Project Report

Project Report

Team ID	**PNT2022TMID35389**
Project Name	**Smart waste management system for metropolitan cities**

1. INTRODUCTION

1.1 Project Overview:

Design a smart waste collection system that allows citizens to segregate the various types of solid waste they want to dispose and the municipal authorities to efficiently collect the same. The system should be mobile app (Android) based.

- Garbage level detection in bins.
- Getting the weight of the garbage in the bin.
- Alerts the authorized person to empty the bin whenever the bins are full.
- Garbage level of the bins can be monitored through a web App.

We can view the location of every bin in the web application by sending GPS location from the device.

1.2 Purpose:

With increasing populations, changing policy requirements, new sustainability and recycling goals and improved technology departments, municipalities across the globe are joining the “smart cities” movement to become more efficient in managing solid waste. The improvement of the urban waste collection service and, in general, the achievement of a more efficient management of the waste, is one of the main challenges that the cities face, especially due to the population growth. Thus, smart waste management is a key factor of smart cities.

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 infectionand transmit diseases. Toxic components such as Persistent Organic Pollutants (POPs) pose particularly significant risks to human health and the environment as they accumulate through thefood 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 hazardouscomponents 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:

- Mohammad Aazam, Marc St-Hilaire, Chung-Horng Lung, Ioannis Lambadaris (2016) provides the idea of sensors-based waste bins, capable of notifying waste level status. An automatic waste bin and make use of cloud computing paradigm to evolve a more robust and effective smart waste management mechanism. Waste management is linked to different stakeholders, including recyclers, importers and exporters, food industry, healthcare, research, environment protection and related organizations, and tourism industry Mohammad Aazam et al proposed Cloud SWAM, in which each bin is equipped with sensors to notify its waste level. Different bins for each category of waste, namely: organic, plastic/paper/bottle, and metal. In this way, each type of waste is already separated and through the status, it is known that how much of waste is collected and of what type. The availability of data stored in the cloud can be useful for different entities and stakeholders in different ways. Analysis and planning can start from as soon as waste starts gathering and up to when recycling and import/export related matters are conducted. The system Cloud SWAM provides Timely waste collection. Timely and efficient way of collecting waste leads to better health, hygiene, and disposal. The system provides shortest path to the location of waste bins. So the collectors can plan a better and fuel efficient route. Recycling and disposal by the system s uses separate smart bins for each type of waste. So the stakeholders will be able to see through the cloud and analyse type of waste and its magnitude. So they can do better arrangements and efficient ways of recycling can be adopted in a dynamic way. Resource management by Cloud SWAM is based on the waste generation trends of a particular city and/or area, resources can be effectively managed since the data is available live through the cloud. Food industry planning can done through the Cloud SWAM. Food industry can plan according to the trends of a certain locality. In this way, not only waste material can be minimized, but also, food trends and habits of an area can be coped in a much more operative way. Taxation with Cloud SWAM keeping track of each kind of waste, better taxation and fine imposition can be performed on unnecessary waste generation. Big Data practices can be used to reduce waste generation and improve its management. Various healthcare stakeholders can take benefit from the gathered waste management data and foresee what type of diseases a particular locality is more prone to and how to prevent from certain types of insects and bugs from breeding. Waste-based energy production means generating energy from waste in the form of electricity or heat.

- Dr. N. Sathish Kumar, B. Vijayalakshmi, R. Jenifer Prarthana, A .Shankar uses tremendous power of RFID technology and presents the development of an electronic monitoring (e-monitoring) system to overcome the problems in the conventional approach. The emonitoring system is an embedded system that comprises of RFID technology interfaced with Arduino micro-controller and a web base which is completely computerized. . Dr. N. Sathish Kumar et al. designed a smart dustbin in which the dust bin gets blocked when it reaches a threshold value. The ultrasonic sensor measures the waste volume .microcontroller reads the data from sensor and alerts the server. For the verification process RFID tag (ID card of the cleaner) interrupts the RFID reader, the ultrasonic sensor checks the status of the dustbin and sends it to the web server. An android application is used to view the alerts and status at the server end. RFID technologies do not need line of sight and the RFID waste tag can be read without actually seeing it. An RFID-based waste management system proposed by Belal Chowdhury and Morshed U. Chowdhury (2007) [3] mainly consists of a smart waste (RFID) tag, a Reader and a waste management IT system (i.e., WMITS). A load cell is used to record the weight of bulk waste from each waste bin. A reader device attached to the PDA (Personal Digital Assistant) or a smart phone placed in waste collector vehicle (garbage/recycling truck) enables the chip to transmit its unique identification to the reader device, allowing the bin to be remotely identified. A RFID reader on each waste collector vehicle will ensure that the weight and identity of the waste is passed to the PDA and automatically logged into an integrated database server. The RFID reader can also request any additional information from the waste tag that is encoded on it. When robotic/lifting arms in the waste collector loaded onto the vehicle then the weighting measures the weight of each bin. The bin ID is then used to calculate actual waste disposal charges for each individual household.

- Belal Chowdhury and Morshed U. Chowdhury designed five layer architecture for RFID and sensor based waste management system. The layers are named as physical layer, middleware layer, process layer, data access layer and user interface layer. The physical layer consists of the actual RFID hardware components and it includes RFID waste tag, reader and antennas. Middleware layer is acting as the interface between the RFID reader, load cell sensor and waste management service providers (i.e., waste collectors, and municipalities) IT system. The important element of RFID and load cell sensor systems is middleware layer, which is viewed as the central nervous system from the waste management system perspective. This layer enables waste management service provider's (e.g., waste collector) a quick connectivity with RFID readers and load cell sensors and also the layer lowers the volume of information that waste management system applications need to process, by grouping and filtering raw RFID and load cell data from readers and sensors respectively. An application-level interface is provided by middleware layer for managing RFID readers, and load cell sensors for processing large volumes of waste data for their applications. The middleware layer is responsible for monitoring physical layer components. The Process Layer provides RFID and sensor based waste management system (business) processes that provide real-time integration into their existing systems. Also this layer enables data mapping, formatting, business rule execution and service interactions with databases. The data access layer is consisting of a RDBMS (Relational Database Management System) and applications that allow waste management service providers to create an RFID and sensor "events". This data access layer interacts with the SQL server and includes a data query/loading approach using SQL and customized data (i.e., customer/household information) that are presented to the waste management service provider (i.e., waste collector) for fast and accurate waste (e.g., garbage, recycling, and green) identification Finally, the user interface layer is composed of an extensible GUI (graphical user interface), which allows RFID devices (e.g., waste tag, reader) and load cell sensors in a uniform, user-friendly way to work seamlessly in a Windows environment. Mohd Helmy Abd Wahab, Aeslina Abdul Kadi

- Mohd Helmy Abd Wahab, Aeslina Abdul Kadir, Mohd Razali Tomari and Mohamad Hairol Jabbar proposed a Smart Recycle Bin that caters for recycling glass, paper, aluminium can and plastic products. It automatically evaluates the value of the wastes thrown accordingly and provide 3R card. The recycle system enables collection of points for performing a disposal activity into designated recycle bins. Such system encourages recycling activities by allowing the points to be redeemable for products or services. The system records the data related to the disposal activities, disposed material, identification of the user and points collected by the user. The user has to touch his card to the specified RFID reader at the recycle bin. Recycle bin doors open and user puts waste one by one. A microcontroller processes information about his user ID and number of wastes and send to a database server. The data base server calculates the user points and updates it. The system provides user login to an online system to check his total points
- Fachmin F olianto, Yong Sheng Low and Wai Leong Yeow proposed Smart bin system has 3 –tier architecture. The ultra sound sensor installed in every Smartbin senses bin fullness and report readings and sensor statuses. The sensor reading is transmitted to the gateway nod which is installed in every sensor cluster. It forwards the information to the backend server. The analytics module in the back end server analyses data collected by the bin sub system. The analytics module processes fullness readings, compares against predefined rules, and generates event upon exceeding threshold. The bin sub-system sends information to the workstation and it shows meaningful information to users through a graphical user interface.

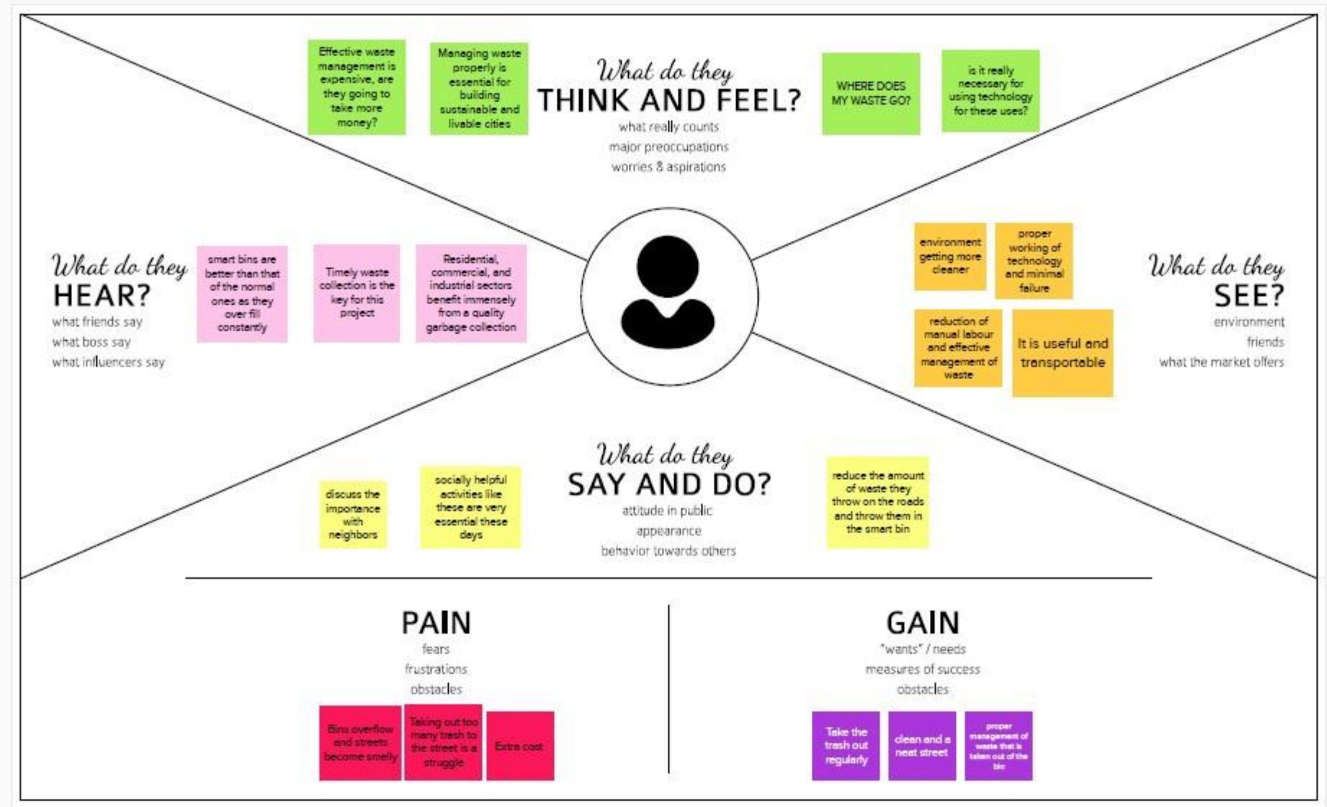
- Keerthana b et al designed internet of bins for trash management in India. The smart TRASH management system using sensor, microcontroller and other modules ensures emptying of dustbins appropriately when the garbage level reaches its maximum. Two threshold limits are set for the bins and an alert message is sent to the van that collects the trash if the waste amount reaches these thresholds. The system further allows the people to drop down the trash bags into the bins till it reaches the threshold limit .It waits for the acknowledgment from the van to clear off the bin and if the acknowledgment is not received it is sent again when it reaches threshold limit and the bin gets locked. When bin gets locked it displays the message "Overloaded". Then the dustbin will be monitored for a specific time and when not cleared within certain time limit, then a message will be sent to the higher authority who can take appropriate action

