PROJECT REPORT

PROJECT NAME : Smart waste management system for metropolitan cities

1. INTRODUCTION

1.1 Project Overview:

The solid waste is increasing in urban and rural areas as the population is increasing and waste management has become a global concern. In implementing the smart cities the great challenge is how to manage waste with low cost and high performance. Waste has a negative impact on the quality of society which smart cities aim to improve. The process of collecting wastes, separating it, and transporting the containers daily and quickly to avoid any prospect of a spread of diseases is a complex process. The Internet and its applications have become an integral part of today's human lifestyle. It has become an essential tool in every aspect. Due to the tremendous demand and necessity, researchers went beyond connecting just computers into the web. With the help of IOT, garbage in the cities can be collected on monitoring the bin level, to prevent overflow of the garbage which negatively impacts the environment and to avoid or postpone garbage collection schedules in case of low garbage levels.

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. Thus, smart waste management provides us 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 odor 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 contain viruses and bacteria (i.e., salmonella and e-coli), which are a risk to human health.mination 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 they accumulate through the food chain.

Animals eating contaminated plants have higher doses of contaminants 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

2.2 References:

LITERATURE SURVEY: A number of researches and reviews have been done over the past few decades on the topic of 'SMART WASTE MANAGEMENT FOR METROPOLITAN CITIES'. A few notable of them are given below.

PAPER 1

TITLE: Smart waste management using internet of things

AUTHOR NAME: 1)K.N.Fallaivi 2)V.R. kumar 3)B.M. Chaithra

PUBLICATION YEAR: 2017 international Conference on I-SMAC(IOT in Social ,Mobile ,Analytics and Cloud)

DESCRIPTION:

At present solid waste management is a major concern in the metropolitan cities of the developing and developed countries. As the population is growing, the garbage is also increasing. This huge unmanaged accumulation of garbage is polluting the environment, spoiling the beauty of the area and also leading to the health hazard. In this era of Internet, IOT

(Internet of Things) can be used effectively to manage this solid waste. In this paper, we have discussed the definition of Internet of Things and its elements, testing and prototyping tool cooja simulator and finally the study of various literatures available on smart waste management system using IOT.

PAPER 2:

AUTHOR NAME: 1)SK. Vasem Akram 2)Rajesh Singh

TITLE: Raspberry pi-based smart

waste management system using IOT

DESCRIPTION:

In the resent days it is becoming a difficult task to distinguish wet and dry waste. The new waste management system covers several levels of enormous workforce. Every time labourers must visit the garbage bins in the city area to check whether they are filled or not. The data communicates to the cloud server for real-time monitoring of the system. With the realtime fill level information collected via the monitoring platform, the system reduces garbage overflow by informing about such instances before they arrive.

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 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:

TITLE: Smart Waste Management System

AUTHOURNAME: 1)Fachmin Folianto 2)Yong Sheng low 3)W.yeow

PUBLICATION YEAR: 2015 IEEE tenth international conference on intelligent sensors

DESCRIPTION:

This Waste management is one of the serious challenges of the cities,the system that identifies fullness of litter bin. The system is designed to collect data and to deliver the data through wireless mesh network. The system also employs duty cycle technique to reduce power consumption and to maximize operational time. The Smartbin system was tested in an outdoor environment. Through the testbed, we collected data and applied sense-making methods to obtain litter bin utilization and litter bin daily seasonality information. With such information, litter bin providers and cleaning contractors are able to make better decision to increase productivity.

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.

PAPER 6:

TITLE: Design and Development of Smart Waste Management System: A Mobile App for Connecting and Monitoring Dustbin Using IoT

AUTHOR NAME: Na Jong Shen, Azham Hussain and Yuhanis Yusof

PUBLICATION YEAR: 2020

DESCRIPTION:

The Smart Waste Management Method is an extremely creative system that will advance the development of the Smart City. We frequently notice that the garbage cans placed in open areas of our city are always overstuffed. The result is filthy conditions in the city, and Malaysia's present waste management system is not optimised to address the issue. Additionally, the old method of physically checking the garbage in dustbins is a difficult

operation that requires a lot more human labour and costs money. A scheme dubbed the Smart Waste Management System is put into place to prevent any such instances. This solution was created to enable mobile applications to communicate with Internet of Things (IoT)-based trash cans. Adaptive Software Development is the approach used to create this project.

PAPER 7:

TITLE: IoT based smart garbage collection system

AUTHOR NAME: Rahul Kumar Borah, Sahana Shetty, Rahul Patidar, Anisha Raniwala and Kratee Jain

PUBLICATION YEAR: 2018

DESCRIPTION:

To create an effective and dynamic waste management system, the smart trash container is crucial. One of the most significant challenges for municipal organisations across the world is managing waste from its inception to transfer. Due to the daily growth in garbage, dustbins placed across finished urban areas and placed in open areas are overflowing, creating unsanitary circumstances for the residents. To maintain a crucial barrier from such a situation, we have proposed a remote strong waste management prototype for smart urban groups. This prototype enables common associations to remotely monitor the status of trash cans, complete web server, and profitably maintain urban areas clean by increasing the cost and time required for it.

PAPER 8:

TITLE: Smart City Waste Management System using IoT and Cloud Computing.

AUTHOR NAME: Aderemi A. Atayero, Segun I. Popoola, Rotimi Williams, Joke A. Badejo and Sanjay Misra

PUBLICATION YEAR: 2021

DESCRIPTION:

Solid waste disposal without consideration is a significant problem in the metropolitan areas of most developing nations, and it seriously jeopardizes the residents' ability to live a healthy lifestyle. Both the local government and the populace will benefit from having access to trustworthy data on the situation with solid waste at various points across the city. In this study, the Internet of Things (IoT) and cloud computing technologies are used to create an intelligent solid waste monitoring system. Ultrasonic sensors are used to measure the solid waste fill levels in each of the containers, which are placed in strategic locations around the

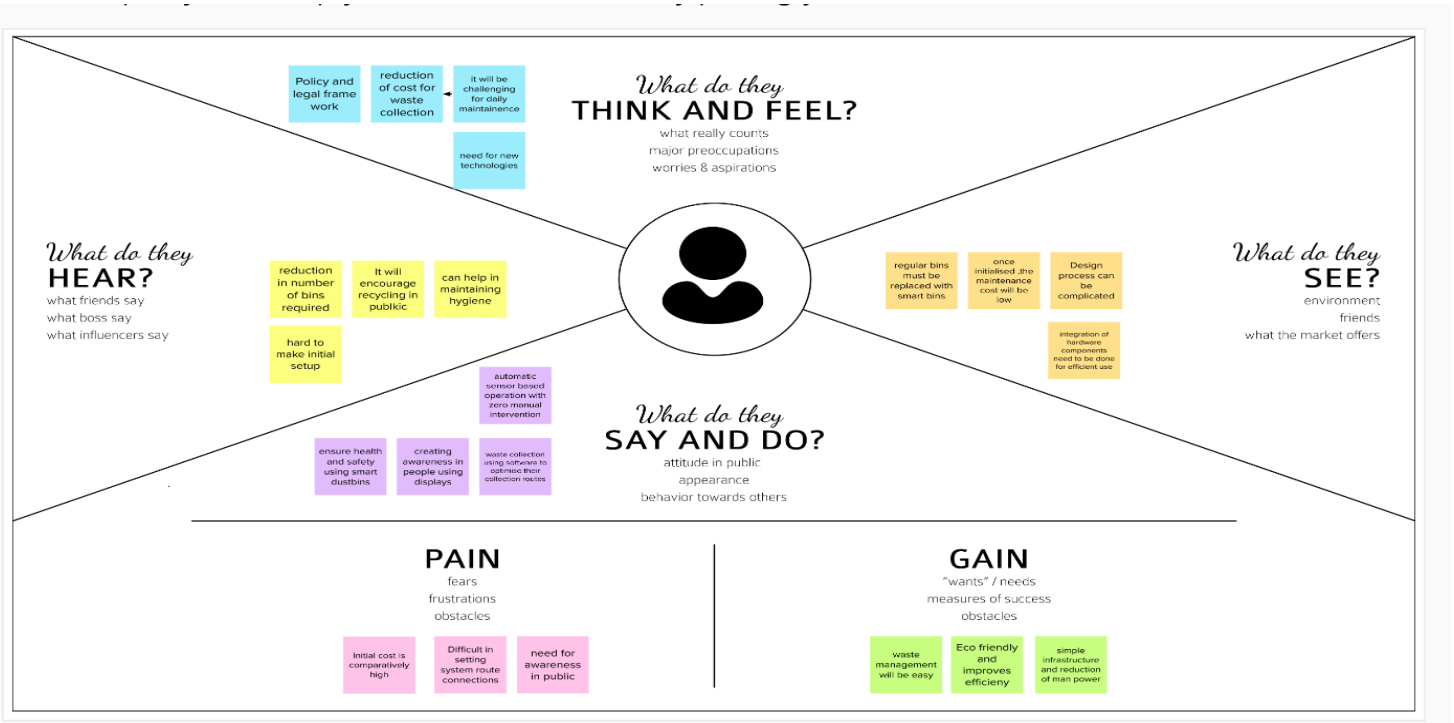
community. The sensor data is sent through a Wireless Fidelity (Wi-Fi) communication link to the Thing Speak IoT cloud platform.

