PROBLEM SOLUTION FIT:

The solution fit for Smart Waste management in metropolitan cities are,

Define CS, fit into CC	**1. CUSTOMER SEGMENT(S)** CS 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.	**6. CUSTOMER CONSTRAINTS** CC No separation bins are provided. people leave waste in plastic bags beside roads. Some households purchased waste bins but then others used these bins too. People do not know where to put their garbage because there are no fixed waste collection points or times for garbage collection.	**5. AVAILABLE SOLUTIONS** AS Smart waste management is characterized by the usage of technology in order to be more efficient when it comes to managing waste. 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.	**Explore AS, differentiate**
Focus on J&P, tap into BE, understand RC	**2. JOBS-TO-BE-DONE / PROBLEM** J&P Identify the pre-incident WMP that best aligns with the specific incident, if applicable. Identify waste management-related policy or implementation issues that require resolution	**9. PROBLEM ROOT CAUSE** RC There are significant safety challenges facing the waste/recycling industry. They include chemical exposure, combustible dust explosions, machine guarding hazards, and exposure to powerful equipment with moving parts.	**7. BEHAVIOUR** BE A reduction in the number of waste collections needed by up to 80%, resulting in less manpower, emissions, fuel use and traffic congestion. A reduction in the number of waste bins needed. Analytics data to manage collection routes and the placement of bins more effectively.	**Focus on J&P, tap into BE, understand RC**
Identify strong TR & EM	**3. TRIGGERS** TR By installing this project we can trigger peoples by seeing their neighbour peoples make the utilization of technology more useful and reading about a more efficient solution in the news. **4.EMOTIONS: BEFORE / AFTER** EM After the implementation of smart waste management system our environment will be neat and clean.	**10. YOUR SOLUTION** SL You can put that reusable bottle to use, save money and reduce waste. By taking your own water with you, you'll also reduce your chances of purchasing more expensive beverages on-the-go. This will eliminate the one-time use containers they come in. While most cans and bottles can be recycled, they require a lot of energy to be produced, shipped to the bottling facility and then to the store for purchase.	**8. CHANNELS OF BEHAVIOUR** CH ONLINE: people may provide review and rating for the system. OFFLINE: People may provide a valuable resource and contribution to the organization.	

4. REQUIREMENT ANALYSIS:

The various functional and non-functional requirements of the project are discussed below :

4.1. FUNCTIONAL REQUIREMENT:

The various functional requirements of project are ;

1) User Registration - Registration through Gmail.

2) User Confirmation - Confirmation via Email and Confirmation via OTP.

3) GPS Access - GPS access to know the location.

4)openweathermap.org App : From this application we are going to read the weather information using arduino via the API key.

5)**Bin level Analysing** - Indication of the levels of Waste bins at a regular interval of time.

6) Transport Router - To make a efficient route for the collection of garbages around a particular area.

4.2. NON-FUNCTIONAL REQUIREMENTS:

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

1) Usability - A smart solution has been proposed to make the waste sorting more simple and accurate , and improve the user experience, usability, and satisfaction. It aims to optimize ease of use while offering maximum functionality.

2) Security - The information of the users will be highly secured,the accounts are verified with Gmail. If the products are misplaced then the GPS driven sensor gives an alert.

3) Reliability - Operates in a defined environment without failure resulting in less manpower, emissions, fuel use and traffic congestion.

4) Performance - The system will provide accurate reports, thus increasing the efficiency of the system. The real-time monitoring of the garbage level with the help of sensors and wireless communication will reduce the total number of trips required of Garbage collecting truck. This will reduce the total expenditure associated with the garbage collection.

5) Availability - The smart waste bins are available in Convention centers, buildings, stadiums, and transportation facilities and captures high-quality waste data and informs staff when it gets well.

6) Scalability - A versatile scalable smart waste-bin system based on limited waste management could potentially lead to great improvements. Once these smart bins are implemented on a large scale by replacing the traditional bins, the waste can be quickly managed to its efficient level as it avoids unnecessary lumping of wastes on roadside.