2.3 Problem Statement Definition:

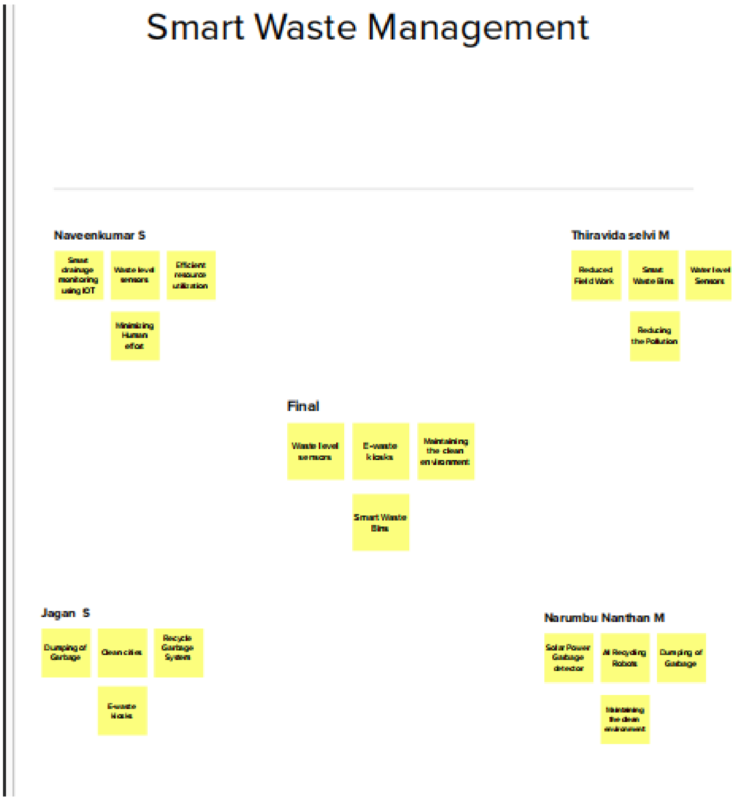
Problem Statement (PS)	**I am (Customer)**	**I'm trying to**	**But**	**Because**	**Which makes mefeel**
PS-1	Municipal corporation authority	Get notified when the trash cans are full and be made aware of where the full cans are located.	Don't havethe facilities atthe moment	There is no toolavailable to determine the level of bins.	Frustrated
PS-2	Individual working for a private limited corporation	Get rid of the example of a surplus of waste	The trash cans are alway sfilled	I occupy a metropolitan where there is acity is invariably crowd.	Worried

3. IDEATION & PROPOSED SOLUTION

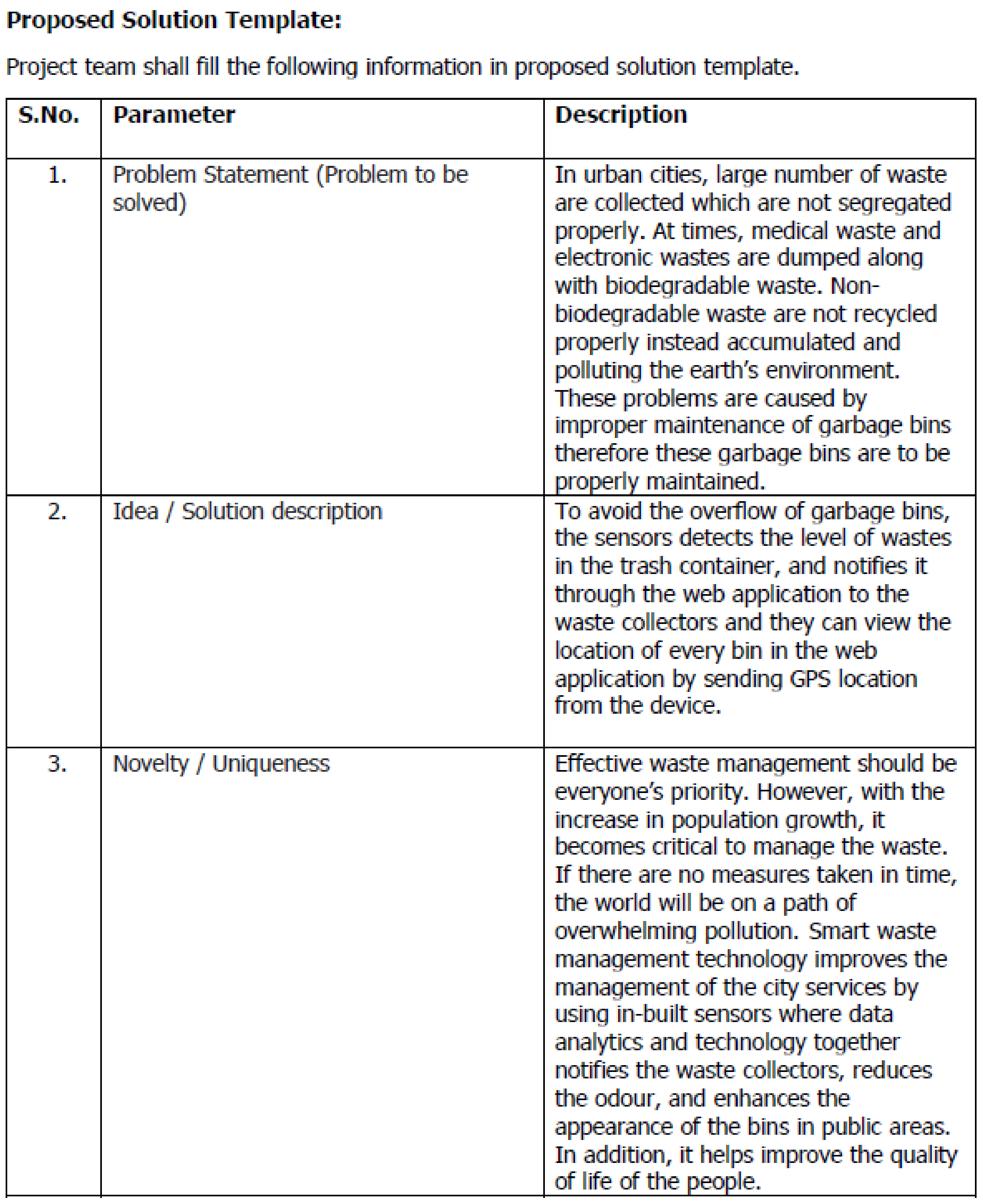
3.1 Empathy Map Canvas


Effective waste management is expensive, are they going to take more money?
Managing waste properly is essential for building sustainable and livable cities
What do they
THINK AND FEEL?
what really counts
major preoccupations
worries & aspirations
WHERE DOES MY WASTE GO?
is it really necessary for using technology for these uses?
What do they
HEAR?
what friends say
what boss say
what influencers say
smart bins are better than that of the normal ones as they over fill constantly
Timely waste collection is the key for this project
Residential, commercial, and industrial sectors benefit immensely from a quality garbage collection
environment getting more cleaner
proper working of technology and minimal failure
reduction of manual labour and effective manegement of waste
It is useful and transportable
What do they
SEE?
environment
friends
what the market offers
discuss the importance with neighbors
socially helpful activities like these are very essential these days
What do they
SAY AND DO?
attitude in public
appearance
behavior towards others
reduce the amount of waste they throw on the roads and throw them in the smart bin
PAIN
fears
frustrations
obstacles
Bins overflow and streets become smelly
Taking out too many trash to the street is a struggle
Extra cost
GAIN
"wants" / needs
measures of success
obstacles
Take the trash out regularly
clean and a neat street
proper management of waste that is taken out of the bin

3.2 Ideation & Brainstorming



3.3 Proposed Solution



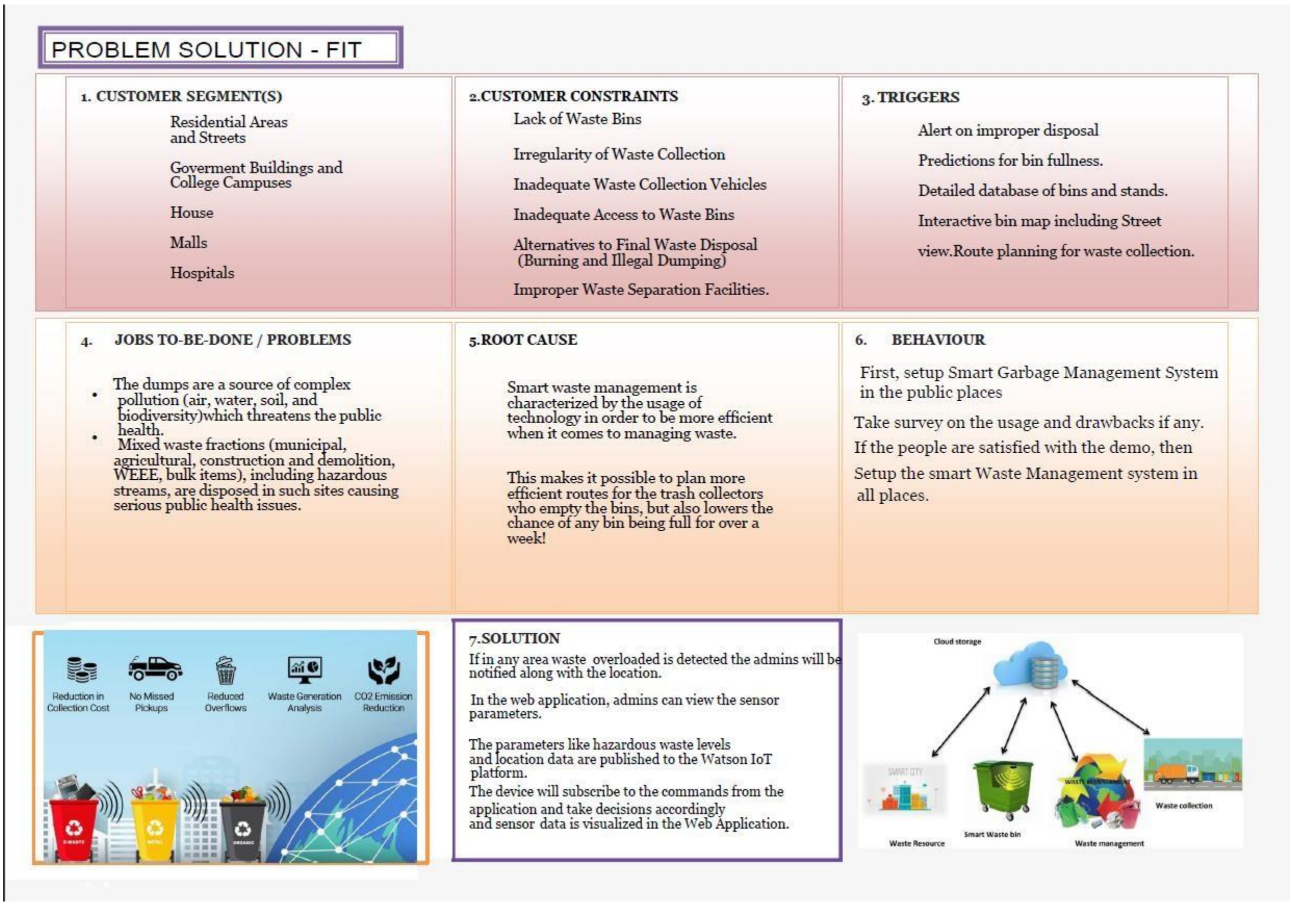
Proposed Solution Template:

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

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	In urban cities, large number of waste are collected which are not segregated properly. At times, medical waste and electronic wastes are dumped along with biodegradable waste. Non-biodegradable waste are not recycled properly instead accumulated and polluting the earth's environment. These problems are caused by improper maintenance of garbage bins therefore these garbage bins are to be properly maintained.
2.	Idea / Solution description	To avoid the overflow of garbage bins, the sensors detects the level of wastes in the trash container, and notifies it through the web application to the waste collectors and they can view the location of every bin in the web application by sending GPS location from the device.
3.	Novelty / Uniqueness	Effective waste management should be everyone's priority. However, with the increase in population growth, it becomes critical to manage the waste. If there are no measures taken in time, the world will be on a path of overwhelming pollution. Smart waste management technology improves the management of the city services by using in-built sensors where data analytics and technology together notifies the waste collectors, reduces the odour, and enhances the appearance of the bins in public areas. In addition, it helps improve the quality of life of the people.

