IOT BASED SMART WASTE MANAGEMENT FOR METROPOLITIAN CITIES

A PROJECT REPORT

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1. INTRODUCTION

a. Project Overview

b. Purpose

2. LITERATURE SURVEY

a. Existing problem

b. References

c. Problem Statement Definition

3. IDEATION & PROPOSED SOLUTION

a. Empathy Map Canvas

b. Ideation & Brainstorming

c. Proposed Solution d. Problem Solution fit

4. REQUIREMENT ANALYSIS

a. Functional requirement

b. Non-Functional requirements

5. PROJECT DESIGN

a. Data Flow Diagrams

b. Solution & Technical Architecture

c. User Stories

6. PROJECT PLANNING & SCHEDULING

a. Sprint Planning & Estimation

b. Sprint Delivery Schedule

c. Reports from JIRA

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

a. Feature 1

b. Feature 2

c. Database Schema (if Applicable)

8. TESTING

a. Test Cases

1.Introduction

1.1 Project Overview

With rapid increase in population, the issues related to sanitation with respect to garbage management are degrading immensely. It creates unhygienic conditions for the citizens in the nearby surrounding, leading to the spread of infectious diseases and illness. To avoid this problem, IoT based "Smart Waste Management" is the best and trending solution. In the proposed system, public dustbins will be provided with embedded device which helps in real time monitoring of level of garbage in garbage bins. The data regarding the garbage levels will be used to provide optimized route for garbage collecting vans, which will reduce cost associated with fuel. The load sensors will increase efficiency of data related to garbage level and moisture sensors will be used to provide data of waste segregation in a dust bin. The analysis of ceaseless data gathered will help municipality and government authorities to improve plans related to smart waste management with the help of various system generated reports.

1.2 Purpose

Smart waste management focuses on solving the previously mentioned solid waste management problems using sensors, intelligent monitoring systems, and mobile applications. The first smart waste management solution to make the

waste collection process more efficient is sensors. Sensors can measure the fill level of the containers and provide updated information at any time and notify waste management services to empty them when they are full or almost full. These devices help optimize the best possible route containing fully filled containers and create smart schedules for drivers. The selection of the containers also minimizes the need for trash collection staff because their duties are deduced. They can also alert the waste management companies or municipalities if an undesirable incident happens such as sudden temperature rise or displacement of the container by their GPS features.

2. Literature survey:

2.1 Existing system

Around 80% of waste collections happen at the wrong time. Late waste collections lead to overflowing bins, unsanitary environments, citizen complaints, illegal dumping, and increased cleaning and collection costs. Early waste collections mean unnecessary carbon emissions, more traffic congestion, and higher running costs. The old way of doing waste management is highly inefficient. And in today's ever-technological world, an innovative and data-driven approach is the only way forward.

Traditionally, municipalities and waste management companies would operate on a fixed collection route and schedule. This means that waste collection trucks would drive the same collection route and empty every single waste container – even if the waste container did not need emptying. This means high labor and fuel costs – which residents ultimately foot the bill for. This is also an unsustainable way of working - the more vehicles on the road carrying out unnecessary collections means more carbon emissions are released into our planet's atmosphere.

2.2 Reference

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2.3 Problem Statement Solution

The nation and world are facing a huge problem today of disposal, segregation, and recycling of solid waste and improper management of these wastes are hazardous and dangerous to human health and ecological system. The generation and disposal of waste in large quantities has created a greater concem over time for the world which is adversely affecting the human lives and environmental conditions. Wastes are the one which grows with the growth of the country. A voluminous amount of waste that is generated is disposed of by means which have an adverse effect on the environment. The common method of disposal of the waste is by unplanned and uncontrolled open dumping at the landfill sites. This method is injurious to human health, plant and animal life. This harmful method of waste disposal can generate liquid leachate which can contaminate the surface and ground waters; can harbor disease vectors which spread harmful diseases, can degrade the aesthetic value of the natural environment and is an unavailing use of land resources. Segregation of waste is important for proper disposal of the vast amount of garbage modern society produces in an environmentally sensible mode. People became adapted to tossing things away and never realize the consequences of their action. The common method of disposal of the industrial waste is by

