Project Report

Team ID	**PNT2022TMID28837**
Project Name	**Smart waste management system for metropolitan cities**

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

1.2 Purpose:

We amalgamate technology along with waste management in order to effectively create a safe and a hygienic environment. Smart waste management is about using technology and data to create a more efficient waste industry. Based on IoT (Internet of Things) technology, smart waste management aims to optimize resource allocation, reduce running costs, and increase the sustainability of waste services. This makes it possible to plan more efficient routes for the trash collectors who empty the bins, but also lowers the chance of any bin being full for over a week. A good level of coordination exists between the garbage collectors and the information supplied via technology. This makes them well aware of the existing garbage level and instigate them whenever the bins reach the threshold level. They are sent with alert messages so that they can collect the garbage on time without littering the surrounding area. The fill patterns of specific containers can be identified by historical data and managed accordingly in the long term. In addition to hardware solutions, mobile applications are used to overcome the challenges in the regular waste management system, such as keeping track of the drivers while they are operating on the field. Thus, smart waste management provides us with the most optimal way of managing the waste in an efficient manner using technology.

2. LITERATURE SURVEY:

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 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 viruses and bacteria (i.e., salmonella and e-coli), which are a risk to human health.

2.2 References:

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.

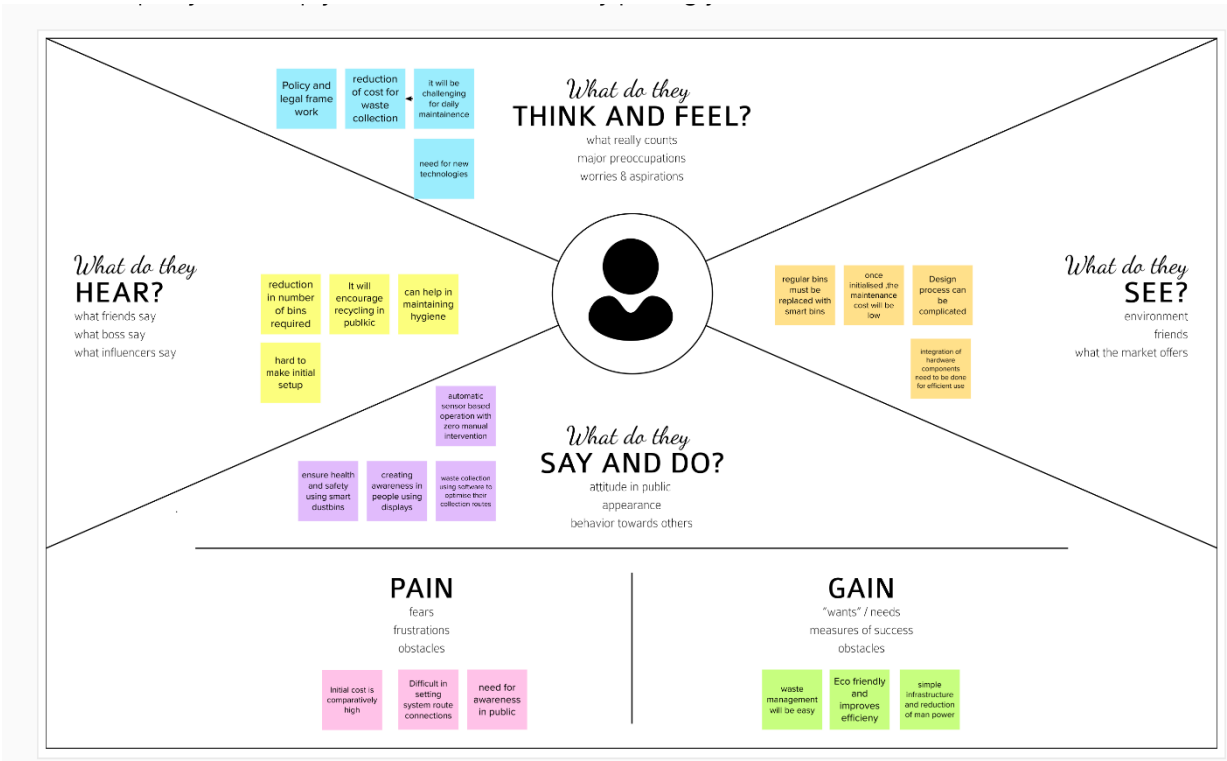
2.3 Problem Statement Definition:

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

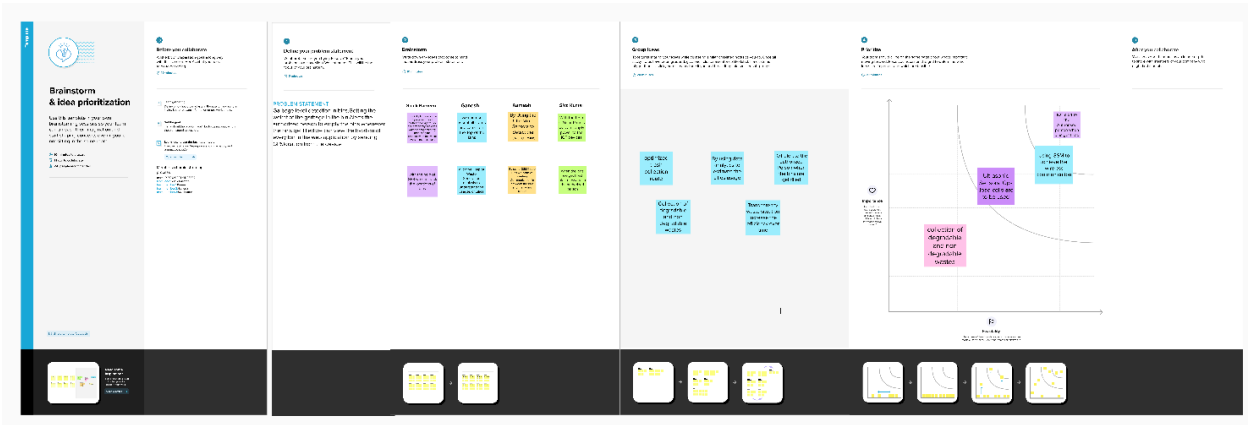
PS-2	A citizen	Dump the waste in the closed dust bins	Due to overfill of waste materials these waste spread all over the surroundings	Improper management of dust bins by municipality	Poorly managed waste often ends up in ponds , reservoirs or drainage systems which leads to diseases like malaria, cholera 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 optmize 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

Proposed Solution Template:

Project team shall fill the following information in proposed solution template.

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.

Problem solution fit:

AS

8. CHANNELS OF BEHAVIOUR

ONLINE:

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

OFFLINE:

People may provide a valuable re
and contribution to the organization

CS

1. CLIENT SECTION

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.

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.

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 of investment as it involves both the collection of waste and its transportation for 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 ways to manage waste yet it challenges are still rife.

9. PROBLEM ROOT CAUSE

There are some problems c
when facing the waste/recycling ind
Misunderstanding of the operations
sensors, setting up the smart sensor
nonoptimized track routes, recycling
nonuniform waste distribution of wa
bins.

Identify strong TR & EM

3. ACTIVATE

After initiating the project we can activate society by seeing their neighbour peoples produce the fulfillment of technology more useful and reading about a more efficient solution in the news.

4.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.