4.	Social Impact / Customer Satisfaction	Waste management services can benefit the citizens and the cities from IoT smart device solutions. Using the technology, the companies can increase efficiency and enhance customer satisfaction, ensuring minimal overflowing bins. To transform the traditional waste collection to smart bins in the cities, one needs to implement innovative waste management techniques. With all these technological aspects available, the market holds a strong future promising to improve urban areas.
5.	Business Model (Revenue Model)	Waste Management generates revenue through the provision of various disposal services and recycling solutions to residential, commercial, industrial, and municipal clients. The Company derives its revenue in the form of various fees associated with its service offerings.
6.	Scalability of the Solution	Scalability is high as this model is easy to process and is cost effective. Wastes collection is managed very efficiently as we are using modern technologies for maintaining the system

3.4 Problem Solution fit



PROBLEM SOLUTION - FIT

1. CUSTOMER SEGMENT(S)

Residential Areas and Streets

Goverment Buildings and College Campuses

House

Malls

Hospitals

2.CUSTOMER CONSTRAINTS

Lack of Waste Bins

Irregularity of Waste Collection

Inadequate Waste Collection Vehicles

Inadequate Access to Waste Bins

Alternatives to Final Waste Disposal (Burning and Illegal Dumping)

Improper Waste Separation Facilities.

3. TRIGGERS

Alert on improper disposal

Predictions for bin fullness.

Detailed database of bins and stands.

Interactive bin map including Street

view.Route planning for waste collection.

4. JOBS TO-BE-DONE / PROBLEMS

- The dumps are a source of complex pollution (air, water, soil, and biodiversity)which threatens the public health.
- Mixed waste fractions (municipal, agricultural, construction and demolition, WEEE, bulk items), including hazardous streams, are disposed in such sites causing serious public health issues.

5.ROOT CAUSE

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!

6. BEHAVIOUR

First, setup Smart Garbage Management System in the public places

Take survey on the usage and drawbacks if any.

If the people are satisfied with the demo, then

Setup the smart Waste Management system in all places.

7.SOLUTION

If in any area waste overloaded is detected the admins will be notified along with the location.

In the web application, admins can view the sensor parameters.

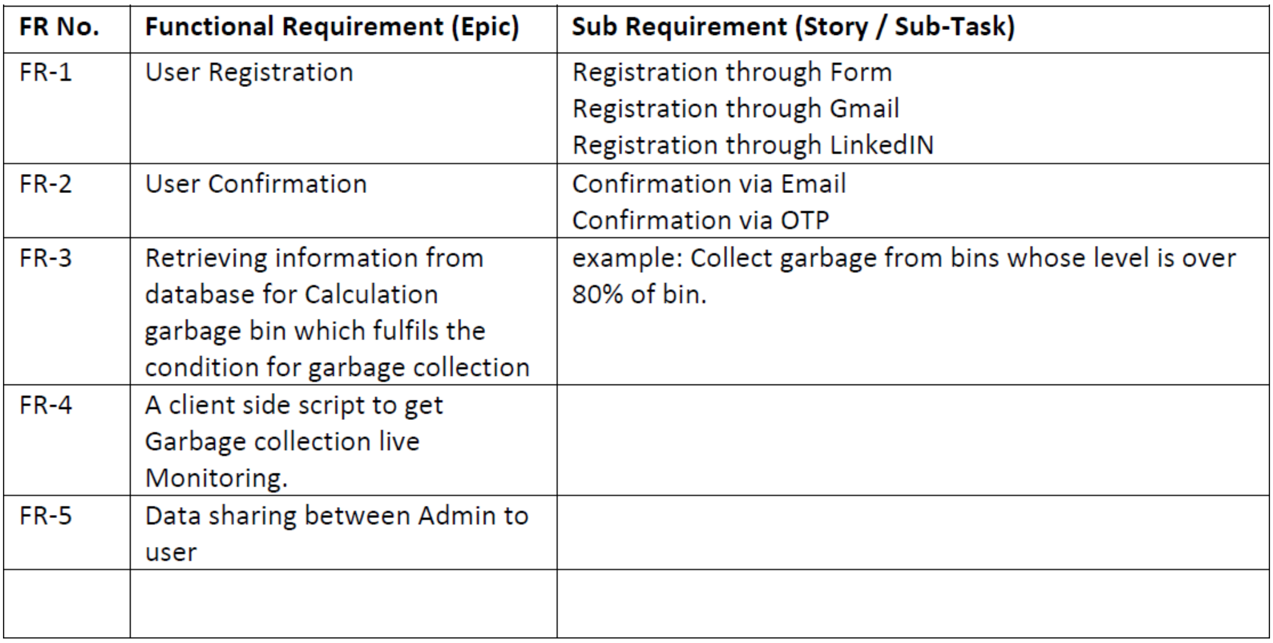
The parameters like hazardous waste levels and location data are published to the Watson IoT platform.

The device will subscribe to the commands from the application and take decisions accordingly and sensor data is visualized in the Web Application.

4. REQUIREMENT ANALYSIS

4.1 Functional requirement

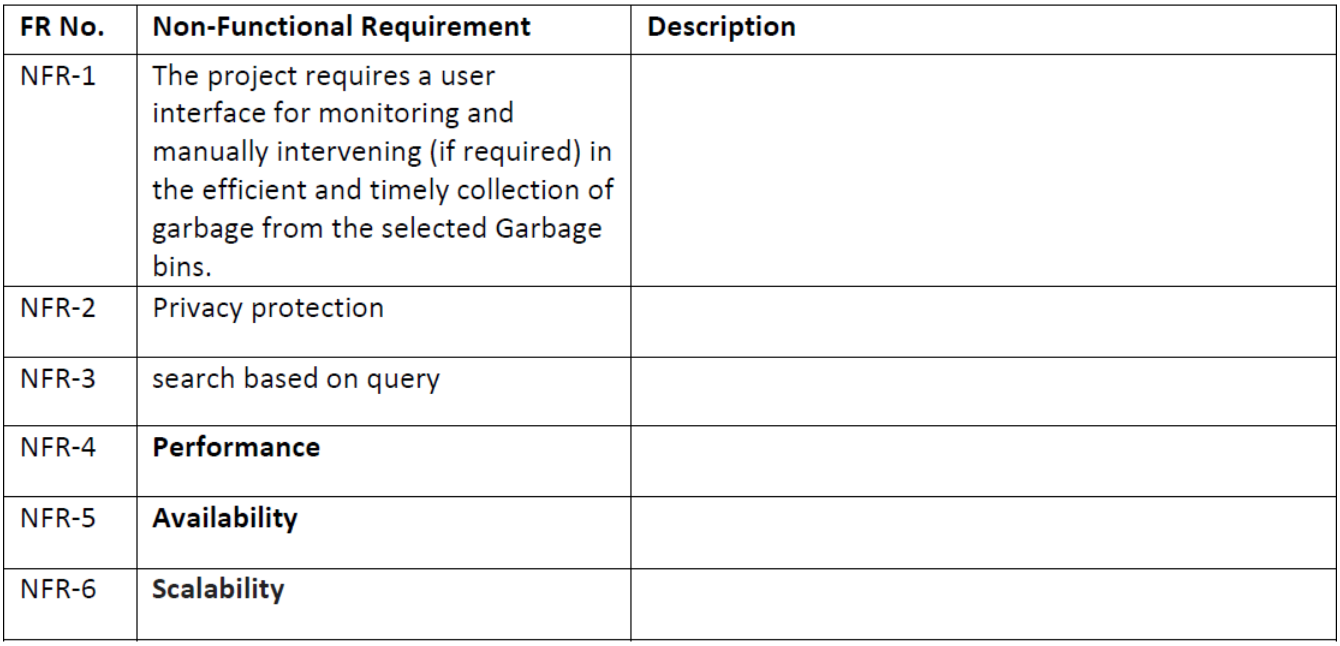
Following are the functional requirements of the proposed solution.



FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Retrieving information from database for Calculation garbage bin which fulfils the condition for garbage collection	example: Collect garbage from bins whose level is over 80% of bin.
FR-4	A client side script to get Garbage collection live Monitoring.	
FR-5	Data sharing between Admin to user	

4.2 Non-Functional requirements

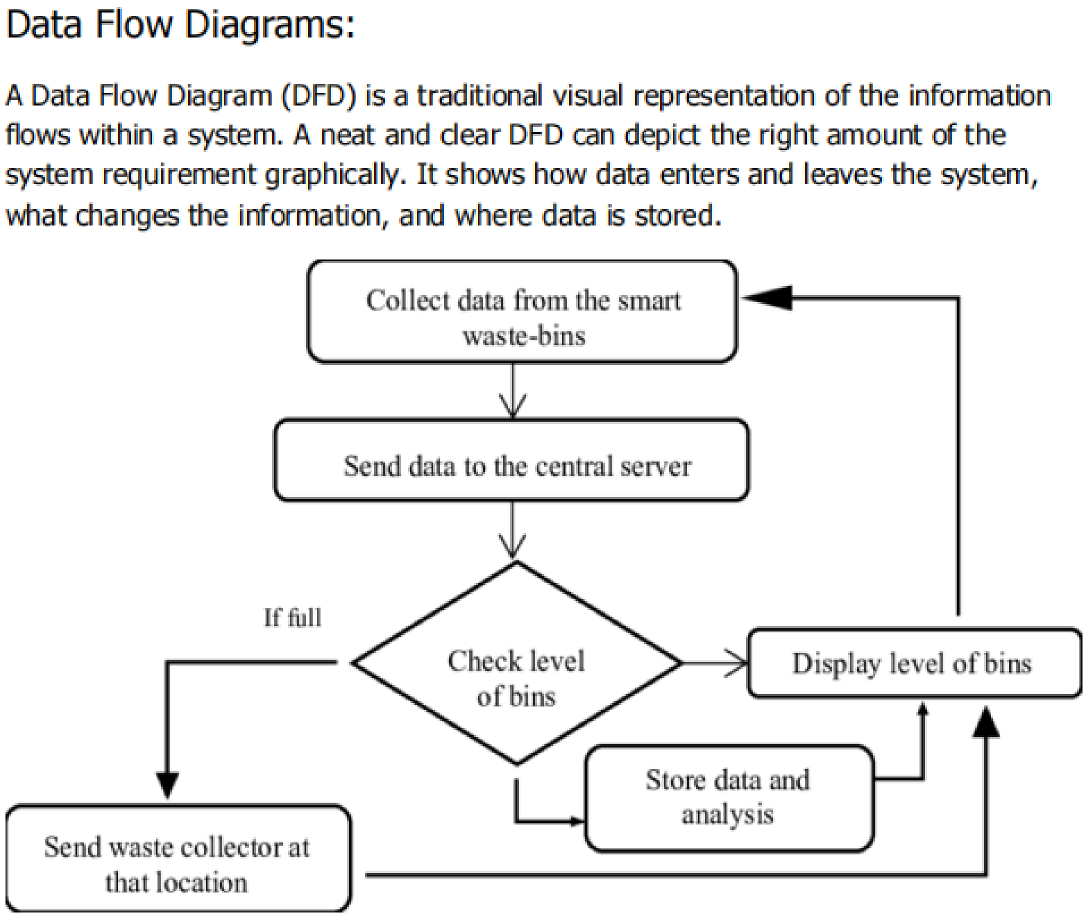
Following are the non-functional requirements of the proposed solution.