5. PROJECT DESIGN:

This section concerns with the design of flow diagrams , solution and technical architectures and user stories

5.1. DATA FLOW DIAGRAM:

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.
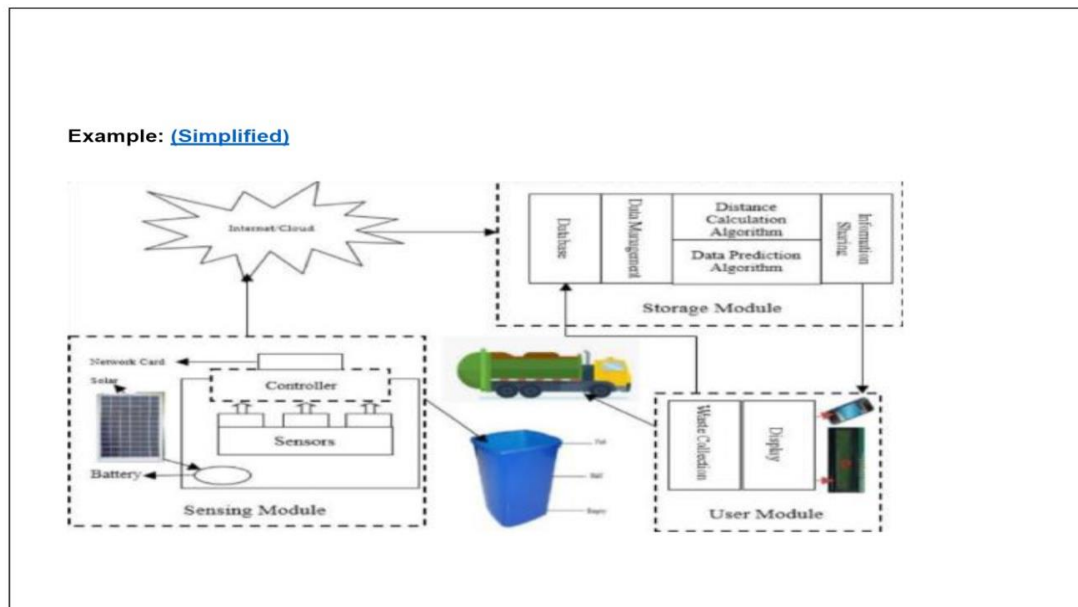

The above dataflow diagram gives the overview of the waste management system performed. Initially the flow diagram consists of the start where the start of the process takes place then it is Initialization which is to initial the waste in dustbin is either full or not. If it is full then it sends its signal to collect the waste by using sensor. Sensor is use to send the data to authorized user about overflow of the dustbin. If it reaches its threshold level then sends the message to collecting vehicle to come and collect the waste's is use to locate the path of the dustbin which is been full. Thus the mechanism repeats

. Considering the following main purposes:

- The provisioning of data has to be performed with high reactivity and high level of scalability.

- The system has to provide new sensors in the sensing environment. To get these requirements, specific design.