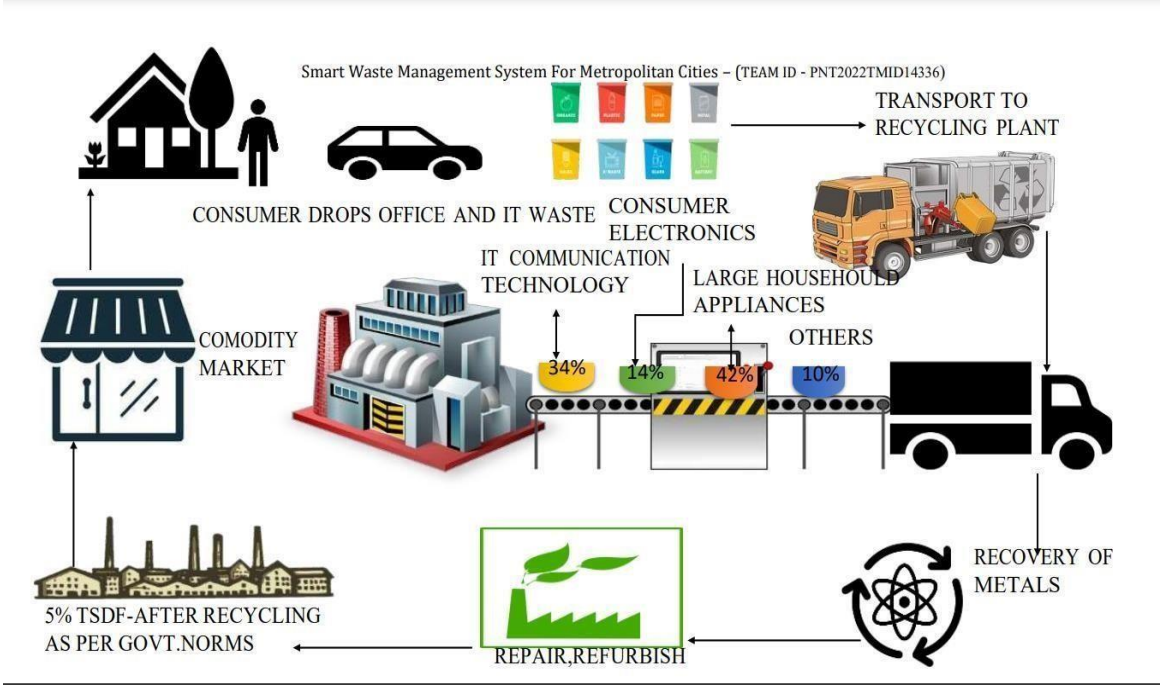
10. YOUR SOLUTION

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.PROJECT DESIGN

4.1Data flow diagram:



User stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	
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.	
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.	
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	
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.	
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	