FR No.	Non-Functional Requirement	Description
NFR-1	The project requires a user interface for monitoring and manually intervening (if required) in the efficient and timely collection of garbage from the selected Garbage bins.	
NFR-2	Privacy protection	
NFR-3	search based on query	
NFR-4	**Performance**	
NFR-5	**Availability**	
NFR-6	**Scalability**	

5. PROJECT DESIGN

5.1Data Flow Diagrams



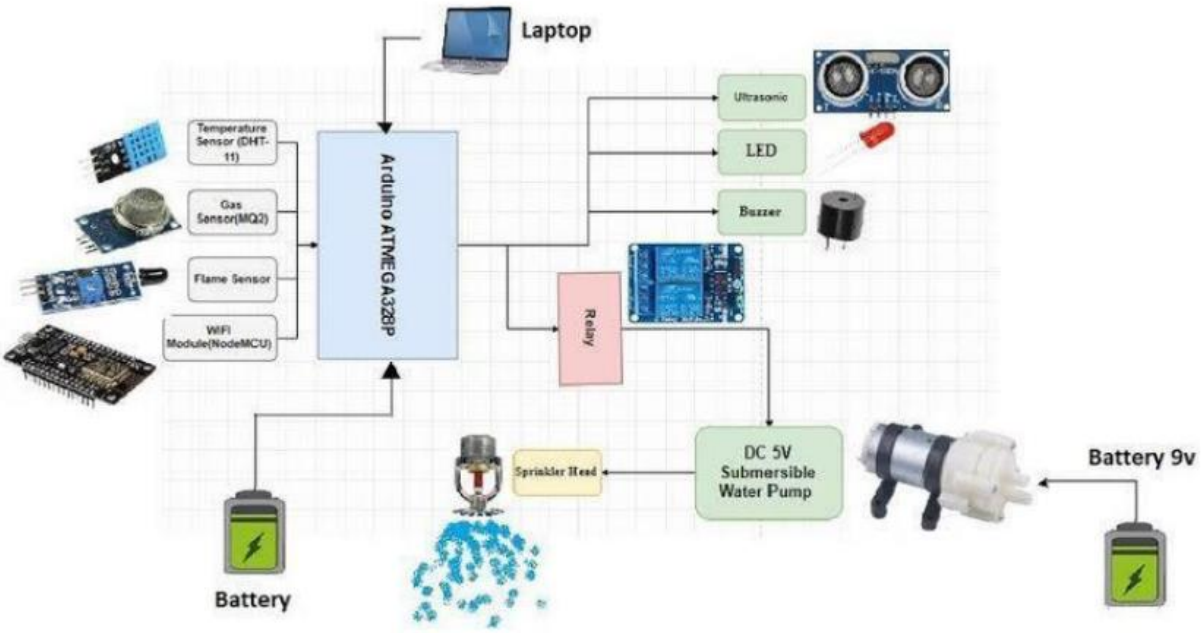
Data Flow Diagrams:

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.

Collect data from the smart waste-bins
Send data to the central server
If full
Check level of bins
Display level of bins
Store data and analysis
Send waste collector at that location

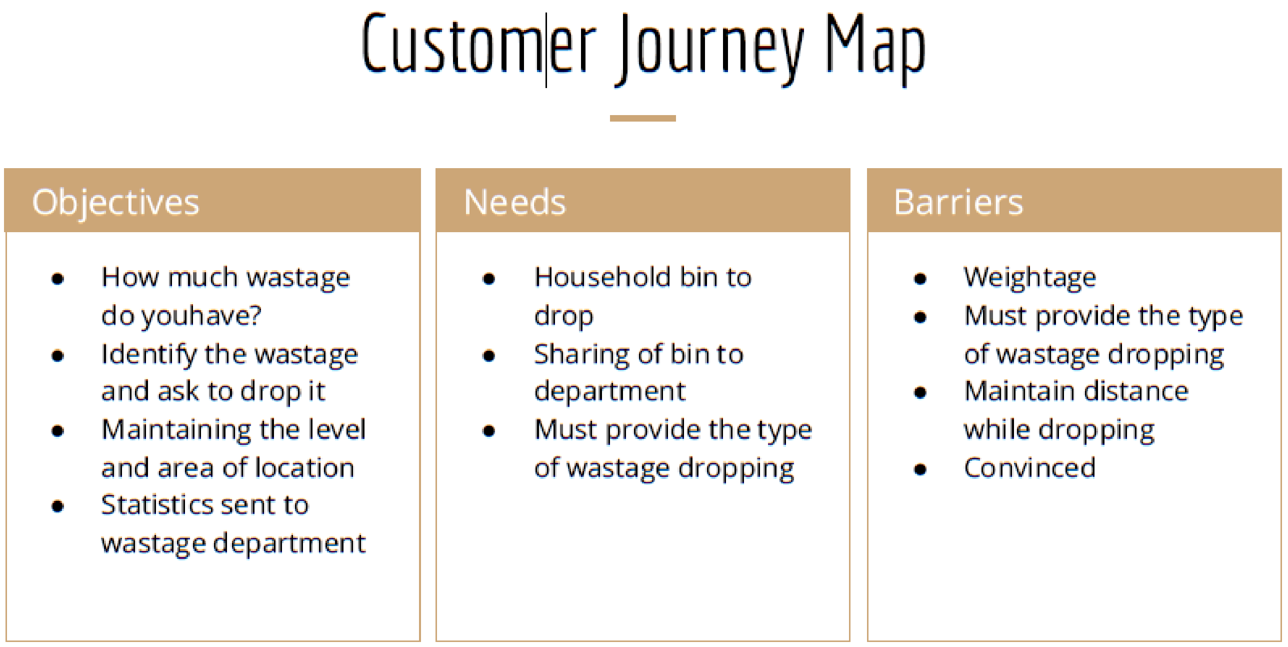
5.2 Solution & Technical Architecture:

TECHNOLOGICAL ARCHITECTURE:



5.3 User Stories

Use the below template to list all the user stories for the product.



Customer Journey Map

Objectives

- How much wastage do youhave?
- Identify the wastage and ask to drop it
- Maintaining the level and area of location
- Statistics sent to wastage department

Needs

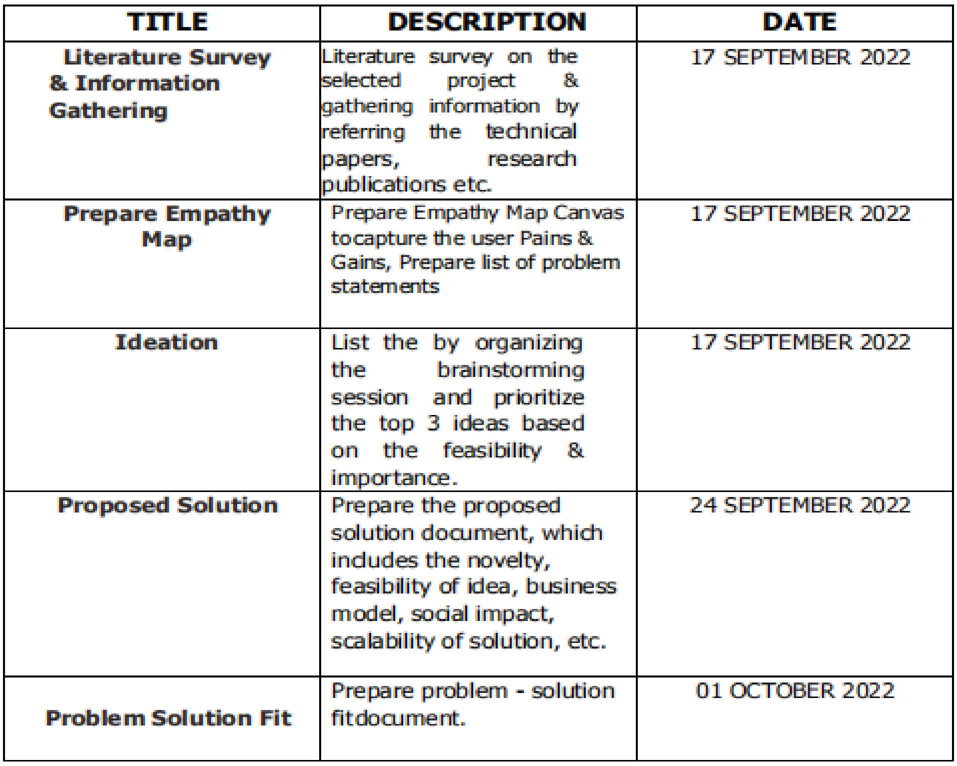
- Household bin to drop
- Sharing of bin to department
- Must provide the type of wastage dropping

Barriers

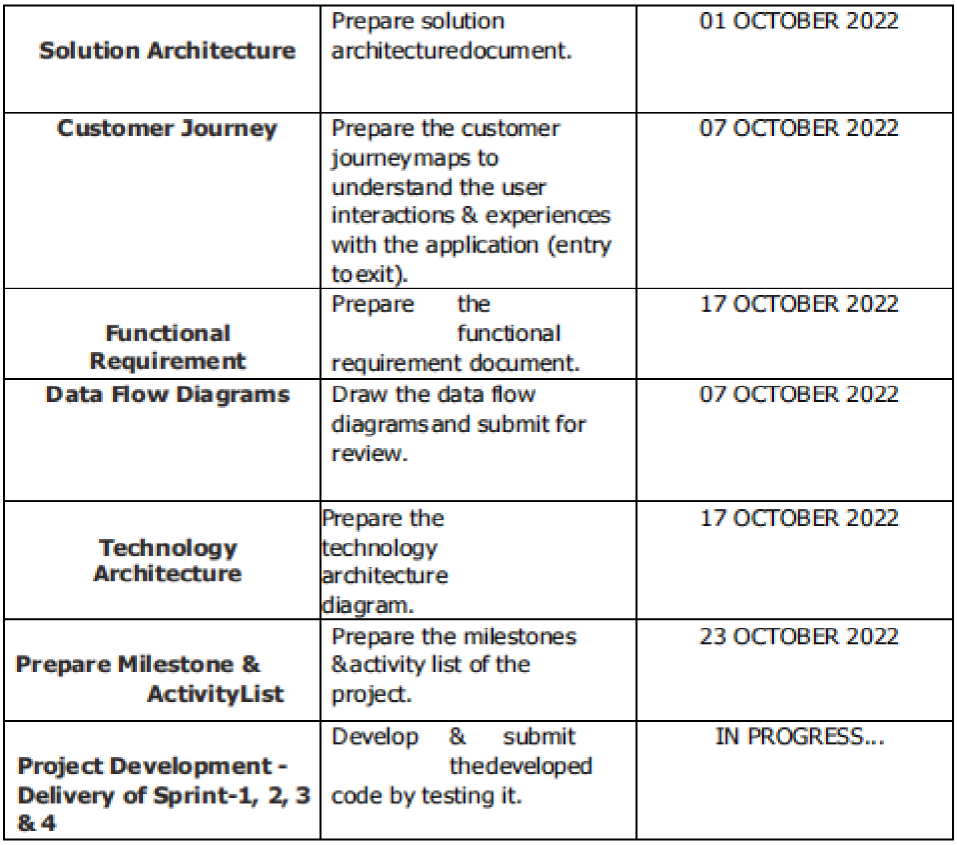
- Weightage
- Must provide the type of wastage dropping
- Maintain distance while dropping
- Convinced