2.3 Problem Statement Definition:

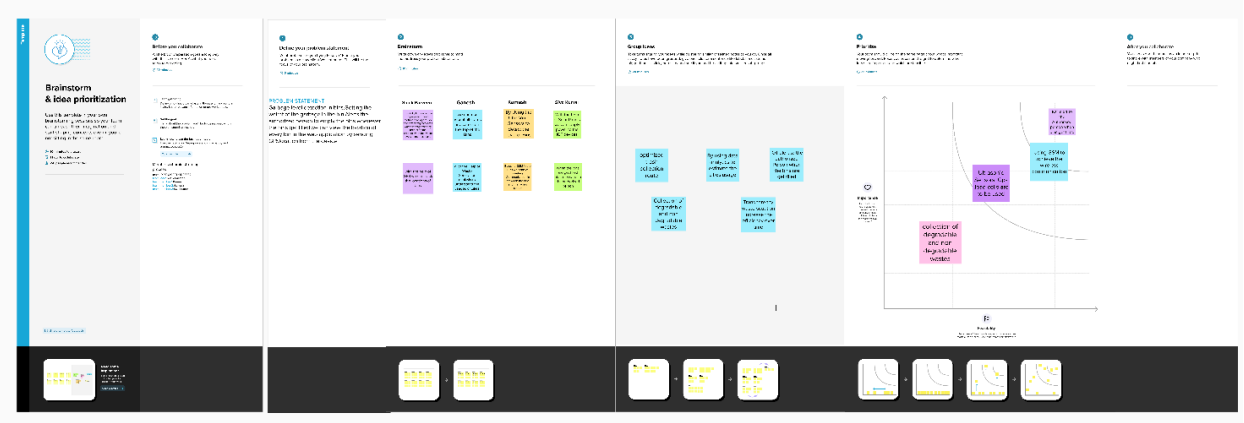
Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Fruit vendor (near the dump yard)	Report to municipal corporation for open burning of hazardous waste	There are not taking any necessary actions	Inactive and negligible municipality members	Landfills, considered the last resort in the waste hierarchy leads to release of hazardous gases which effect the waste workers or other people involved in waste burning and community members while leads to health problems
PS-2	A citizen	Dump the waste in the closed dust bins	Due to overfill of waste materials these waste spread all over the surroundings	Improper management of dust bins by municipality	Poorly managed waste often ends up in ponds , reservoirs or drainage systems which leads to diseases like malaria, cholera etc,.

3.IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas


Policy and legal frame work
reduction of cost for waste collection
it will be challenging for daily maintainence
need for new technologies
What do they
THINK AND FEEL?
what really counts
major preoccupations
worries & aspirations
What do they
HEAR?
what friends say
what boss say
what influencers say
reduction in number of bins required
It will encourage recycling in publkic
can help in maintaining hygiene
hard to make initial setup
regular bins must be replaced with smart bins
once initialised ,the maintenance cost will be low
Design process can be complicated
integration of hardware components need to be done for efficient use
What do they
SEE?
environment
friends
what the market offers
automatic sensor based operation with zero manual intervention
ensure health and safety using smart dustbins
creating awareness in people using displays
waste collection using software to optimise their collection routes
What do they
SAY AND DO?
attitude in public
appearance
behavior towards others
PAIN
fears
frustrations
obstacles
Initial cost is comparatively high
Difficult in setting system route connections
need for awareness in public
GAIN
"wants" / needs
measures of success
obstacles
waste management will be easy
Eco friendly and improves efficieny
simple infrastructure and reduction of man power

3.2 Ideation & Brainstorming



3.3 Proposed Solution

SL .No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	This proposed system deals with the problem of waste management in smart cities, where the garbage collection system is not optimized and in smart cities the efficient management of waste is a crucial challenge for the environment that IOT tends to address . This project enables the organizations to meet their needs of smart garbage management systems. This system allows the authorised person to alert the fill level of each garbage bin in a cities , to give a cost-effective and timesaving route to the truck drivers to collect the waste.

2.	Idea / Solution description	The key research objectives are as follows: • The proposed system would be able to do the waste bin includes a container with a lid, and its enclosure is equipped with sensors such as the HC-SR04 module, an ultrasonic sensor responsible for measuring the level of waste filling present inside the compartment. This is significant within the solution, because through its operation it is possible to avoid the overflow of waste or excessive garbage deposit. *The Proposed system consists of main subsystems namely Smart Trash System(STS) and Smart Monitoring and Controlling Hut(SMCH).
		In the proposed system, The solution also includes a load cell module (load sensor) that measures the weight of the residues present in the compartment. It is characterized by a great importance within the system, since many residues have a small volume and significant mass. The load sensor is coupled to a specific driver, such as HX711, which amplifies the signal emitted by the load cell in addition to providing interconnection with the microcontroller • In the proposed system, the received signal indicates the waste bin status at the monitoring and controlling system.
3.	Novelty / Uniqueness	During the festival season and other important events are monitored carefully so that we can predict the garbage overflow and also we can find the shortest route to reach the destiny so that we can reduce the consumption of fuel and time.

4.	Social Impact / Customer Satisfaction	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 and loss in property values .
5.	Business Model (Revenue Model)	Waste Management organises its operations into two reportable business segments: It is a eco friendly model. 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- toenergy facilities in the INDIA, and its recycling brokerage services, as well as various corporate functions.
6.	Scalability of the Solution	This proposed system gives a solution that comprises hardware, software, and communication integrated into a solution that aims to optimize the management of the waste produced in cities through an approach that generates saving of the public money, contributes with the environment, and also encourages citizenship. Recycling is promoted between residents, results in clean &sustainable environment.

3.4 PROBLEM SOLUTION FIT

Define CS, fit into CC

1. CLIENT SECTION CS

Smart waste management is an innovative approach to handling and collecting waste. Based on Internet of Things technology, smart waste management provides data on waste generation patterns and behaviour.

AS

5. AVAILABLE SOLUTIONS

Smart waste management is characterized by the usage of technology i order to be more efficient when it comes t managing waste. With the use of IoT solutions for waste management , these issues can be solved by creating more efficient pathway for garbage trucks.

8. CHANNELS OF BEHAVIOUR

ONLINE:

people may present/provide analysis and rating for this technology of smart waste management system.

OFFLINE:

People may provide a valuable resource and contribution to the organization

xplore AS, differentiate

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

2. JOBS-TO-BE-DONE

Smart waste management solutions provide real time insights on waste fill levels, collection routes, and bin movements and locations.