4.2 Solution & Technical Architecture:

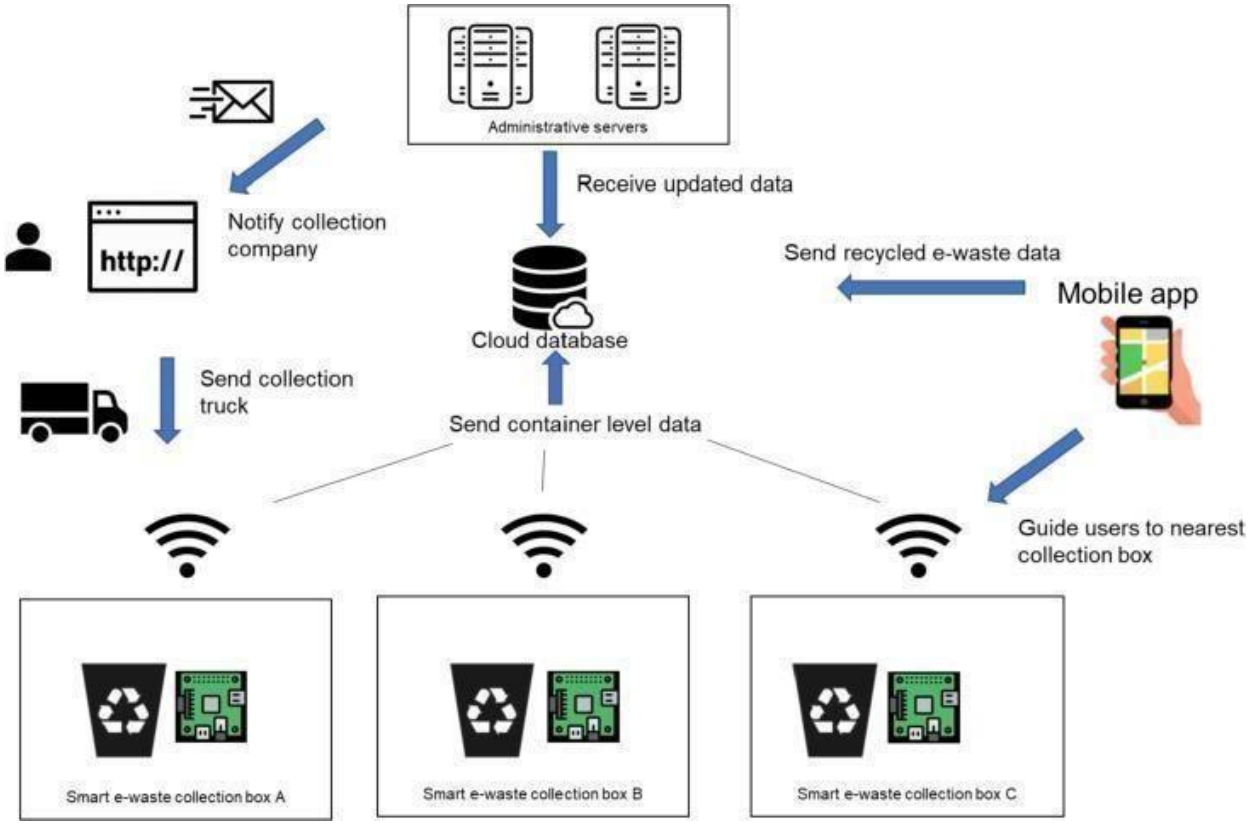


Table-1: Components & Technologies:

S. No	Component	Description	Technology
1.	User Interface	IOT cloud platform /WEB PORTAL	HTML,CSS,NODE RED PROTOCOL
2.	Application Logic-1	The bin waste data's are collected using sensors	Python /ultraso
3.	Application Logic-2	The data which is collected are monitored using IOT	IBM Watson ST
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, NoSQL

6.	Cloud Database	Database service on cloud	IBM DB2, IBM Cl
7.	File Storage	File storage requirements	IBM Block Storag
8.	External API-1	External APIs expose a project's internal resources to outside users or applications	IBM Weather API
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 naviga 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 to data and objects in a set of Windows folders called data directories	Cloud server- My Local server-HTT

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

5. functional requirements

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Detailed bin inventory.	The bins and stands which are monitored can be seen on the map, and we can also visit them at any time via the Street View feature from Google map .Bins or stands are visible on the map as green, orange circles. We can also see the bin details in the Dashboard – last weight measurement, GPS location and collection schedule.
FR-2	Real time bin monitoring.	The Dashboard displays which displays all the real-time data on filling levels of bins monitored by smart sensors. Along to the percentage of fill level, based on the previous data, the tool predicts when the bin will become full, one of the functionalities that are not included even in the best waste management software.. Sensors recognize picks as well; so you can check when the bin was collected last . With the help of real-time data and predictions, you can eliminate the overflowing bins and stop collecting half-empty ones.

FR-3	Expensive bins.	One can help you identify bins that drove up your collection costs. The tool calculates a rating for each bin in terms of collection costs. *The tool considers the average distance depo bin discharge in the area. The tool assigns bin a rating and calculates the distance from depo bin discharge.
FR-4	Adjust bin distribution.	Ensure that the most optimal distribution of bins and Identify areas with either dense or sparse bin distribution. Make sure that all trash types are represented within a stand. Based on the previous data, you can adjust bin capacity or location where ever necessary.
FR-5	Eliminate Unefficient picks.	Removing 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 can be collected.
FR-6	Plan waste collection routes.	The tool which semi-automates the waste collection planning of route. Based on current bin fill levels and predictions of reaching full capacity, we need to be ready to respond and schedule waste collection. We can also compare planned vs. executed routes to identify any inconsistencies.

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. In the design process with user experience as the core, the analysis of users' product usability can indeed help designers better understand users' potential needs in waste management, behavior and experience.
NFR-2	**Security**	Use a reusable bottles Use reusable grocery bags Purchase wisely and recycle Avoid single use food and drink containers.
NFR-3	**Reliability**	Smart waste management is also about creating better working conditions for waste collectors and drivers. Instead of driving the same collection routes and servicing empty bins, waste collectors will spend 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 (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 Sensoneo's Smart Waste Management Software System, a powerful cloud-based platform, for data-driven daily operations, available also as a waste management app. Customers are hence provided data-driven decision making, and optimization of waste collection routes, frequencies, and vehicle loads resulting in route reduction by at least 30%.
NFR-5	**Availability**	By developing & deploying resilient hardware and beautiful software 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