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

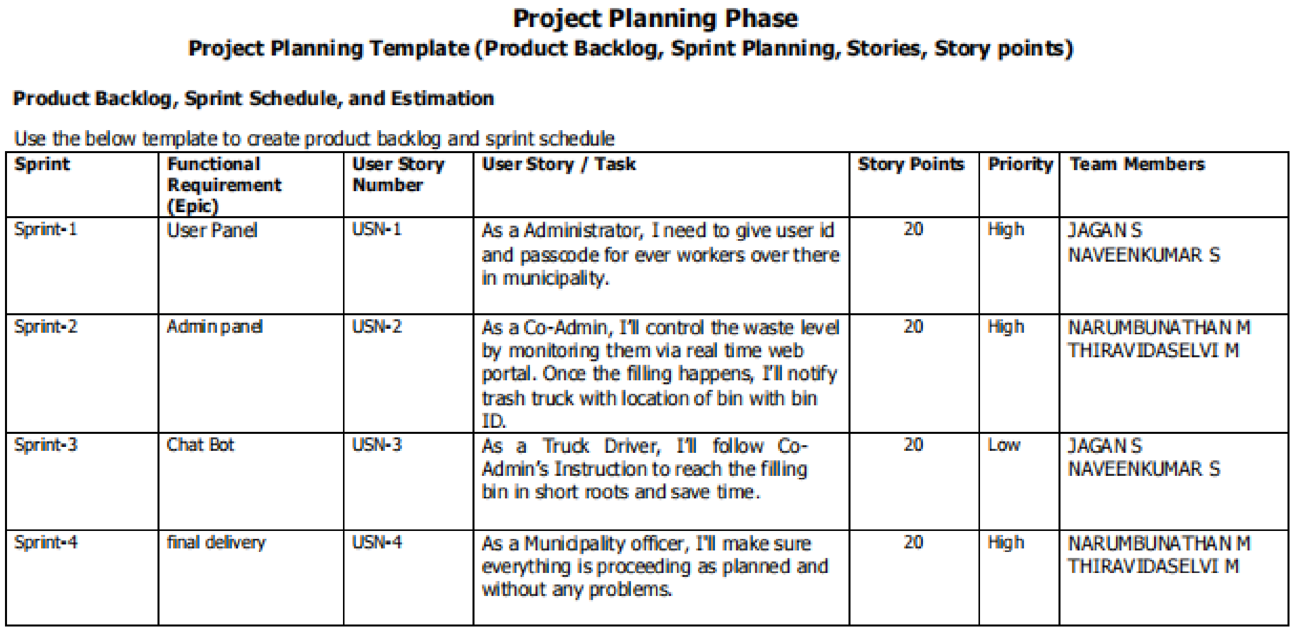


TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the technical papers, research publications etc.	17 SEPTEMBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas tocapture the user Pains & Gains, Prepare list of problem statements	17 SEPTEMBER 2022
Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	17 SEPTEMBER 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	24 SEPTEMBER 2022
Problem Solution Fit	Prepare problem - solution fitdocument.	01 OCTOBER 2022



Solution Architecture	Prepare solution architecturedocument.	01 OCTOBER 2022
Customer Journey	Prepare the customer journeymaps to understand the user interactions & experiences with the application (entry toexit).	07 OCTOBER 2022
Functional Requirement	Prepare the functional requirement document.	17 OCTOBER 2022
Data Flow Diagrams	Draw the data flow diagramsand submit for review.	07 OCTOBER 2022
Technology Architecture	Prepare the technology architecture diagram.	17 OCTOBER 2022
Prepare Milestone & ActivityList	Prepare the milestones &activity list of the project.	23 OCTOBER 2022
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit thedeveloped code by testing it.	IN PROGRESS...

6.2. Sprint Delivery Schedule



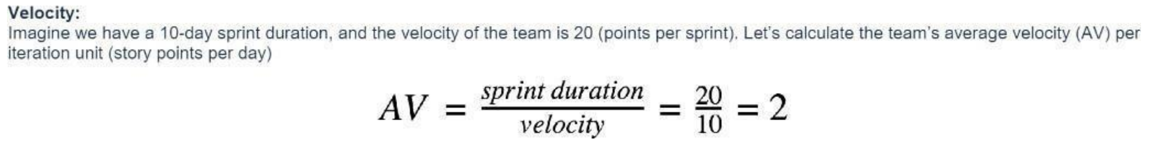
Project Planning Phase

Project Planning Template (Product Backlog, Sprint Planning, Stories, Story points)

Product Backlog, Sprint Schedule, and Estimation

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	User Panel	USN-1	As a Administrator, I need to give user id and passcode for ever workers over there in municipality.	20	High	JAGAN S NAVEENKUMAR S
Sprint-2	Admin panel	USN-2	As a Co-Admin, I'll control the waste level by monitoring them via real time web portal. Once the filling happens, I'll notify trash truck with location of bin with bin ID.	20	High	NARUMBUNATHAN M THIRAVIDASELVI M
Sprint-3	Chat Bot	USN-3	As a Truck Driver, I'll follow Co-Admin's Instruction to reach the filling bin in short roots and save time.	20	Low	JAGAN S NAVEENKUMAR S
Sprint-4	final delivery	USN-4	As a Municipality officer, I'll make sure everything is proceeding as planned and without any problems.	20	High	NARUMBUNATHAN M THIRAVIDASELVI M



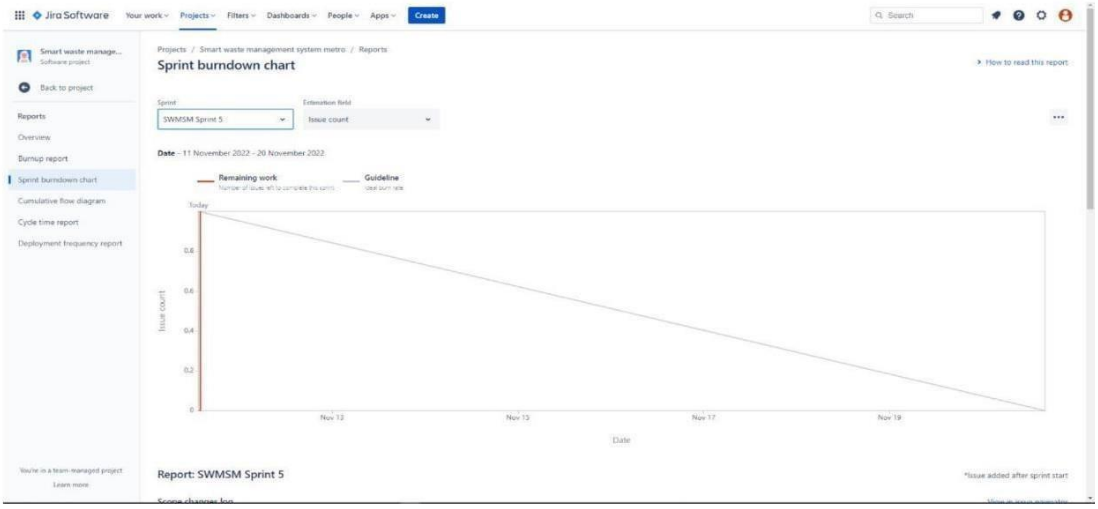
Velocity:

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)

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

6.2 Reports from JIRA

BURNDOWN CHART



Projects / Smart waste management system metro / Reports

Sprint burndown chart

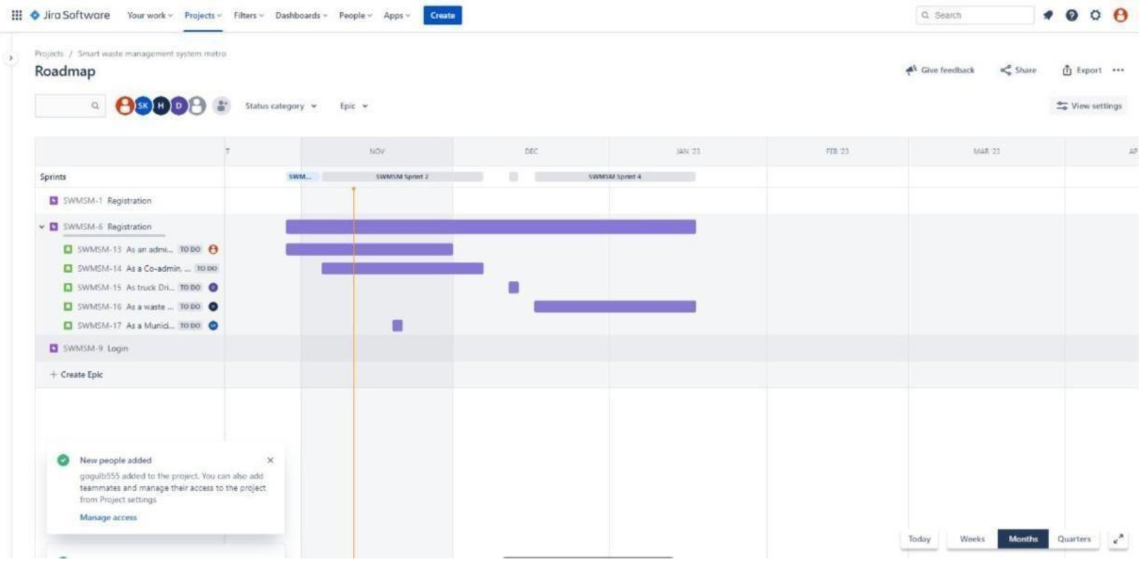
Sprint: SWMSM Sprint 5

Estimation field: Issue count

Date - 11 November 2022 - 20 November 2022

Report: SWMSM Sprint 5

*Issue added after sprint start



Projects / Smart waste management system metro

Roadmap

Sprints: SWM... | SWMSM Sprint 2 | SWMSM Sprint 4

- SWMSM-1 Registration
- SWMSM-6 Registration
  - SWMSM-13 As an admi... TO DO
  - SWMSM-14 As a Co-admin. ... TO DO
  - SWMSM-15 As truck Dri... TO DO
  - SWMSM-16 As a waste ... TO DO
  - SWMSM-17 As a Munici... TO DO
- SWMSM-9 Login