6.CUSTOMER PRESSURE

There is no separation of bins are contribute. Waste management in cities is often times the most expensive item o investment as it involves both the collectio of waste and its transportation fo appropriate disposal.

Over the last couple of years, technologies have been created for smart waste management to improve the collection and disposal of waste. Waste bins equipped with sensors now provide data on waste disposal, allowing cities to save resources and costs. These are seemingly effective

9. PROBLEM ROOT CAUSE

There are some problems created when facing the waste/recycling industry. Misunderstanding of the operations of smart sensors, setting up the smart sensor, nonoptimized track routes, recycling and nonuniform waste distribution of waste in bins.

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

Identify strong TR & EM

3. ACTIVATE

After initiating the project we can activate ociety by seeing their neighbour peoples roduce the fulfillment of technology more seful and reading about a more efficient olution in the news.

.EMOTIONS: BEFORE / AFTER EM

Whenever the initiation of smart waste management system completed /started our environment will be neat and blank.

7. BEHAVIOUR

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 collectior routes and the placement of bins more effectively.

10. YOUR SOLUTION

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.

Identify strong TR & EM

\4.REQUIREMENT ANALYSIS

4.1 Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	**Fitting IoT device in the trashcans.**	The IoT device need to be fixed in the dustbin with Water proof safety. The IoT device consists Ultrasonic sensor, IR sensor, Weight sensor. To send data to the cloud GPRS/GSM is used.
FR-2	**Bin monitoring**	All monitored bins and stands can be seen on the map, and you can visit them at any time via the Street View feature from Google. Bins or stands are visible on the map as green, orange or red circles. You can see bin details in the Dashboard – capacity, waste type, lastmeasurement, GPS location and collection schedule or pick recognition.
FR-3	**Predictions for bin fulness**	It is a 24×7 monitoring system is designed for monitoring the dumpster. If either of the containers is full then an alert message is sent from the dustbin to employees and the cloud. In turn, employees can clear the corresponding dumpster. The bin has Sensors that can recognize picks as well;so you can check when the bin was last collected. With real-time data and predictions, you can eliminate the overflowing bins and stop collecting half-empty ones.
FR-4	**Plan waste collection routes**	Based on current bin fill-levels and predictions of reaching full capacity, you are ready to respond andschedule waste collection. You can compare planned vs. executed routes to identify any inconsistencies.

4.2 Non-Functional requirements

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	A smart solution has been proposed to make the waste by sorting more simple and accurate and improve the user experience, usability, and satisfaction. It aims to optimize ease of use while offering maximum functionality.
NFR-2	**Security**	Building and deploying IoT-based smart waste management in cities can be a complex,time consuming and resource-intensive process. Many municipal IT departments will not have the resources or in-house skills to support such a project internally.
NFR-3	**Reliability**	Smart waste management is also about creating better working conditions for waste collectors and drivers. Operates in a defined environment without failure resulting in less manpower, emissions, fuel use and traffic congestion.
NFR-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.
NFR-5	**Availability**	Another purpose of this project is to make the proposed waste management system as cheap as possible. By this we empower cities,businesses, and countries to manage waste smarter.
NFR-6	**Scalability**	Using smart waste bins reduce the number of bins inside town , cities coz we able to monitor the garbage 24/7 more cost effect and scalability when we moves to smarter.

5.PROJECT DESIGN

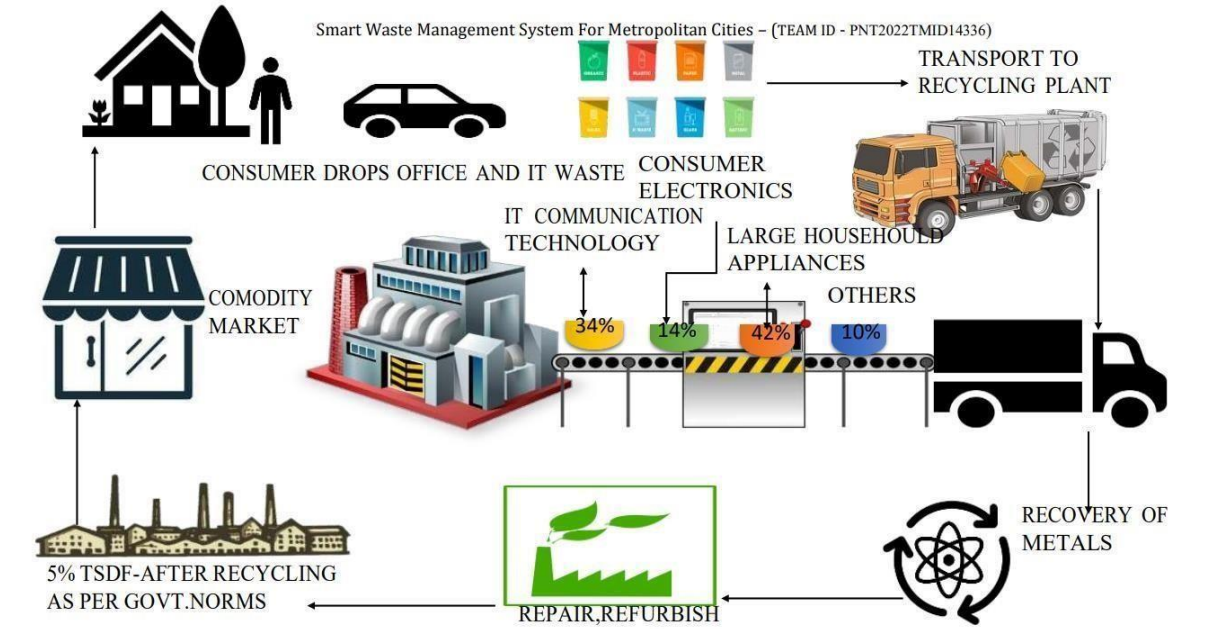
5.1 Data Flow Diagrams

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.

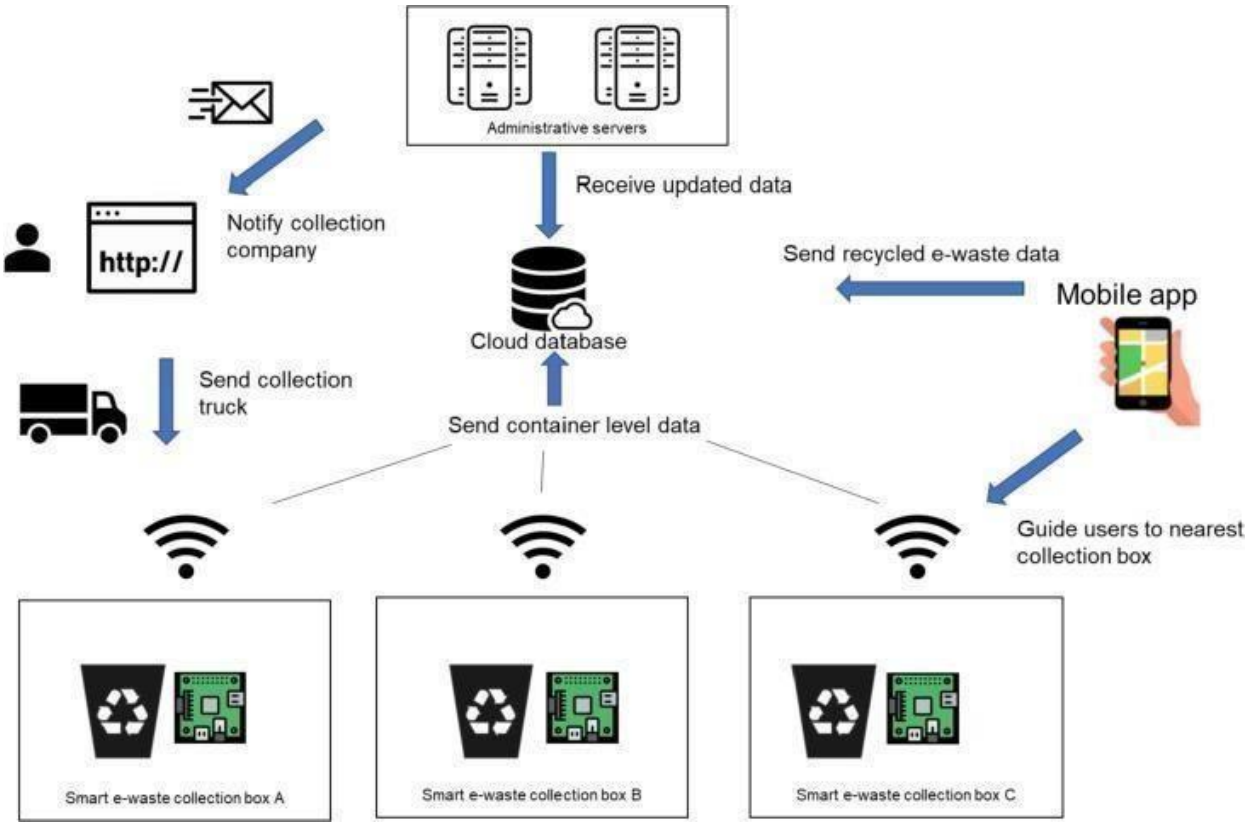
It shows how data enters and leaves the system, what changes the information, and where data is stored.