5.2. SOLUTION & TECHNICAL ARCHITECTURE :
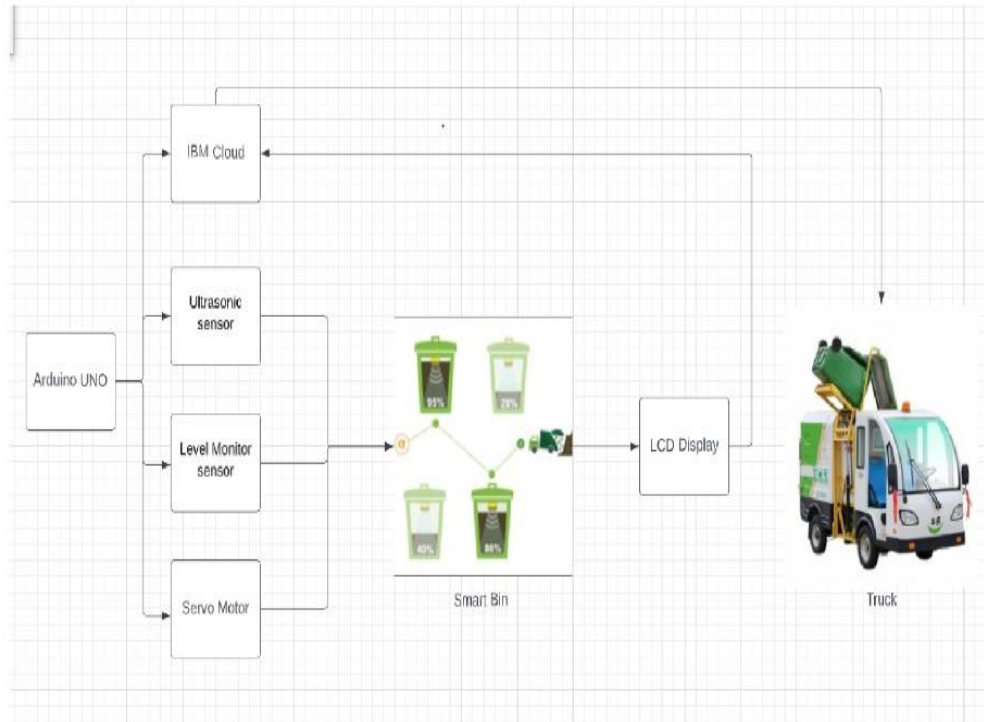
In this block diagram shows that the Arduino UNO I connected with IBM cloud,Ultrasonic Sensor,Level Monitor Sensor and Servo Motor.The IBM cloud is used to send the alertness of municipality.Ultrasonic Sensor is used to detect the level of distance.Level Monitor Sensor is used to detect the level of waste filled in the garbage.Servo Motor is used to automatically open and closed the trash bin lid.LCD is used to if the level of waste is filled in trash bin the the LCD will display the message like "THE LEVEL OF WASTE IS FILLED SO PUT IT ON THE WASTE ON NEXT TRASH BIN".

5.3. USER STORIES:

The various user stories are discussed here :

➢ As a user, I can register for the application by entering my email, password, and confirming my password.
➢ As a user, I will receive confirmation email once I have registered for the application
➢ As a user, I can register for the application through Gmail
➢ As a user, I can log into the application by entering email & password
➢ Cleanliness for that day can be seen.
➢ Level sensor indication can be noted.

➢ It is used to control the overflow of waste from bins.

6. PROJECT PLANNING & SCHEDULING:

This section contains the project planning and the schedules for various tasks.

6.1 Sprint Planning & Estimation

Sprint-1

As a user, I can register for the application by entering my email, password, and confirming my password. As a user, I can register for the application by entering my email, password, and confirming my password. Create the IBM Cloud services which are being used in this project. Configure the IBM Cloud services which are being used in completing this project.

Sprint-2

IBM Watson IoT platform acts as the mediator to connect the web application to IoT devices, so create the IBM Watson IoT platform. In order to connect the IoT device to the IBM cloud, create a device in the IBM Watson IoT platform and get the device credentials. Configure the connection security and create API keys that are used in the Node-RED service for accessing the IBM IoT Platform.

Sprint-3

To create a web application create a Node-RED service. Launch the cloudant DB and create a database to store the image URL.

Sprint-4

Create a cloud object storage service, create a bucket to store the images, and configure the bucket settings. Develop a python script. Develop a python script to publish random sensor data such as temperature, moisture, soil and humidity to the IBM IoT platform.