New people added

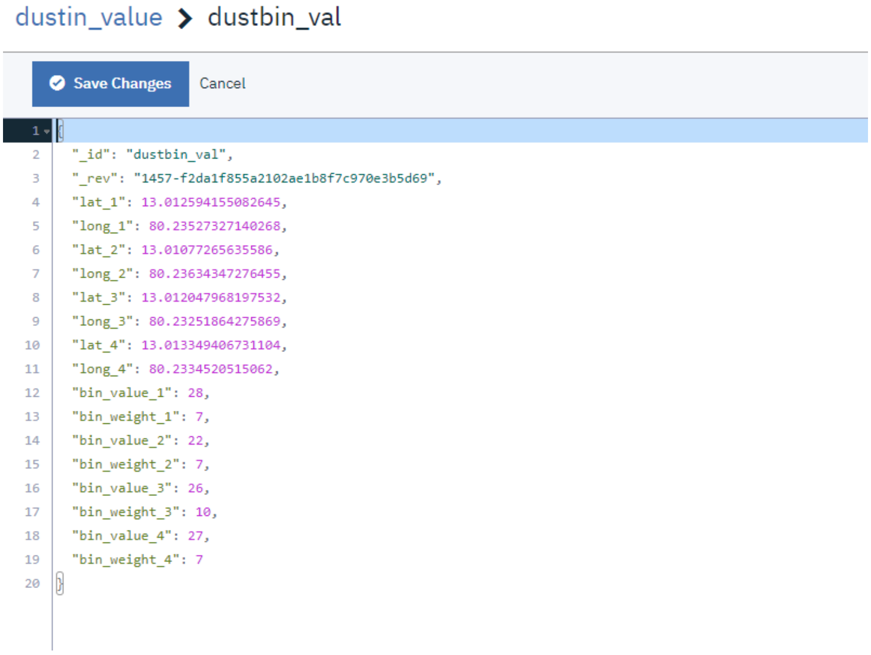
gogulb555 added to the project. You can also add teammates and manage their access to the project from Project settings