A smart waste management platform uses analytic 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



5.2 SOLUTION AND TECHNICAL ARCHITRCTURE



S. No	Component	Description	Technology
1.	User Interface	IOT cloud platform /WEB PORTAL	HTML,CSS,NODE R /MQTT PROTOCOL
2.	Application Logic-1	The bin waste data's are collected using sensors	Python /ultras
3.	Application Logic-2	The data which is collected are monitored using IOT	IBM Watson S
4.	Application Logic-3	To Get the location of the garbage	GPS
5.	Database	• MySQL is a relational database that is based on a tabular design. • NoSQL is non-relational and has a documentbased design.	MySQL, NoSQ
6.	Cloud Database	Database service on cloud	IBM DB2, IBM C
7.	File Storage	File storage requirements	IBM Block Stora
8.	External API-1	External APIs expose a project's internal resources to outside users or applications	IBM Weather AP
9.	External API-2	External API allow you to access third party resources that are available through RESTful web services	Aadhar API, etc.
10.	Machine Learning Model	The proper algorithm makes planning good. It will guide the goodness character and which path should be taken and which garbage bin should be collected first	Python IDLE or Anaconda navig Jupitar
11.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Cloud Server Configuration: Cloud deployment is the process of deploying an application through one or more hosting models—software as a service (SaaS), platform as a service (PaaS) and or infrastructure as a service (IaaS) that leverage the cloud Local Server Configuration : A local server gives you exclusive access	Cloud server- My Local server-HT

		to data and objects in a set of Windows folders called data directories	

Table-2: Application Characteristics:

S. No	Characteristics	Description	Technology
1.	Open-Source Frameworks	NodeRed ,python ,IBM Simulator	IOT
2.	Security Implementations	Fundamental component of data security that dictates who's allowed to access and use company information and resources. Firewalls use a rule-based access control model with rules expressed in an access control list.	Firewall

3.	Scalable Architecture	By Using smart waste bins ,we can decrease the number of bins used in cities and towns so that we can able to monitor the garbage anytime .It will be more cost efficient and scalable when we moves to smarter.	IOT
4.	Availability	By Automatic adjustment of farming equipment made possible by linking information like crops/weather and equipment to auto-adjust temperature, humidity, etc.	IOT, RFID
5.	Performance	The Smart Sensors use ultrasound technology to measure the fill levels (along with other data) in bins several times a day. Using a variety of IoT networks ((NB-IoT, GPRS), the sensors send the data to Sensor's Smart Waste Management Software System, a powerful cloud-based platform, for data-driven daily operations, available also as a waste management app.	IOT, GPRS

6.PROJECT PLANNING AND SCHEDULING

6.1. Sprint Planning and Estimation

TITLE	DESCRIPTION	RELEASE DATE
Literature Survey and Information Gathering	Surveying on the topic of selected project & gathering information by referring the, technical papers ,research publications etc.	23 SEPTEMBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user pains & gains on particular issue.	25 SEPTEMBER 2022
Ideation	Jot down the ideas by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	27 SEPTEMBER 2022
Proposed Solution	Prepare your proposed solution of the project which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	28 SEPTEMBER 2022
Problem Solution Fit	Prepare problem - solution fit document.	28 SEPTEMBER 2022
Solution Architecture	Prepare solution architecture document.	30 SEPTEMBER 2022
Customer Journey Map	Prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit)	17 OCTOBER 2022
Functional Requirement	Prepare the functional requirement for the project.	17 OCTOBER 2022
Data Flow Diagrams	Draw the data flow diagrams to understand the flow of execution of the project.	18 OCTOBER 2022
Technology Architecture	Prepare the technology architecture diagram.	18 OCTOBER 2022
Milestone & Activity List	Prepare the milestones & activity list of the project.	29 OCTOBER 2022

Delivery of Sprints	Submit the coding development of the project and submit in sprints. Sprint -1 Sprint -2 Sprint -3 Sprint -4	30 October 2022 5 November 2022 11 November 2022 17 November 2022

6.2. Sprint Delivery Schedule

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	P
Admin (who manage web server)	Web server login	USN-1	As a admin, I have my own user name and a password so that i can manage workers and co workers.	I can manage web account and direct workers.	H
Co-admin	Login	USN-2	As a co admin , i'll manage the garbage levels whenever it get full or over loaded we will have the alert so that it will be cleared in a scheduled time.	I can monitor garbage bins activities.	H
Truck driver	worker	USN-3	As a truck driver , I will be subsequent to the way addressed by the co-admin to reach the filled garbage.	I can update my activities on site when the given task has been completed	m
Local garbage collector	Worker	USN-4	As a waste collector, I'll collect all the trash from garbage and load into garbage truck and send them to landfill.	I can attend calls and respond people by rectifying the problem.	m
Municipality	Worker	USN-5	As a municipality, I will look at the process carefully happening in ordered manner and I will manage for without causing any issues.	I can manage all these process going good	H

Project Tracker, Velocity & Burndown Chart: (4 Marks)

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	30 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

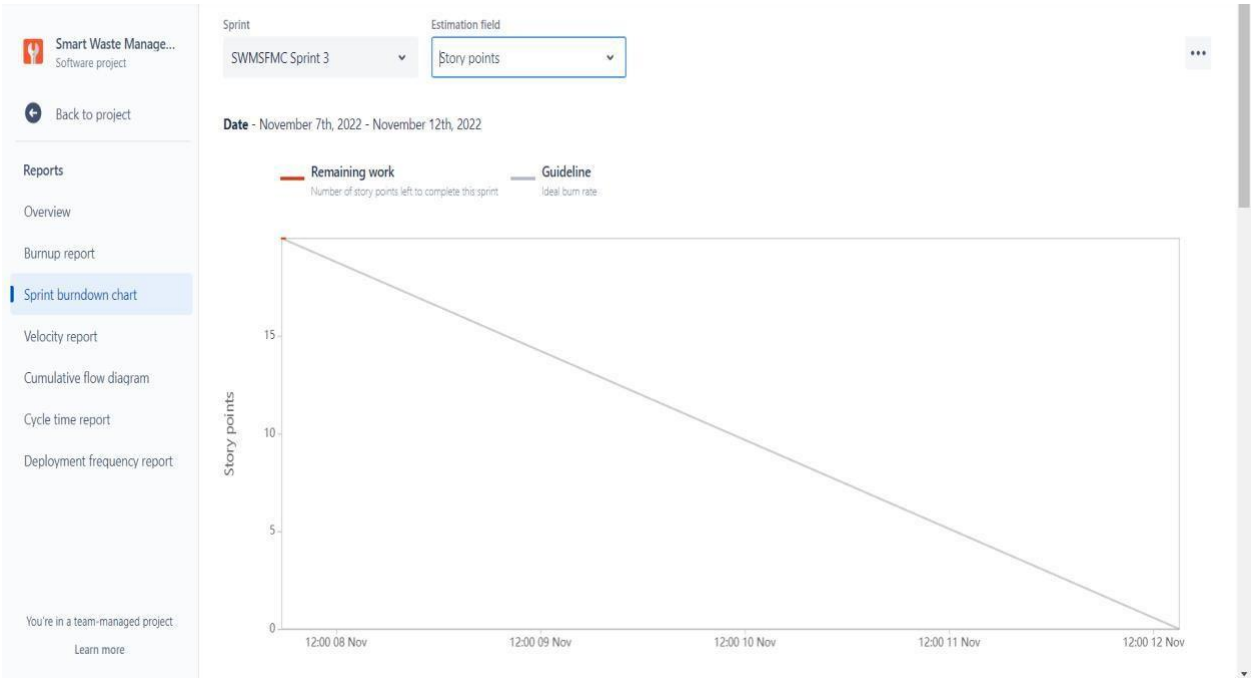
Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