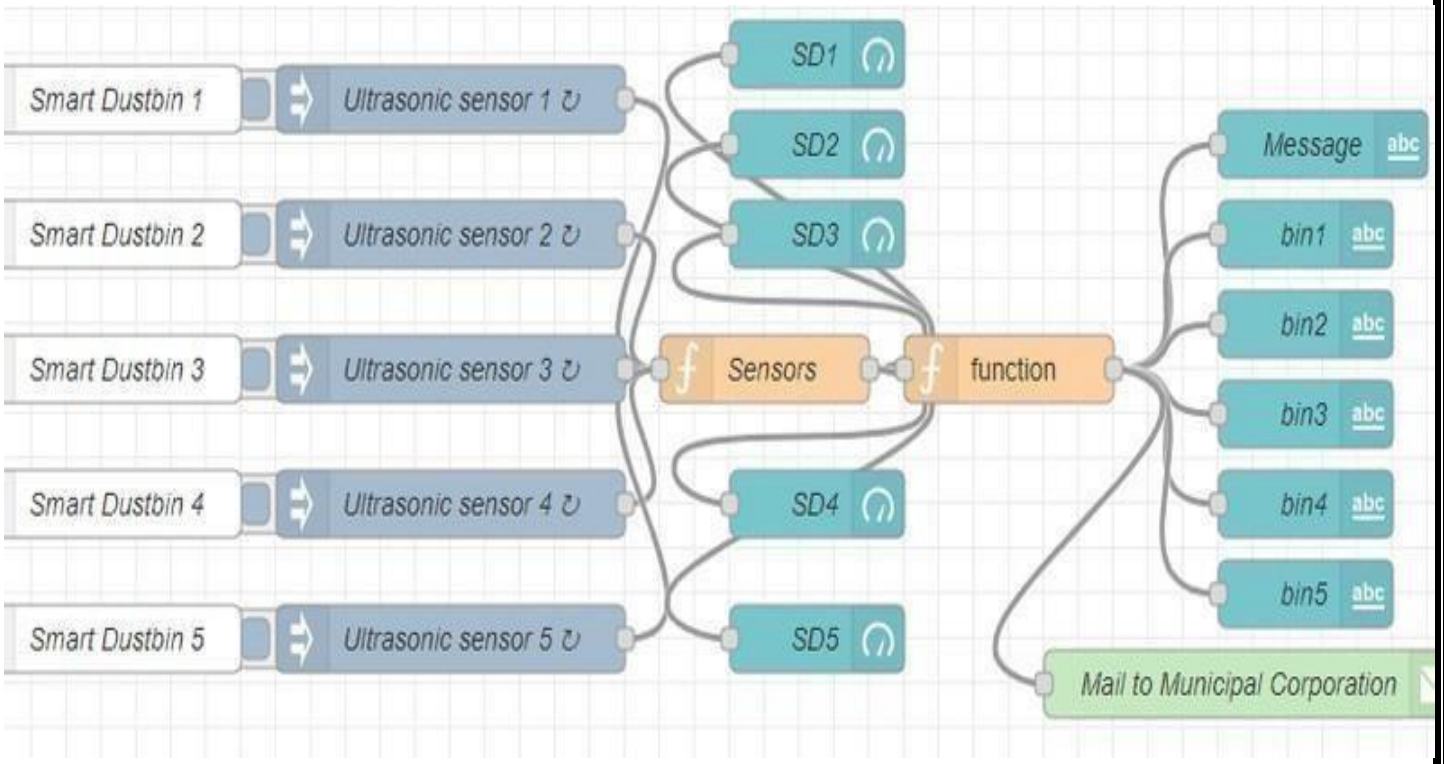
Non-functional Requirements:

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

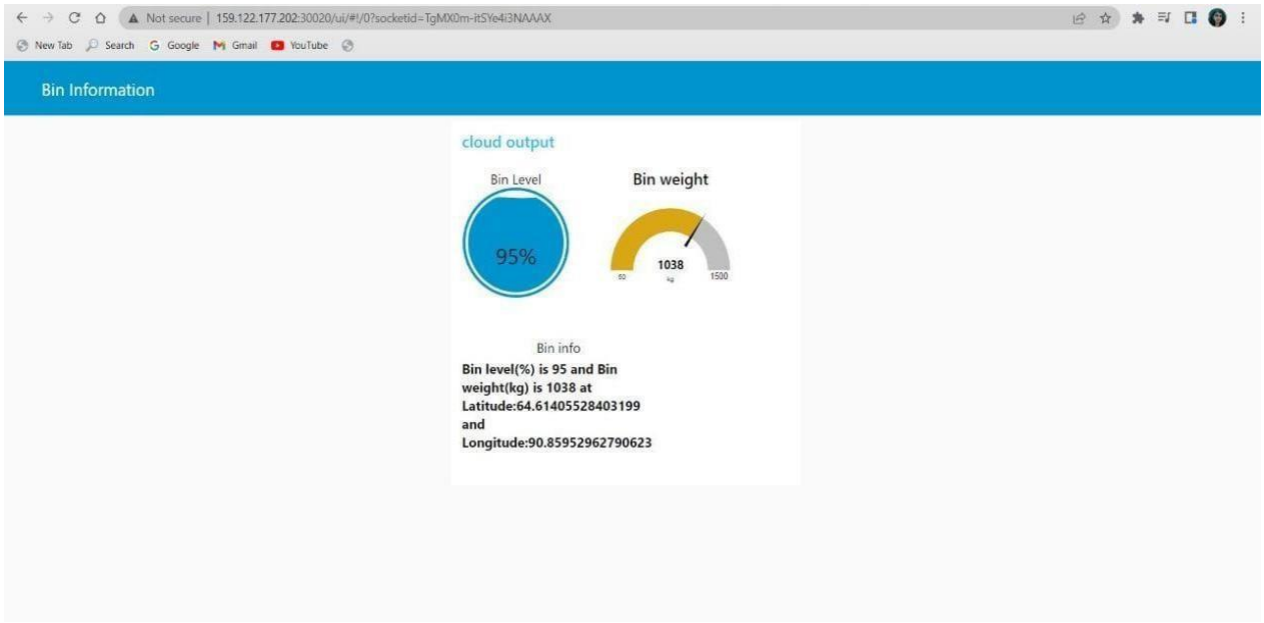
		garbage 24/7 more cost effect and scalability when we moves to smarter.