Manage access

7. CODING & SOLUTIONING

7.1 Feature 1- LOCATION TRACKER AND LIVE UPDATE

The location of the dustbins is constantly updated in the Cloudant Database and can be seen in the map present in the dashboard. Below images depict the same.



```
{
  "_id": "dustbin_val",
  "_rev": "1457-f2da1f855a2102ae1b8f7c970e3b5d69",
  "lat_1": 13.012594155082645,
  "long_1": 80.23527327140268,
  "lat_2": 13.01077265635586,
  "long_2": 80.23634347276455,
  "lat_3": 13.012047968197532,
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  "lat_4": 13.013349406731104,
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  "bin_weight_2": 7,
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  "bin_value_4": 27,
  "bin_weight_4": 7
}
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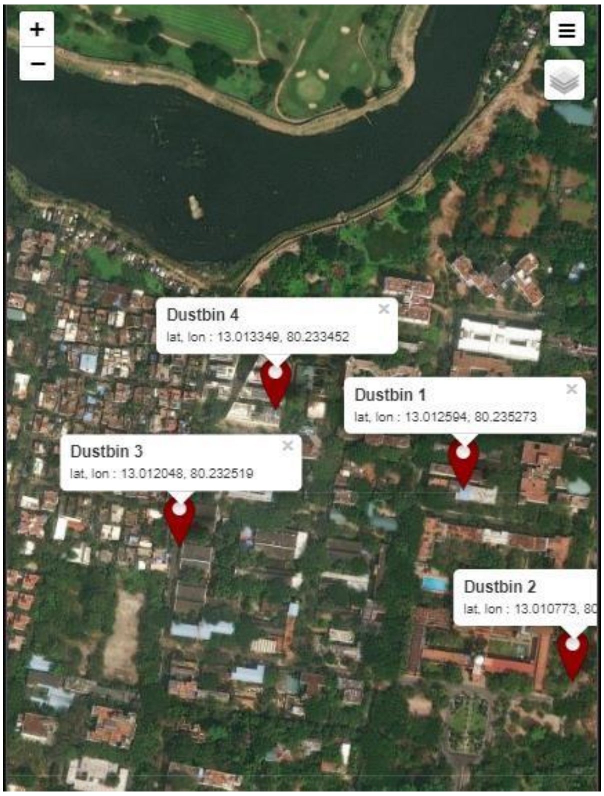
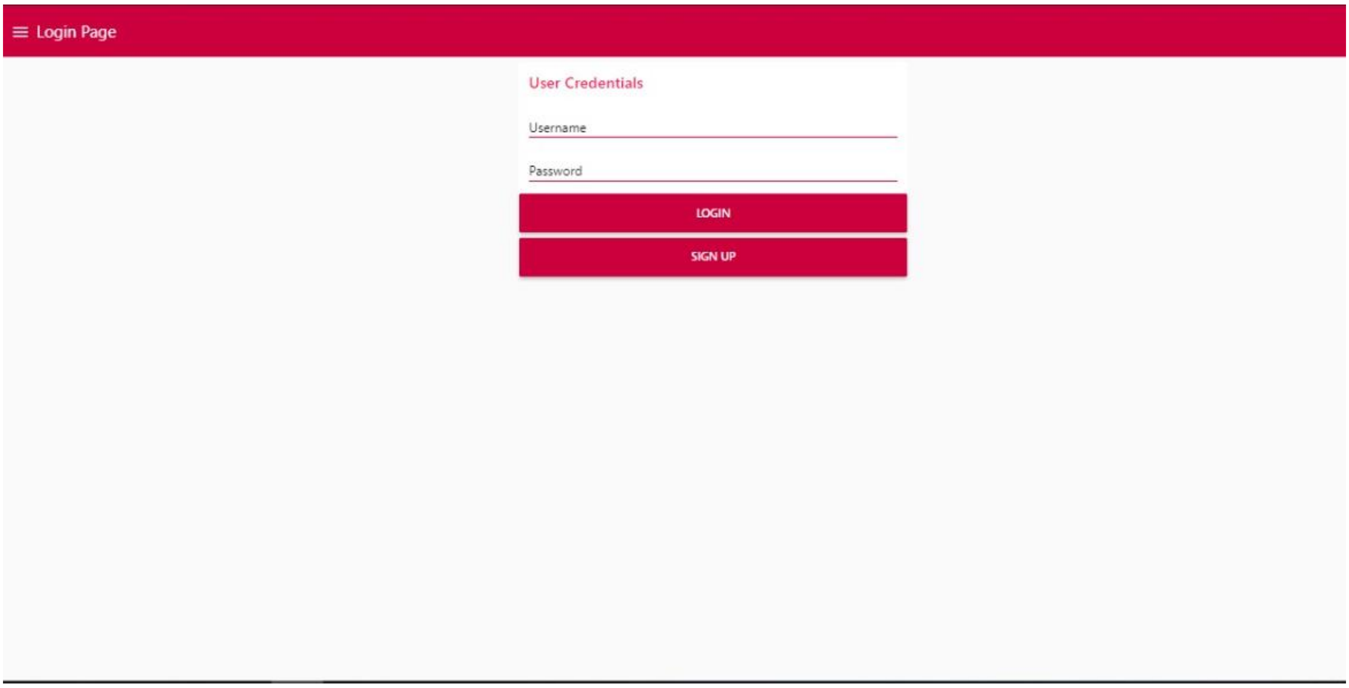
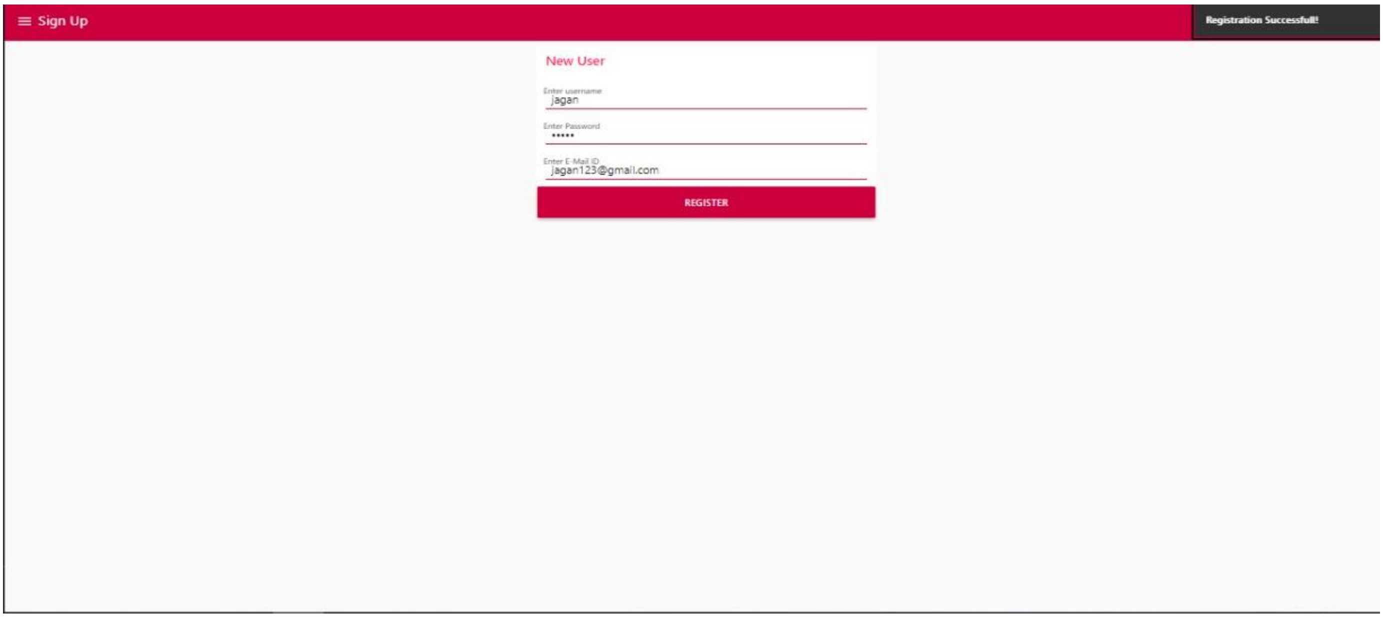

+
−
Dustbin 4
lat, lon : 13.013349, 80.233452
Dustbin 1
lat, lon : 13.012594, 80.235273
Dustbin 3
lat, lon : 13.012048, 80.232519
Dustbin 2
lat, lon : 13.010773, 80

7.2 Feature 2- Registration and Log In portal

The dustbins can be monitored only by authorized users. This is achieved by a registration portal and a login page. Each user needs to register first. Then they should login using their created account after which they will be allowed to access the Dustbin's dashboard.





Registration Successfull!

New User

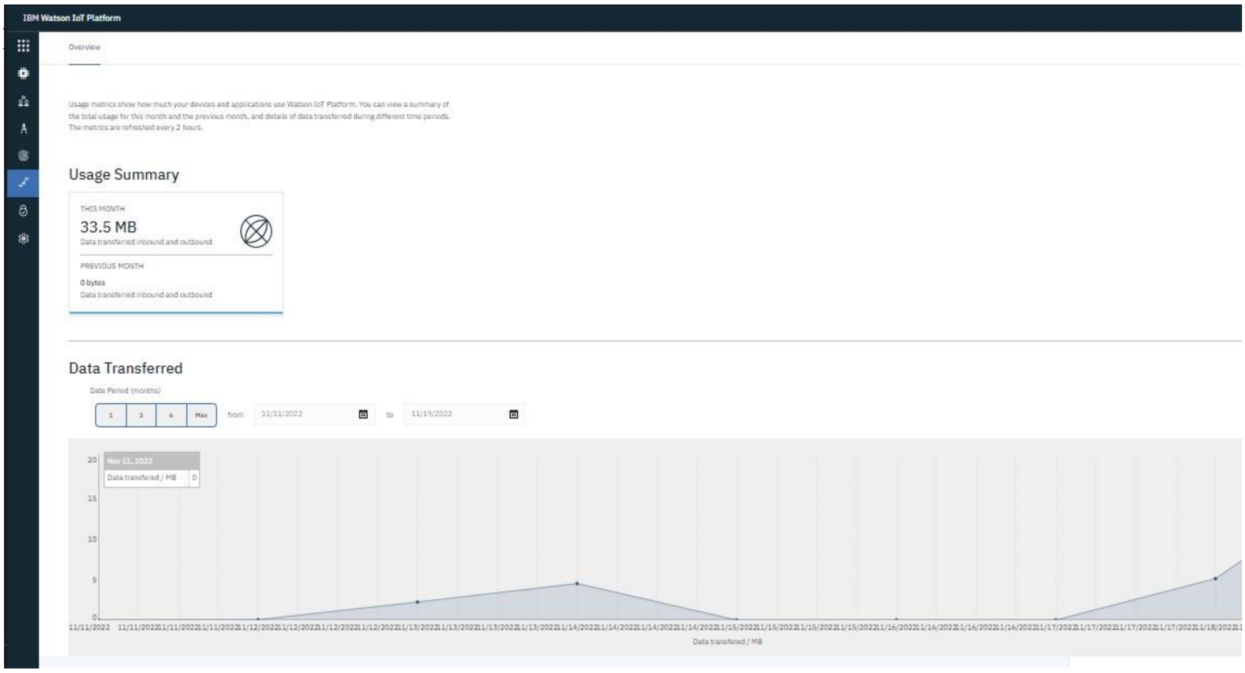
Enter username: jagan

Enter Password: *****

Enter E-Mail ID: jagan123@gmail.com

8. RESULTS & TESTING

8.1 Performance Metrics



Usage metrics show how much your devices and applications use Watson IoT Platform. You can view a summary of the total usage for this month and the previous month, and details of data transferred during different time periods. The metrics are refreshed every 2 hours.

Usage Summary

THIS MONTH
33.5 MB
Data transferred inbound and outbound

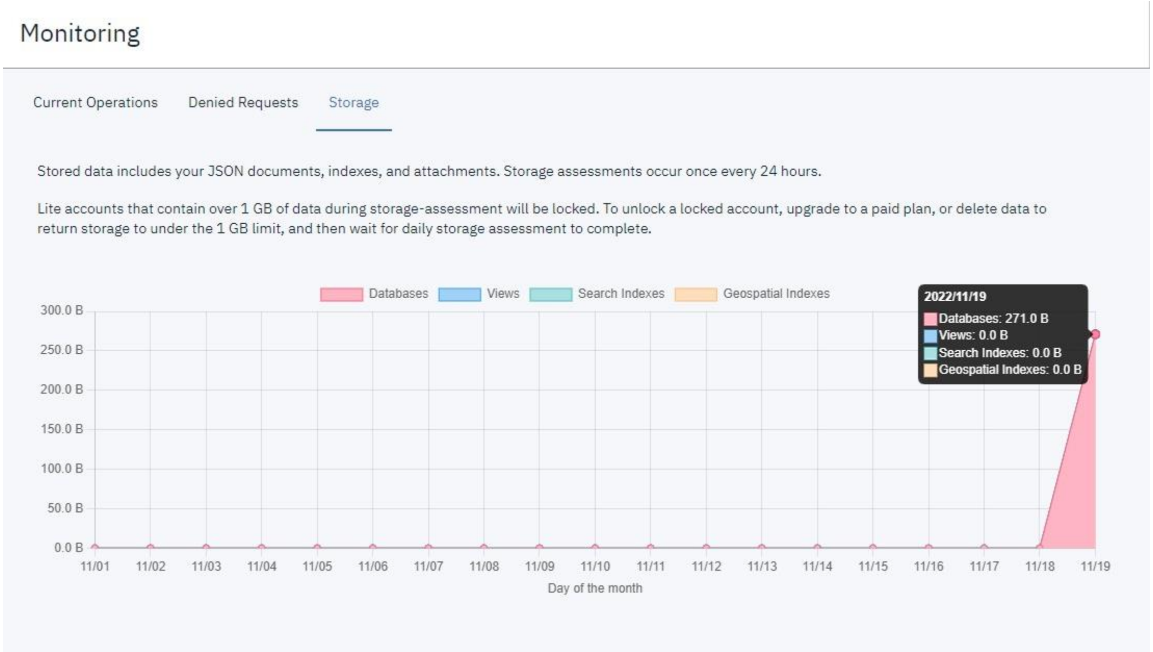
PREVIOUS MONTH
0 bytes
Data transferred inbound and outbound

Data Transferred

Date Period (months)

from 11/11/2022 to 11/19/2022

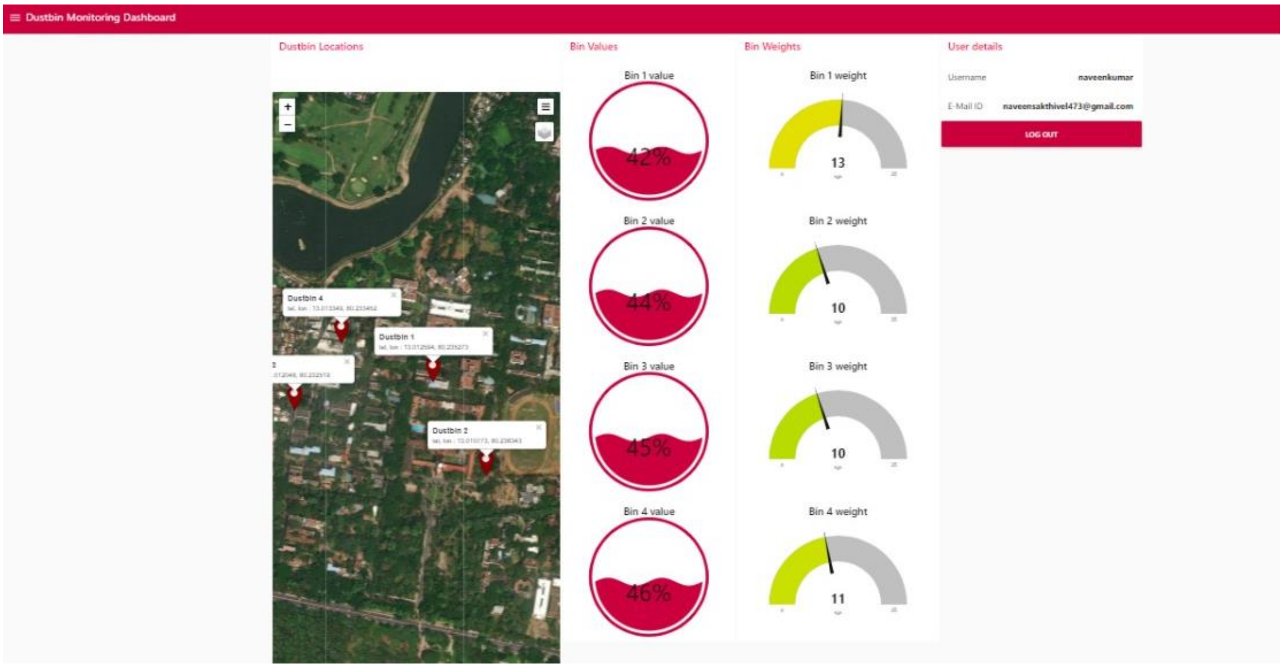
Cloudant DB:


Monitoring

Stored data includes your JSON documents, indexes, and attachments. Storage assessments occur once every 24 hours.

Lite accounts that contain over 1 GB of data during storage-assessment will be locked. To unlock a locked account, upgrade to a paid plan, or delete data to return storage to under the 1 GB limit, and then wait for daily storage assessment to complete.

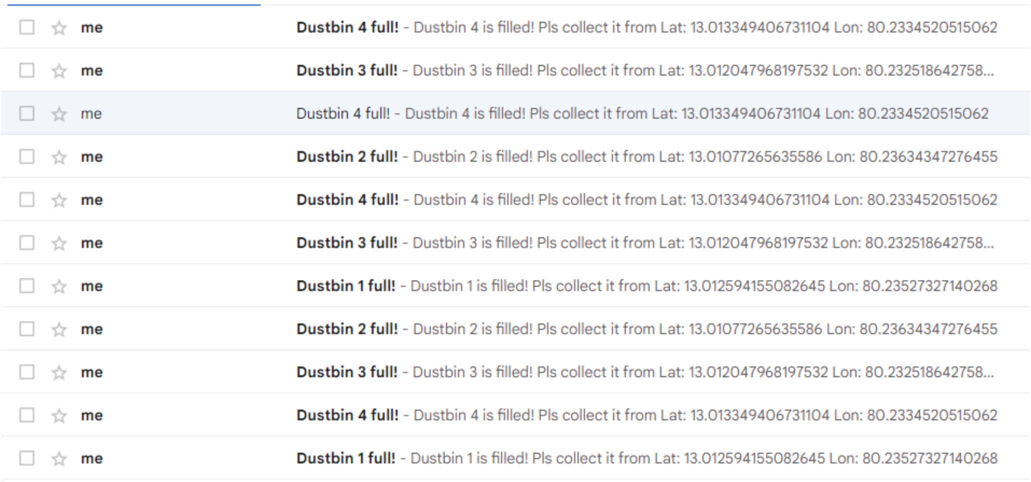
Web UI Dashboard:



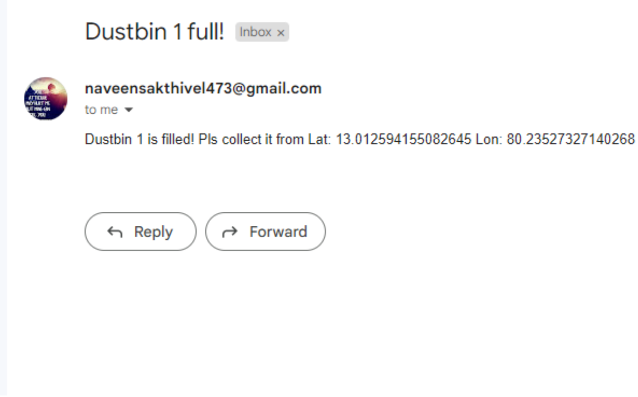
Username naveenkumar

E-Mail ID naveensakthivel473@gmail.com

E-Mail Alert when dustbins are filled:



□	☆	**me**	**Dustbin 4 full!** - Dustbin 4 is filled! Pls collect it from Lat: 13.013349406731104 Lon: 80.2334520515062
□	☆	**me**	**Dustbin 3 full!** - Dustbin 3 is filled! Pls collect it from Lat: 13.012047968197532 Lon: 80.232518642758...
□	☆	me	Dustbin 4 full! - Dustbin 4 is filled! Pls collect it from Lat: 13.013349406731104 Lon: 80.2334520515062
□	☆	**me**	**Dustbin 2 full!** - Dustbin 2 is filled! Pls collect it from Lat: 13.01077265635586 Lon: 80.23634347276455
□	☆	**me**	**Dustbin 4 full!** - Dustbin 4 is filled! Pls collect it from Lat: 13.013349406731104 Lon: 80.2334520515062
□	☆	**me**	**Dustbin 3 full!** - Dustbin 3 is filled! Pls collect it from Lat: 13.012047968197532 Lon: 80.232518642758...
□	☆	**me**	**Dustbin 1 full!** - Dustbin 1 is filled! Pls collect it from Lat: 13.012594155082645 Lon: 80.23527327140268
□	☆	**me**	**Dustbin 2 full!** - Dustbin 2 is filled! Pls collect it from Lat: 13.01077265635586 Lon: 80.23634347276455
□	☆	**me**	**Dustbin 3 full!** - Dustbin 3 is filled! Pls collect it from Lat: 13.012047968197532 Lon: 80.232518642758...
□	☆	**me**	**Dustbin 4 full!** - Dustbin 4 is filled! Pls collect it from Lat: 13.013349406731104 Lon: 80.2334520515062
□	☆	**me**	**Dustbin 1 full!** - Dustbin 1 is filled! Pls collect it from Lat: 13.012594155082645 Lon: 80.23527327140268



Dustbin 1 full! Inbox ×

naveensakthivel473@gmail.com

to me ▾

Dustbin 1 is filled! Pls collect it from Lat: 13.012594155082645 Lon: 80.23527327140268

9. ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Reduction in Collection Cost
- No Missed Pickups
- Reduced Overflows
- Waste Generation Analysis
- CO2 Emission Reduction

DISADVANTAGES:

- System requires a greater number of waste bins for separate waste collection as per populationin the city.
- This results into high initial cost due to expensive smart dustbins compare to other methods.
- Sensor nodes used in the dustbins have limited memory size.

10. CONCLUSION

A Smart Waste Management system that is more effective than the one in use now is achievable byusing 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 thefollowing:

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

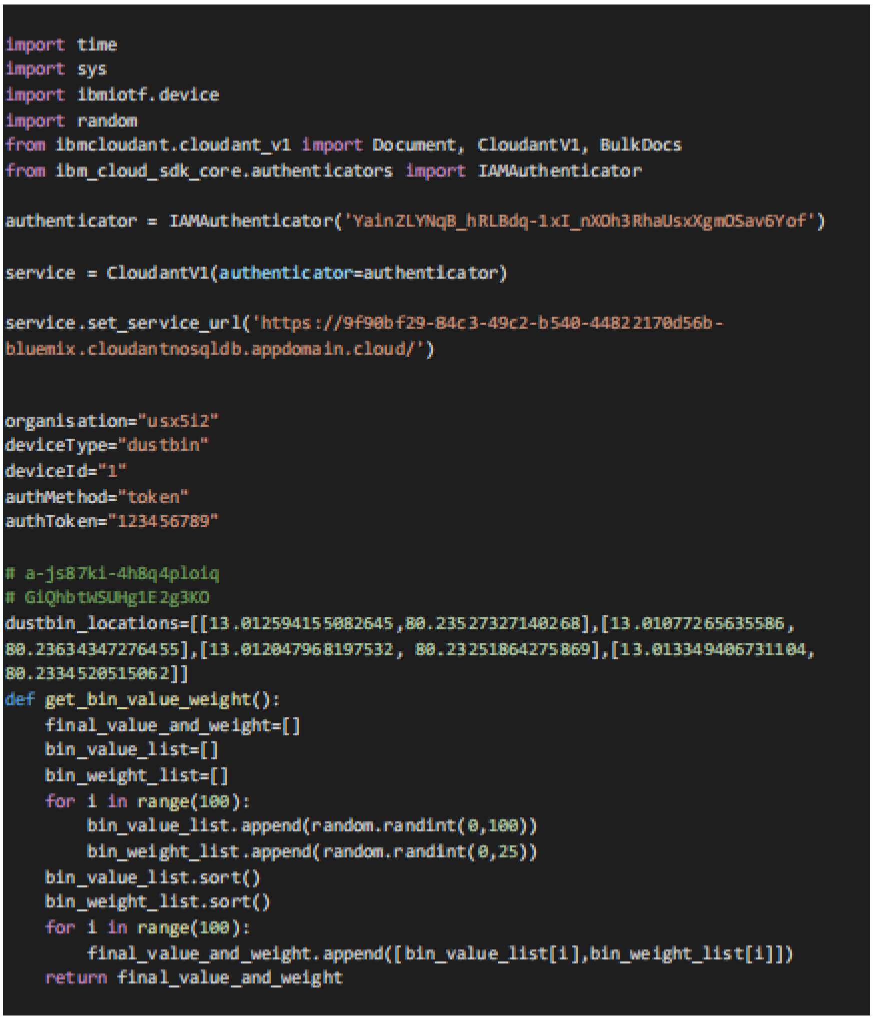
2. The concept of green points would encourage the involvement of residents or end users, makingthe idea successful and aiding in the achievement of collaborative waste management efforts, thus fulfilling the idea of Swachh Bharath.

3. Having case study or data analytics on the type and times waste is collected on different days orseasons, 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

DEVELOPMENT OF PYTHON CODE:



```
import time
import sys
import ibmiotf.device
import random
from ibmcloudant.cloudant_v1 import Document, CloudantV1, BulkDocs
from ibm_cloud_sdk_core.authenticators import IAMAuthenticator

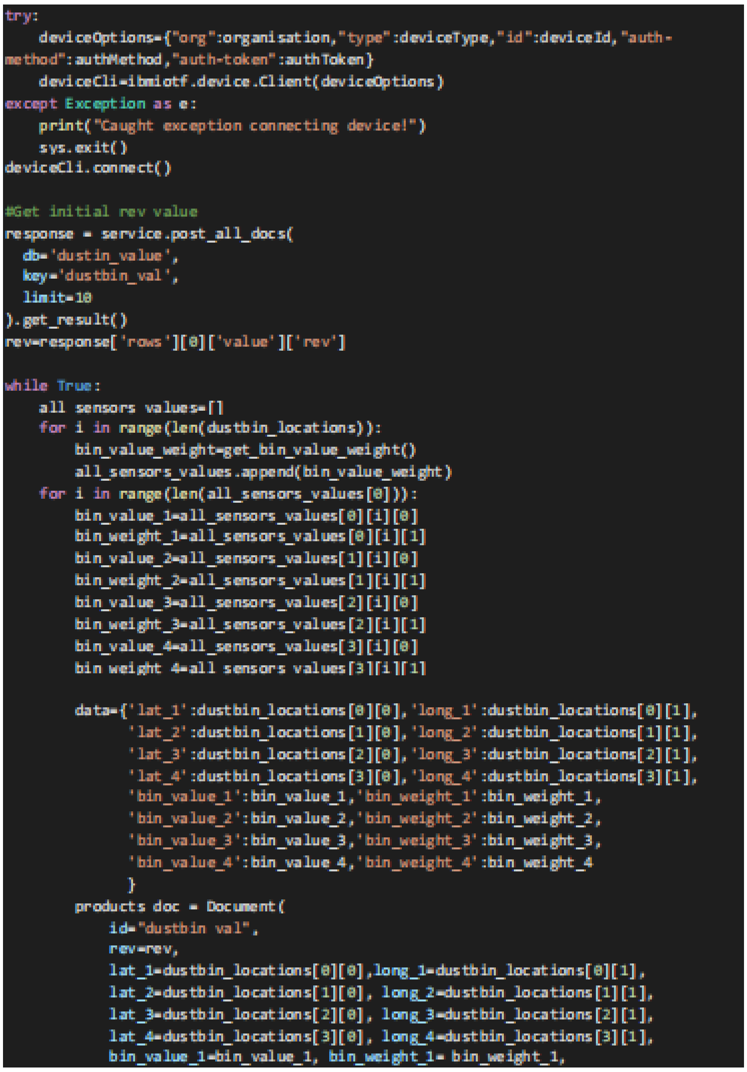
authenticator = IAMAuthenticator('YainZLYNqB_hRLBdq-1xI_nXOh3RhaUsxXgmOSav6Yof')

service = CloudantV1(authenticator=authenticator)

service.set_service_url('https://9f90bf29-84c3-49c2-b540-44822170d56b-
bluemix.cloudantnosqldb.appdomain.cloud/')


organisation="usx5i2"
deviceType="dustbin"
deviceId="1"
authMethod="token"
authToken="123456789"

# a-js87ki-4h8q4ploiq
# GiQhbtWSUHg1E2g3KO
dustbin_locations=[[13.012594155082645,80.235273271402 68],[13.01077265635586,
80.23634347276455],[13.012047968197532, 80.23251864275869],[13.013349406731104,
80.2334520515062]]
def get_bin_value_weight():
    final_value_and_weight=[]
    bin_value_list=[]
    bin_weight_list=[]
    for i in range(100):
        bin_value_list.append(random.randint(0,100))
        bin_weight_list.append(random.randint(0,25))
    bin_value_list.sort()
    bin_weight_list.sort()
    for i in range(100):
        final_value_and_weight.append([bin_value_list[i],bin_weight_list[i]])
    return final_value_and_weight
```

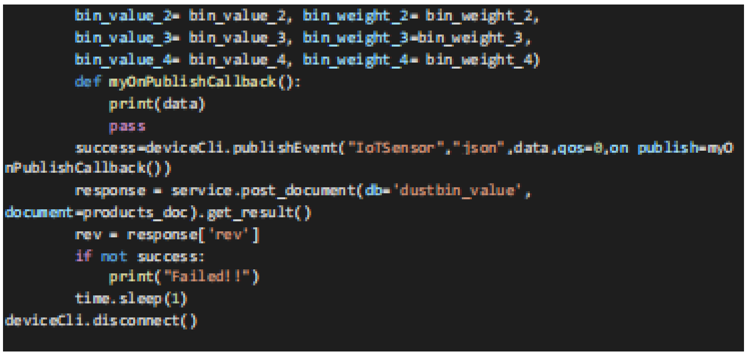


```
try:
    deviceOptions={"org":organisation,"type":deviceType,"id":deviceId,"auth-
method":authMethod,"auth-token":authToken}
    deviceCli=ibmiotf.device.Client(deviceOptions)
except Exception as e:
    print("Caught exception connecting device!")
    sys.exit()
deviceCli.connect()

#Get initial rev value
response = service.post_all_docs(
  db='dustin_value',
  key='dustbin_val',
  limit=10
).get_result()
rev=response['rows'][0]['value']['rev']

while True:
    all sensors values=[]
    for i in range(len(dustbin_locations)):
        bin_value_weight=get_bin_value_weight()
        all_sensors_values.append(bin_value_weight)
    for i in range(len(all_sensors_values[0])):
        bin_value_1=all_sensors_values[0][i][0]
        bin_weight_1=all_sensors_values[0][i][1]
        bin_value_2=all_sensors_values[1][i][0]
        bin_weight_2=all_sensors_values[1][i][1]
        bin_value_3=all_sensors_values[2][i][0]
        bin_weight_3=all_sensors_values[2][i][1]
        bin_value_4=all_sensors_values[3][i][0]
        bin weight 4=all sensors values[3][i][1]

        data={'lat_1':dustbin_locations[0][0],'long_1':dustbin_locations[0][1],
              'lat_2':dustbin_locations[1][0],'long_2':dustbin_locations[1][1],
              'lat_3':dustbin_locations[2][0],'long_3':dustbin_locations[2][1],
              'lat_4':dustbin_locations[3][0],'long_4':dustbin_locations[3][1],
              'bin_value_1':bin_value_1,'bin_weight_1':bin_weight_1,
              'bin_value_2':bin_value_2,'bin_weight_2':bin_weight_2,
              'bin_value_3':bin_value_3,'bin_weight_3':bin_weight_3,
              'bin_value_4':bin_value_4,'bin_weight_4':bin_weight_4
              }
        products doc = Document(
            id="dustbin val",
            rev=rev,
            lat_1=dustbin_locations[0][0],long_1=dustbin_locations[0][1],
            lat_2=dustbin_locations[1][0], long_2=dustbin_locations[1][1],
            lat_3=dustbin_locations[2][0], long_3=dustbin_locations[2][1],
            lat_4=dustbin_locations[3][0], long_4=dustbin_locations[3][1],
            bin_value_1=bin_value_1, bin_weight_1= bin_weight_1,
```



```
        bin_value_2= bin_value_2, bin_weight_2= bin_weight_2,
        bin_value_3= bin_value_3, bin_weight_3=bin_weight_3,
        bin_value_4= bin_value_4, bin_weight_4= bin_weight_4)
        def myOnPublishCallback():
            print(data)
            pass
        success=deviceCli.publishEvent("IoTSensor","json",data,qos=0,on publish=myO
nPublishCallback())
        response = service.post_document(db='dustbin_value',
document=products_doc).get_result()
        rev = response['rev']
        if not success:
            print("Failed!!")
        time.sleep(1)
deviceCli.disconnect()
```

13. LINKS

GitHub Link: LINK

Video Link: LINK