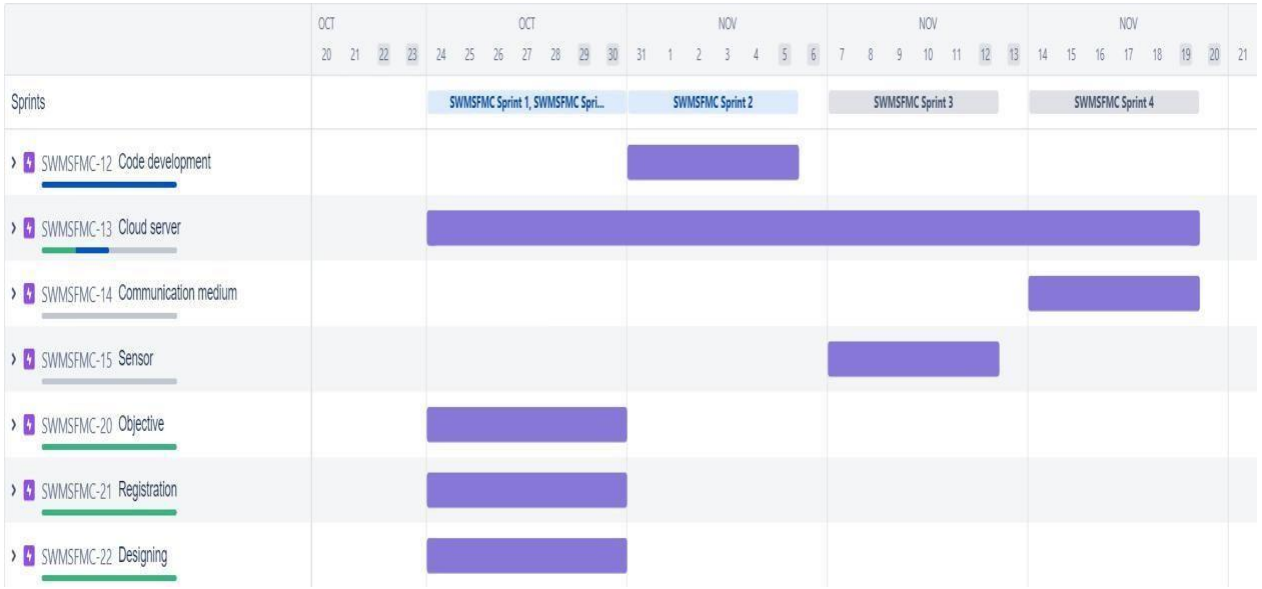
6.3 Reports from JIRA

BURNOUT CHART

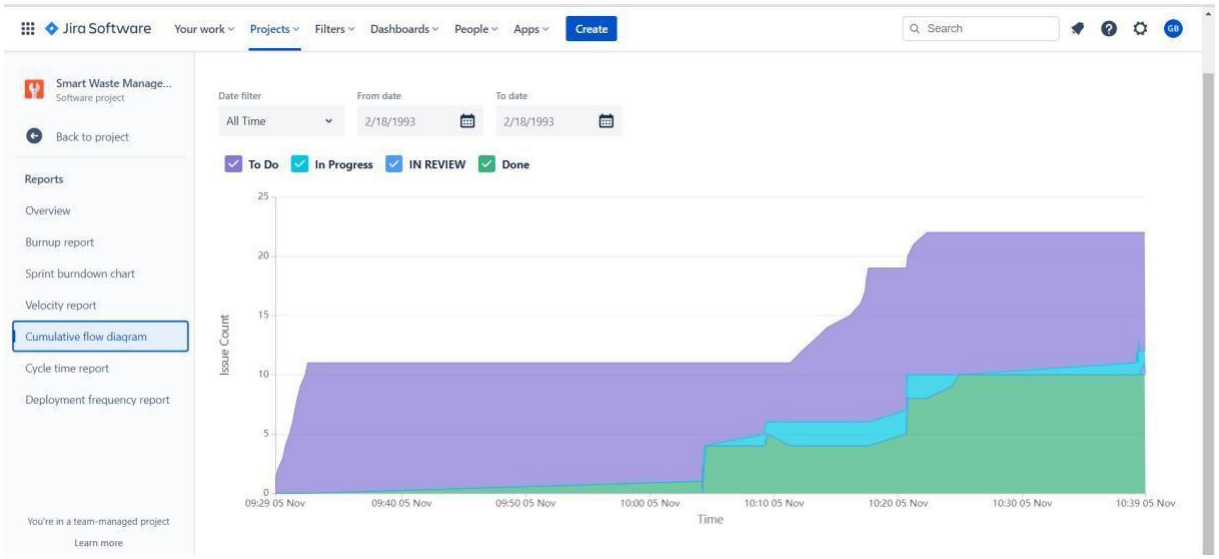


JIRA SOFTWARE SCREENSHOTS

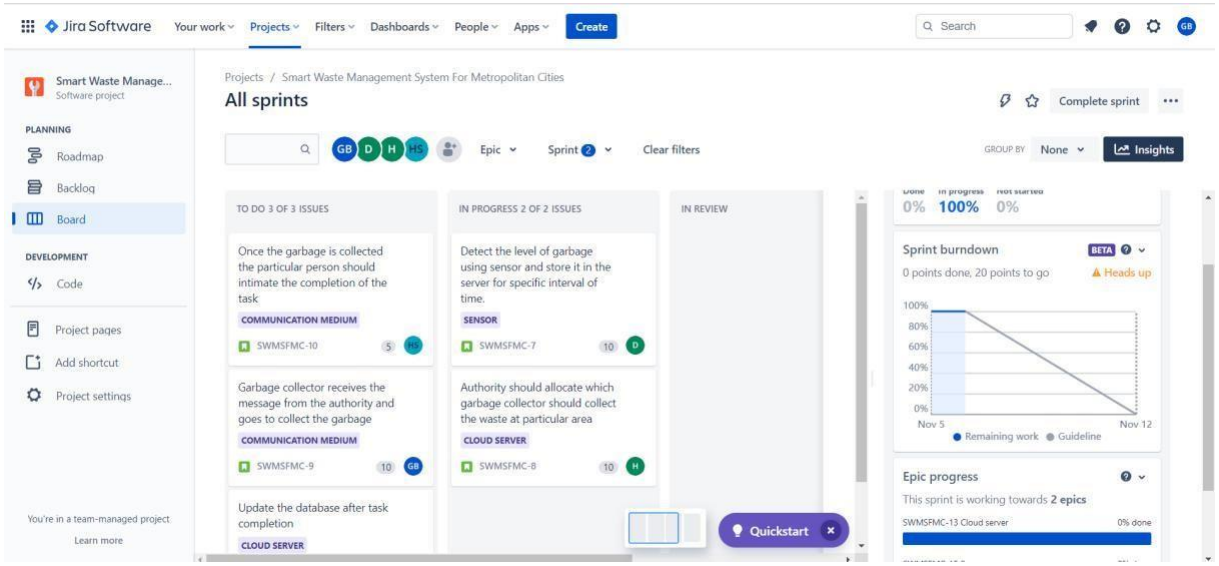
ROADMAP



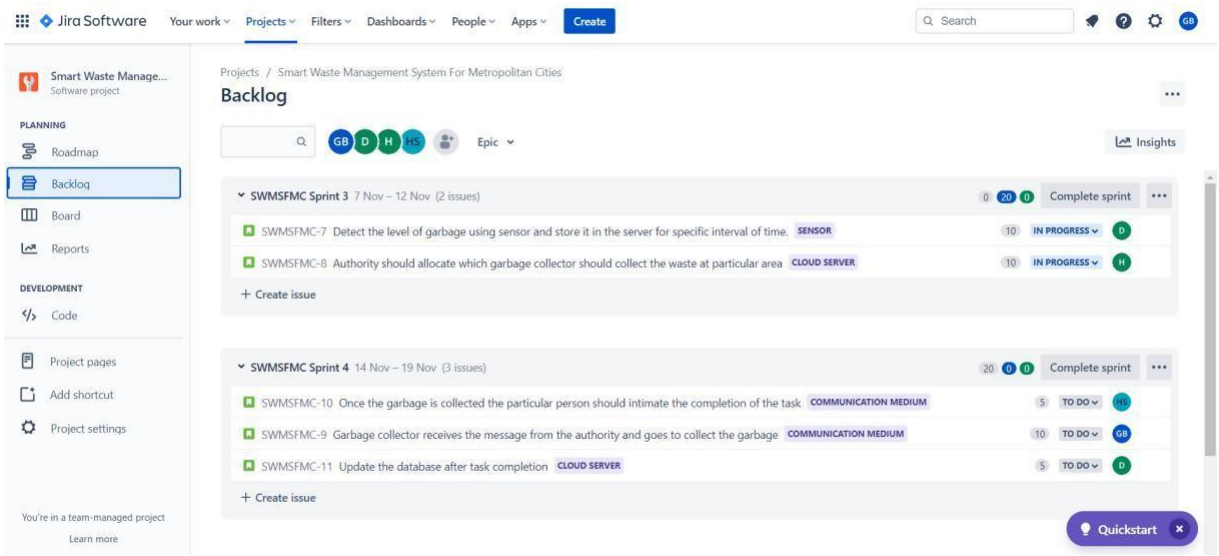
CUMULATIVE FLOW DIAGRAM



BOARDS

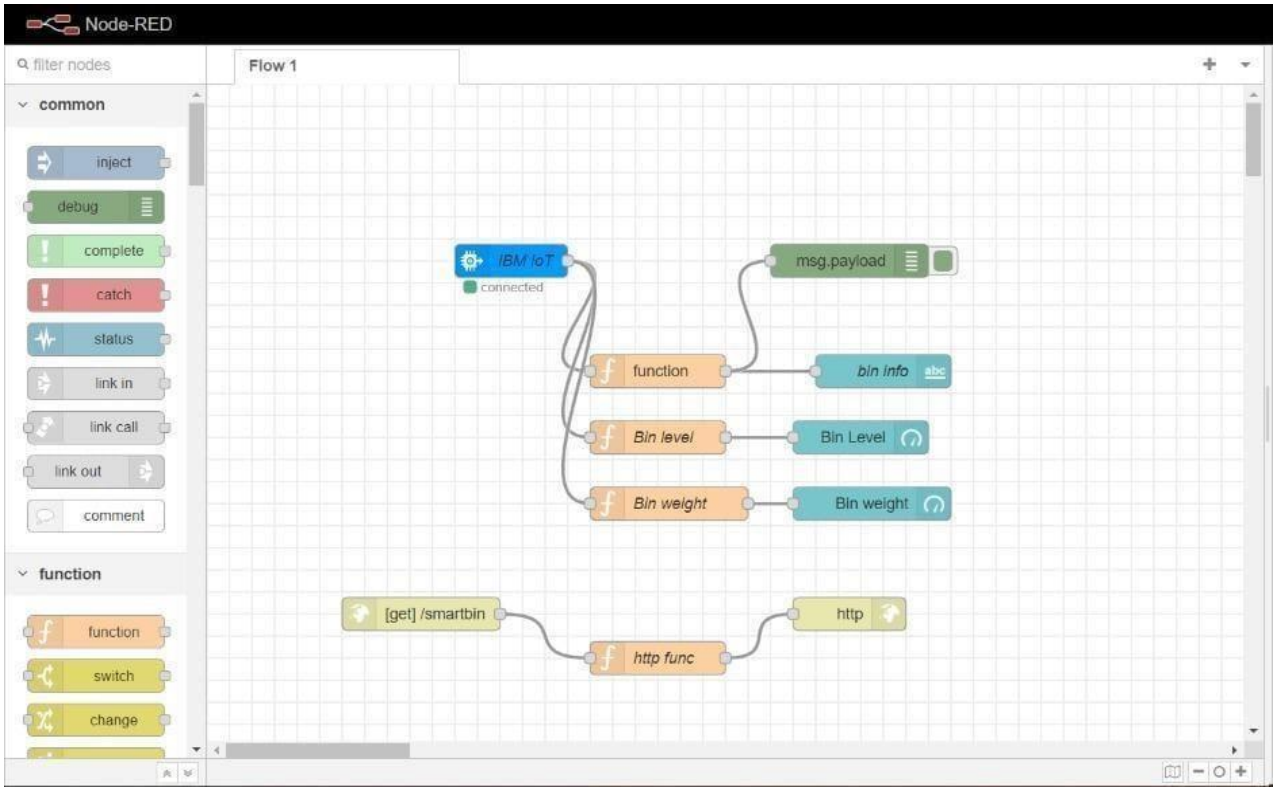


BACKLOG

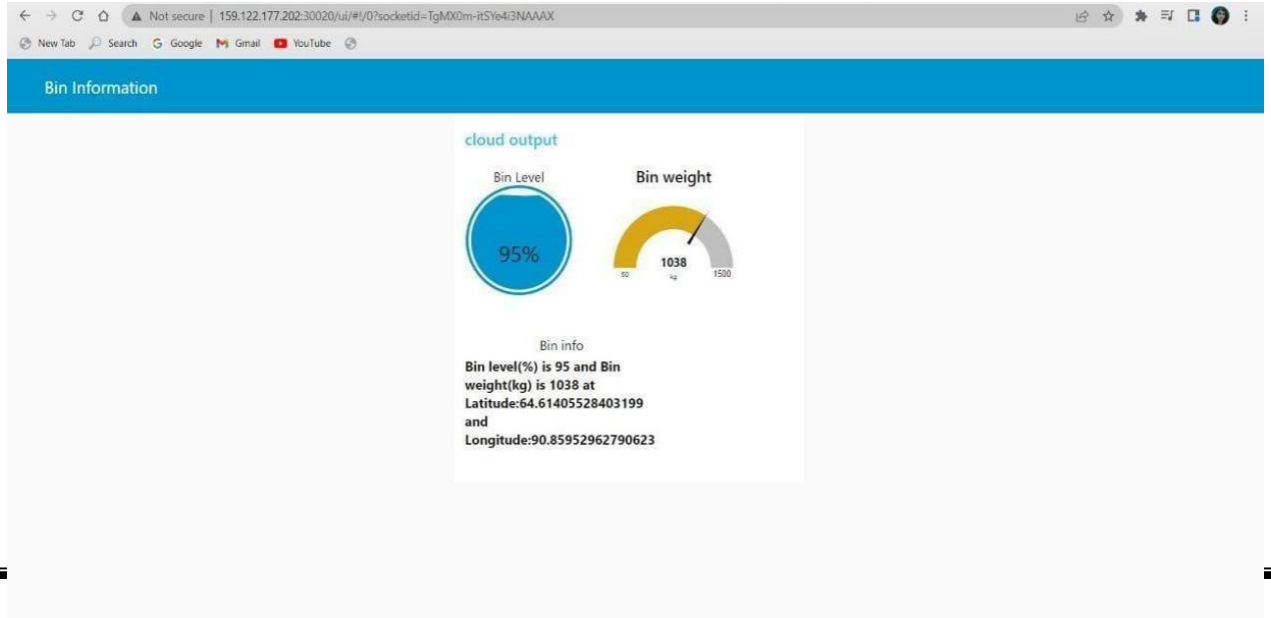


7. CODING & SOLUTIONING (Explain the features added in the project along with code)

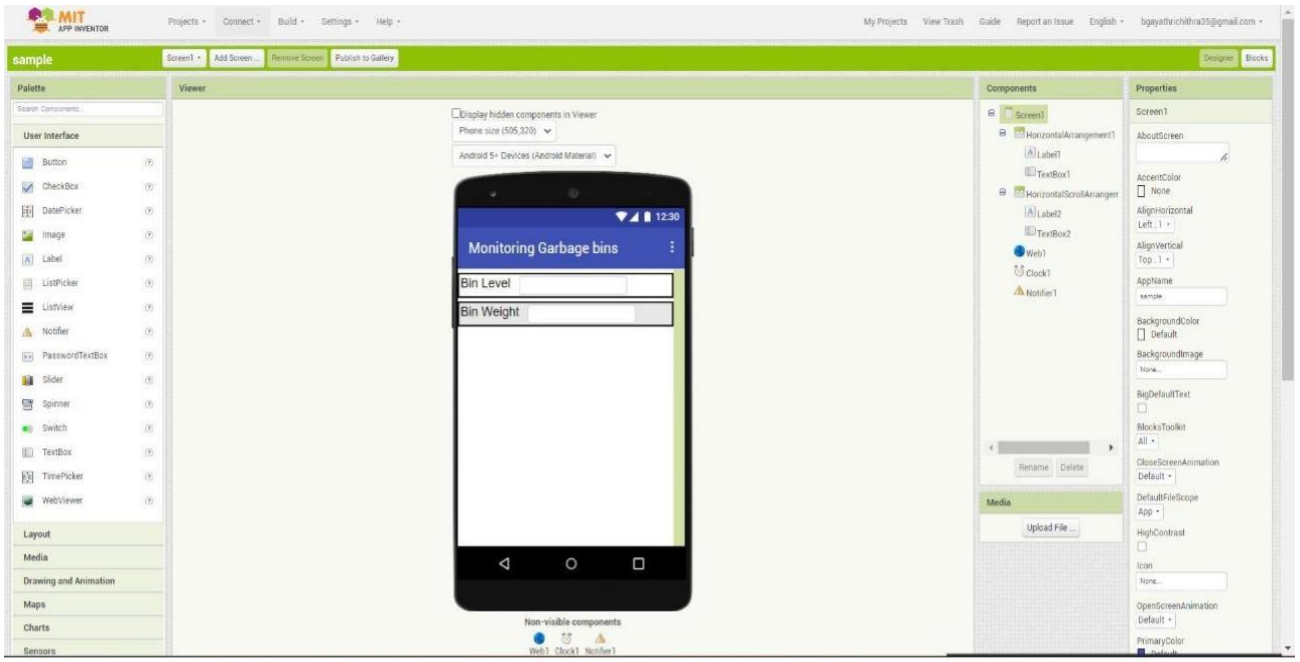
7.1 Feature 1 - Node Red

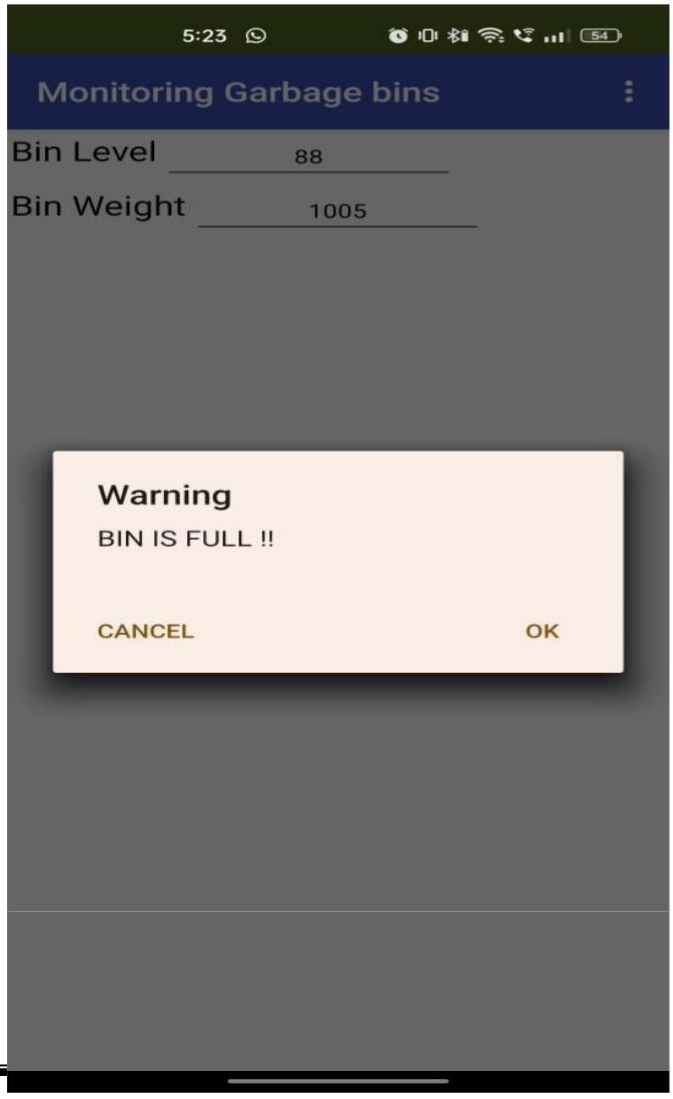