6.2 Sprint Delivery & Schedule:

The sprint delivery schedule is shown below :

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

6.3. REPORT FROM JIRA:

Burn-Down Chart :
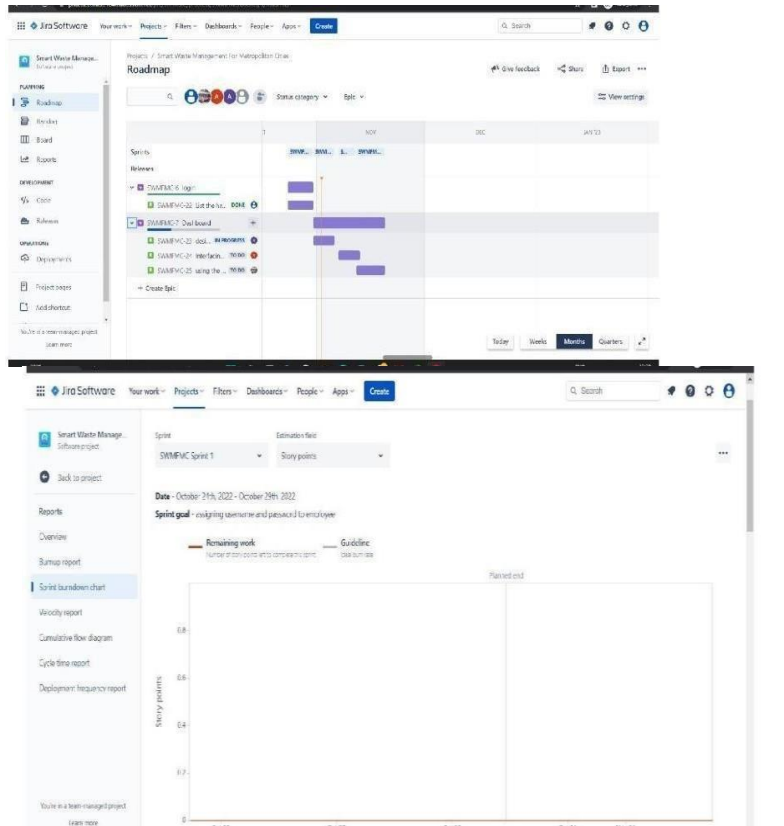
A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.
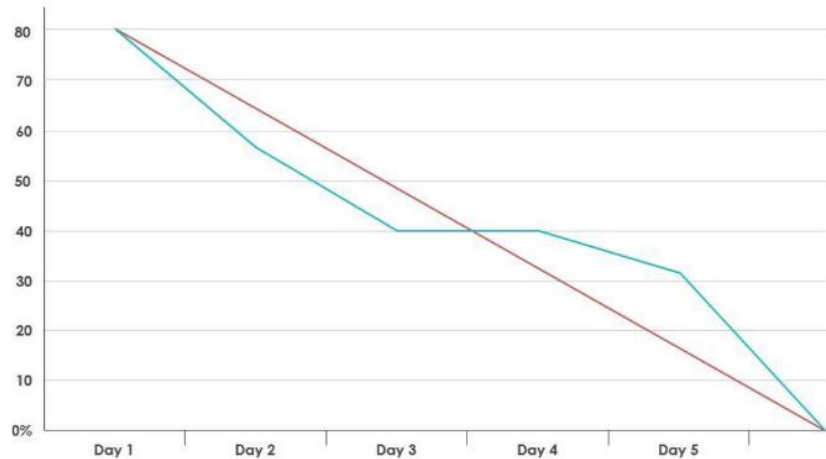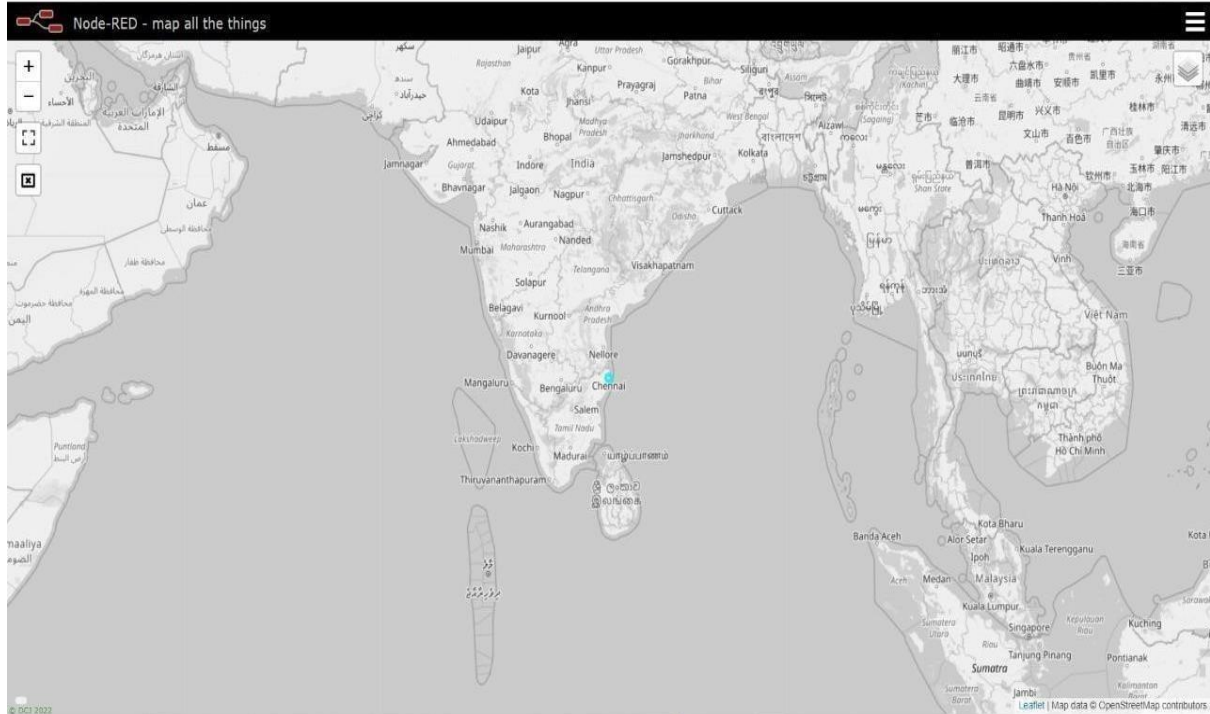