6)CODING SOLUTION

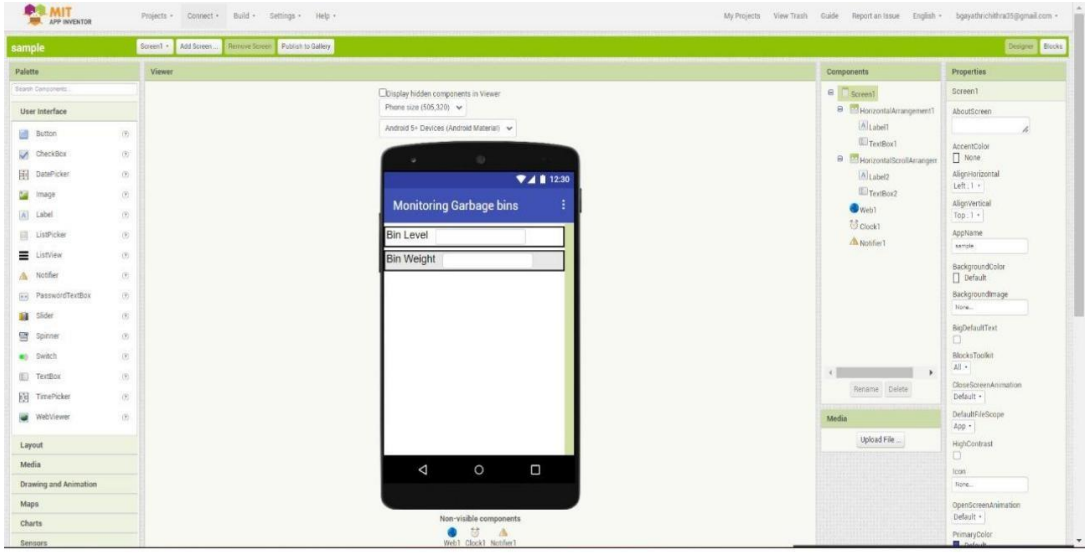
6.1 feature 1 – node red

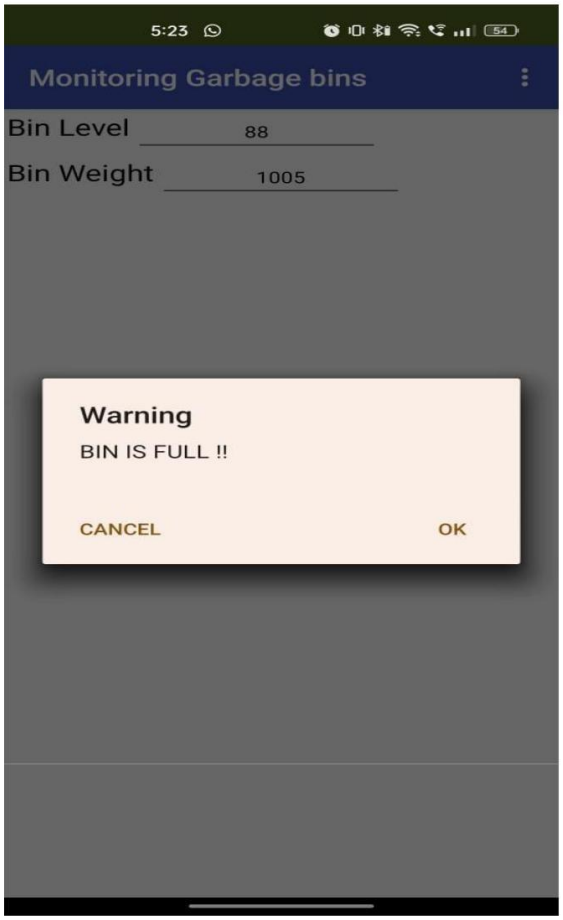


6.2 feature2 – web UI displaying bin details

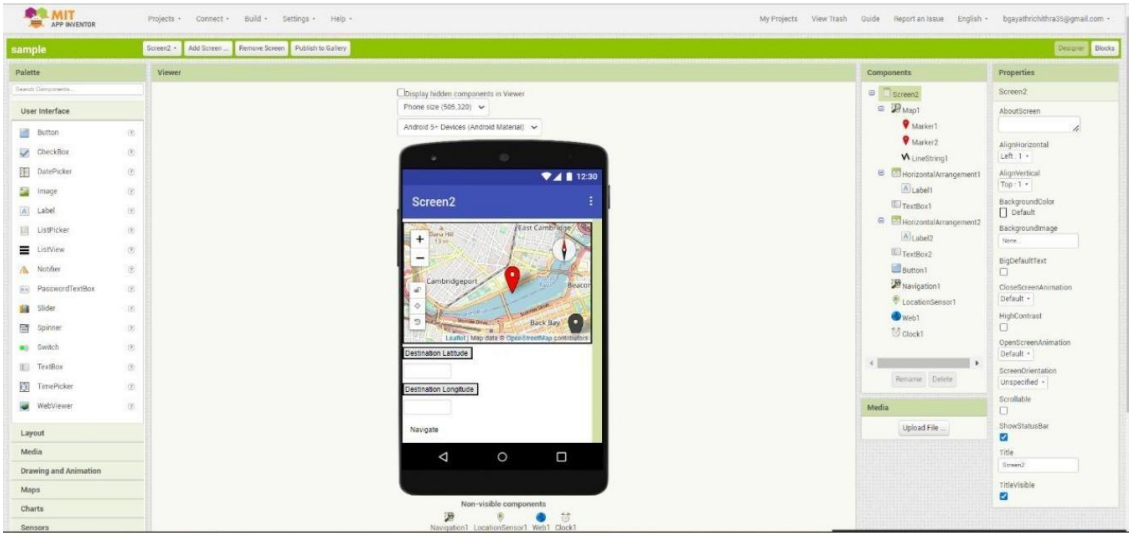


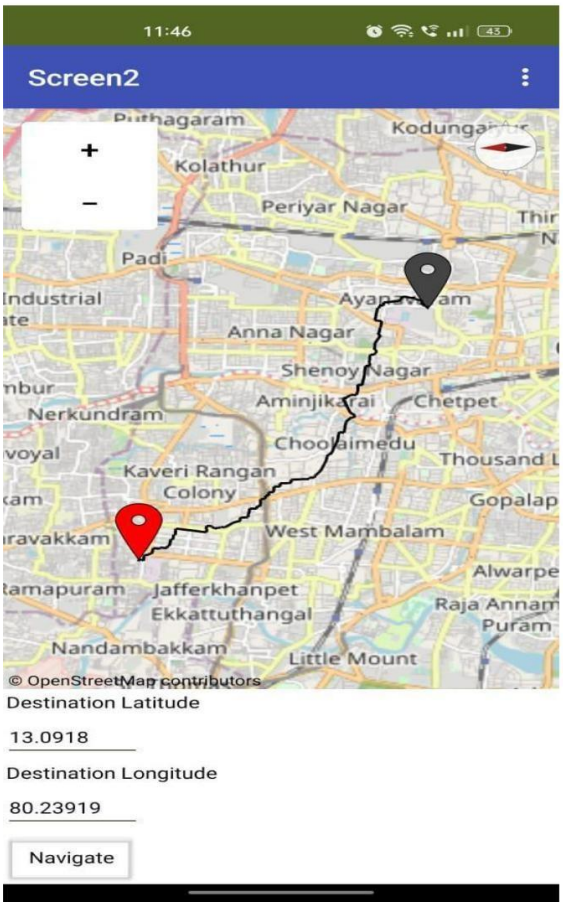
6.3 Feature3-Liveupdateon collectedData





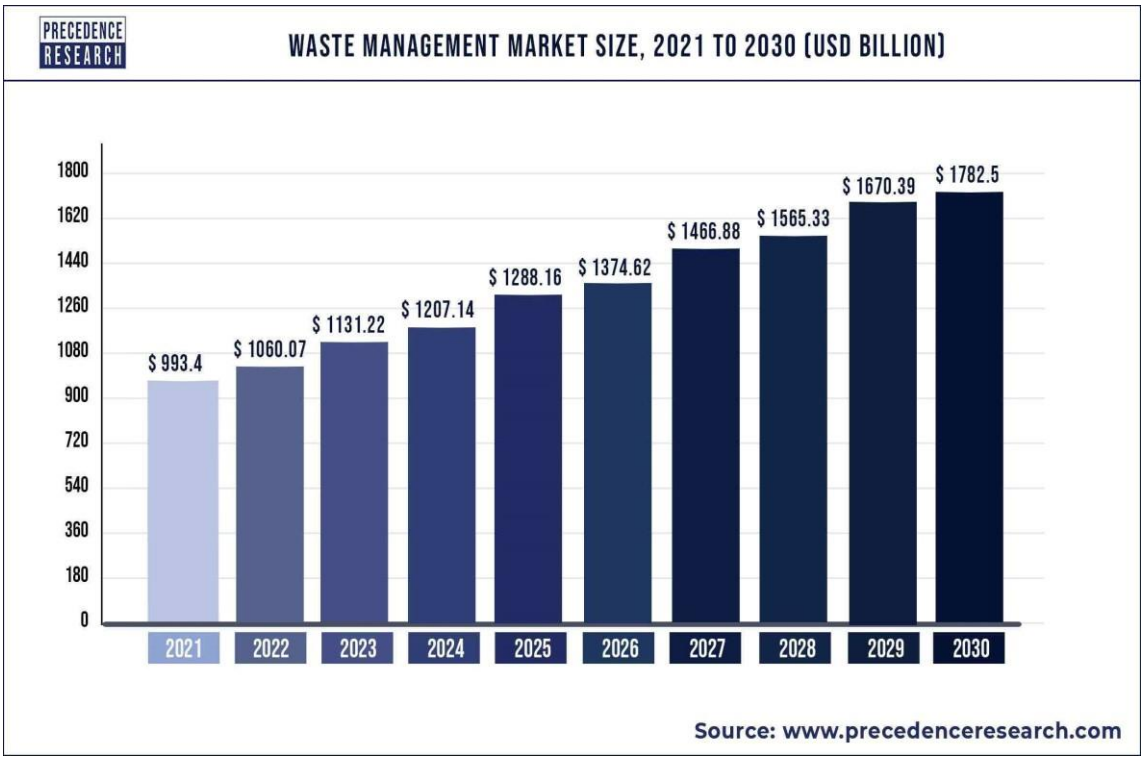
6.4 Feature4 - LocationTracker





7.RESULTS

7.1 Performance Metrics



8. 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.

9.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.

10.FUTURE SCOPE

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

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

2. The concept of green points would encourage the involvement of residents or end users, making the idea successful and aiding in the achievement of collaborative waste management efforts, thus fulfilling the idea of Swachh Bharath.

3. Having case study or data analytics on the type and times waste is collected on different days or seasons, making bin filling predictable and removing the reliance on electronic components, and fixing the coordinates.

4. Improving the Server's and Android's graphical interfaces

11) 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