7.2 Feature 2- Web UI Displaying bin details

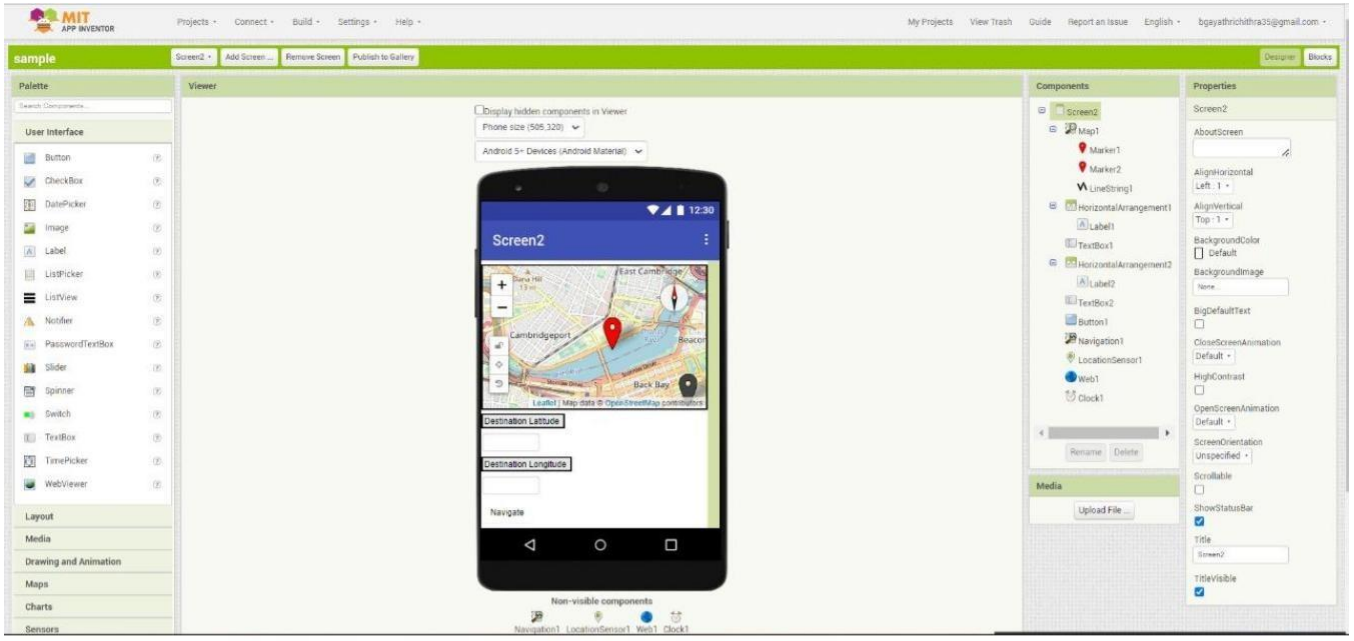


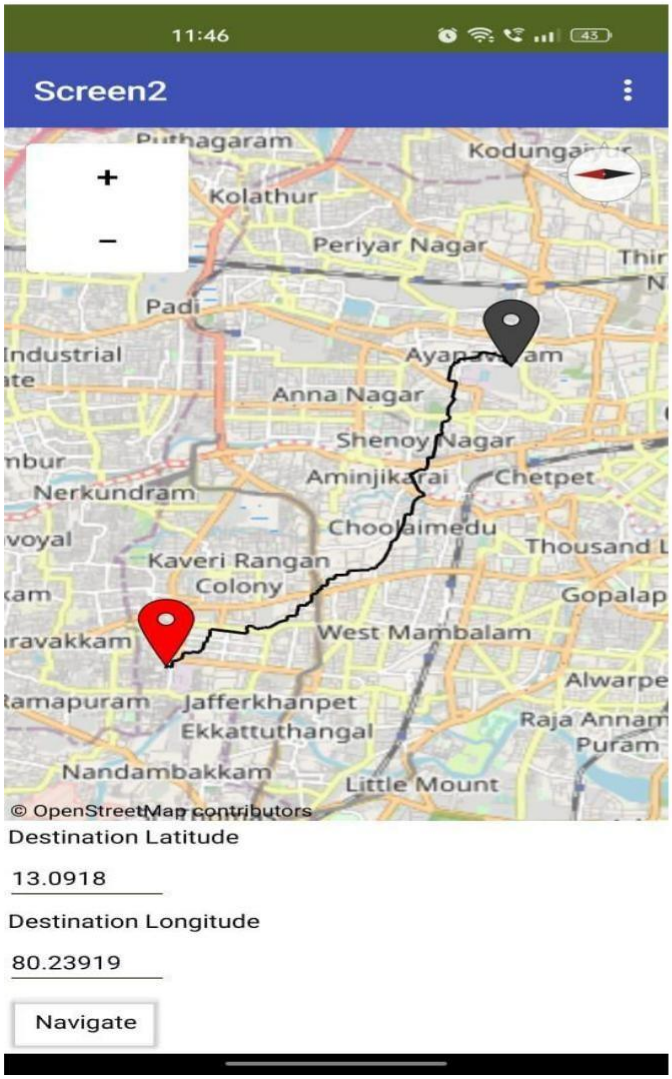
7.3 Feature 3-Live update on collected Data





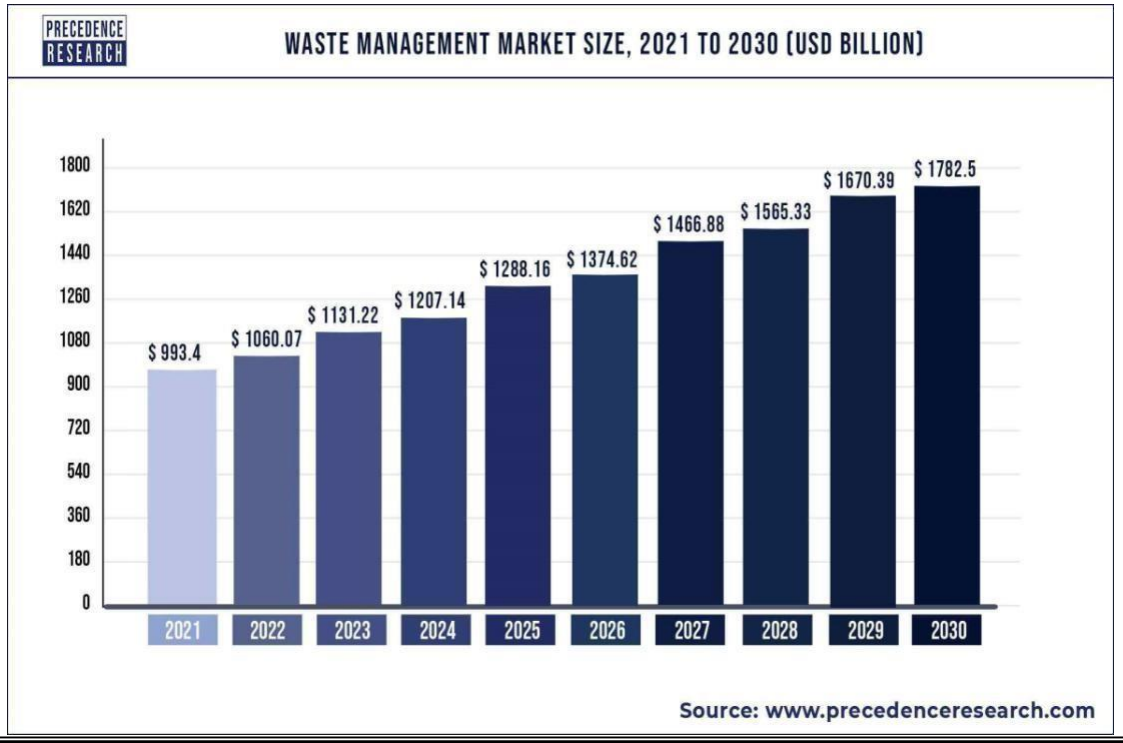
7.4 Feature 4 - Location Tracker





8.RESULTS

8.1 Performance Metrics



9. ADVANTAGES &

DISADVANTAGES ADVANTAGES:

1.Reduction in Collection Cost

2.No Missed Pickups

3.Reduced Overflows

4.Waste Generation Analysis

5.CO2 Emission Reduction

DISADVANTAGES:

System requires a greater number of waste bins for separate waste collection as per population in the city.

This results in 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

12)APPENDIX

SOURCE CODE

```
import wiotp.sdk.device
import time
import random
myConfig = {
    "identity": {
        "orgId": "ktymlx",
        "typeId": "new",
        "deviceId":"09876"
    },
    "auth": {
        "token": "Kamesh@2002"
    }
}

def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
    m=cmd.data['command']

client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()

while True:
    latitude=random.uniform(27.2046,125.25)
    longitude=random.uniform(77.4977,100.1526)
    binlevel=random.randint(10,100)
    if binlevel >=90:
        myData={'latitude':latitude, 'longitude':longitude,'binlevel':binlevel}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0, onPublish=None)
##print("Published data Successfully: %s", myData)
print("!!BIN IS FULL!!",myData)
client.commandCallback = myCommandCallback
time.sleep(4)

else :
 print(“bin is in normal level”)
time.sleep(4)



client.disconnect()
```

GITHUB LINK :

https://github.com/IBM-EPBL/IBM-Project-51591-1660980706