ROAD MAP:

7. CODING & SOLUTIONING:

7.1 Feature 1- LOCATION TRACKER:

7.2. FEATURE 2- LIVE UPDATE ON COLLECTED DATA:

8. Testing:

8.1. Testcases:

TEST CASE 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_TC _001	FUNCTIONAL	HOME PAGE	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SIG N UP WEN CLICK ON MY ACCOUNT BUTTON		1.ENTER URL AND CLICK GO 2.VERIFY LOGIGN UP	https://169.51.204.219.30 106	L0gin page is visible	Working as expected	PASS	**Successful**			SUDHESHWARI N

Test Case ID	Type	Module	Description	Test Steps	Test Data	Expected Result	Actual Result	Status	Result			Tester
LOGIN PAGE_TC _003	FUNCTI ONA L	LOGI N PAGE	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SI G N 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	Id:1111 passwo r d:5678	User should navigat e your home page.	Workin g as expecte d	PASS	Succ ess ful			**MUTHU KANNAN N**
LOGIN	FUNCTI ONA	LOGI N	VERIFY	1.ent er url	Id:1111	Confirm	Workin	PASS	Succ ess			**PRIYALAKSHMI M**
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	pass wor d:56 78		ation message sent	g as expecte d		
LOGIN PAGE_TC_ 005	UI	LOGIN 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:1 111 pass wor d:56 78	Confirm ation message sent	Workin g as expecte d	PASS				

LOGIN	FU N CT IO N A L	LOGIN	VERIFY		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:1	Custom	Workin	PASS	**AKSHAR A S S**
PAGE_TC_ 006		PAGE FOR ADMIN	THE USER IS ABLE TO SEE THE LOGIN/SIG N UP WEN USER CLICK ON MY ACCOUNT BUTTON			111 pass wor d:56 78	er databas e is visible	g as expecte d		

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

9.RESULTS:

Global Waste Management Market Value and Growth, 2016 – 2026 (US$ Mn) (Y-o-Y %)

9.1. Performance Metrics:

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

10. ADVANTAGES & DISADVANTAGES

ADVANTAGES:

•   Reduction in Collection Cost

•   No Missed Pickup

•   Reduced Overflow

       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 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 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