uncontrolled and unplanned and exposed dumping at the river sites and open areas. This method is injurious to plants, human and animal life. There is a rapid increase in capacity and categories of solid as a result of urbanization, constant economic growth and industrialization. Global Waste Market reported that the amount of waste generated worldwide produced is 2.02 billion tonnes.”Wastes are not always waste, it has to be handled, segregated, transported and disposed of as to reduce the risk to the public lives and sustainable environments. The economic value of waste is best comprehended when it is segregated. There is no such system employed of segregation of glass, plastic and metallic wastes at, the industrial level. Dry waste consisting of cans, Aluminium foils, plastics, metal, glass and paper could be recycled. If we do not dispose of the waste in a more systematic manner, more than 1400 sq.km of land, which is the size of the city of Delhi, would be required in the country by the year 2047 to dispose of it.

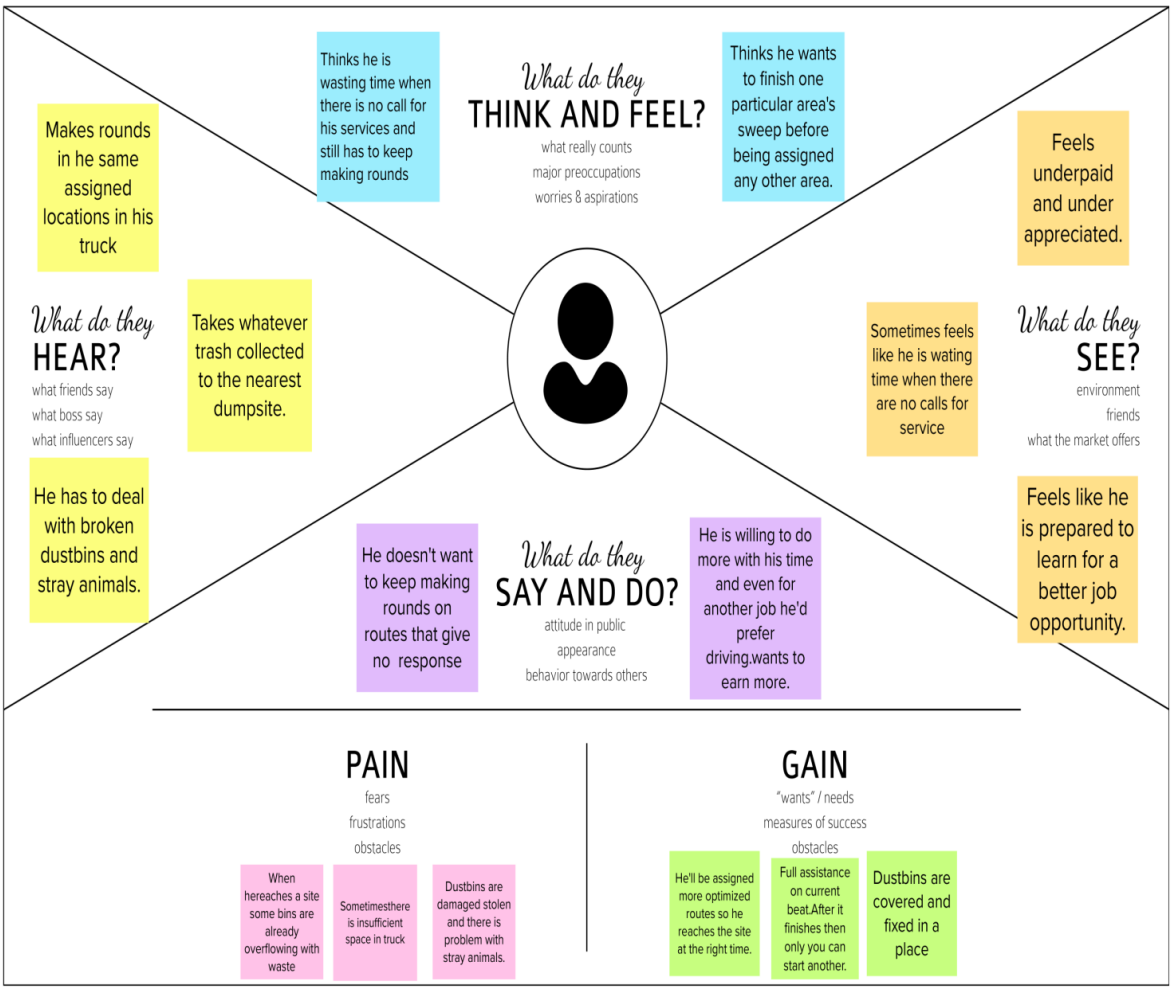
3. Ideation and proposed solution:

3.1 Empathize & Discover

Empathy Map Canvas:

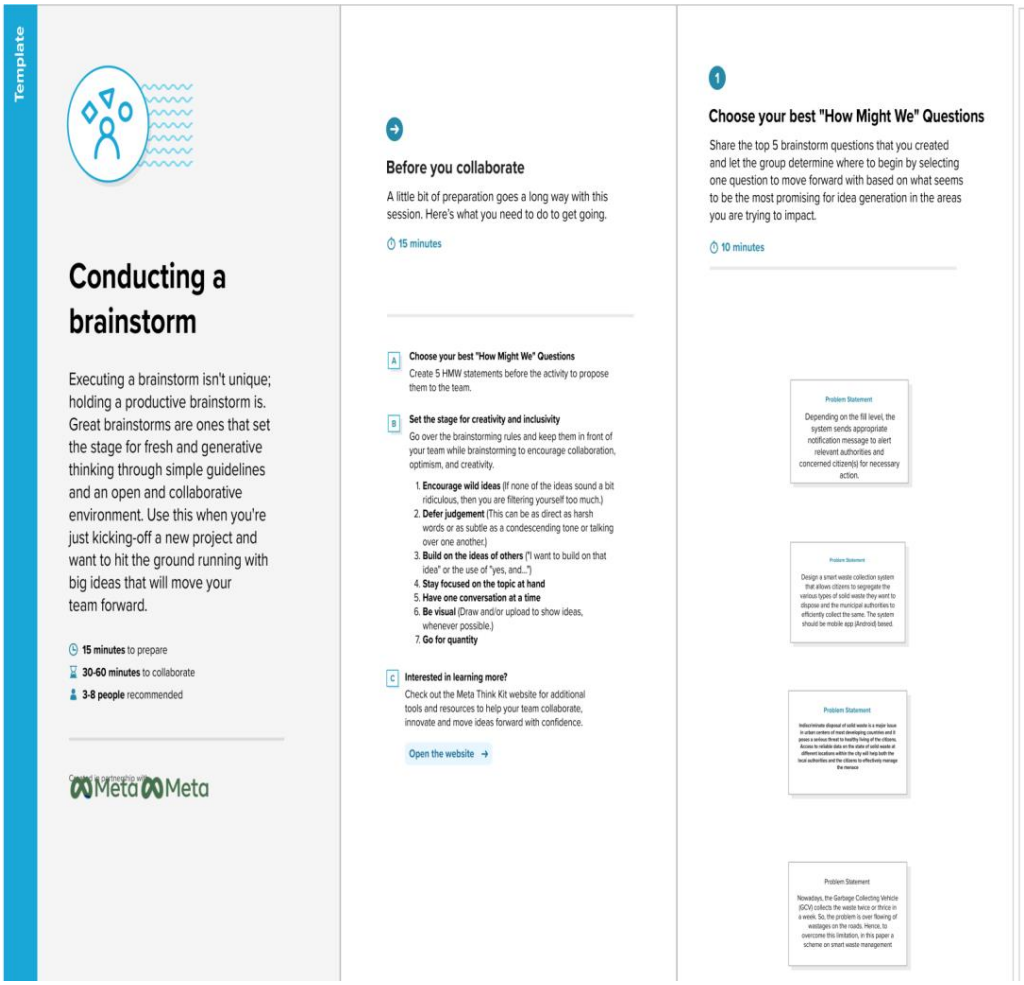
An empathy map is a simple, easy-to-digest visual that captures knowledge about a user’s behaviours and attitudes. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user’s

perspective along with his or her goals and challenges.



3.2 Brainstorm & Idea Prioritization Template

Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping

2

Brainstorm solo

Have each participant begin in the "solo brainstorm space" by silently brainstorming ideas and placing them into the template. This "silent-storming" avoids group-think and creates an inclusive environment for introverts and extroverts alike. Set a time limit. Encourage people to go for quantity.

10 minutes

3

Brainstorm as a group

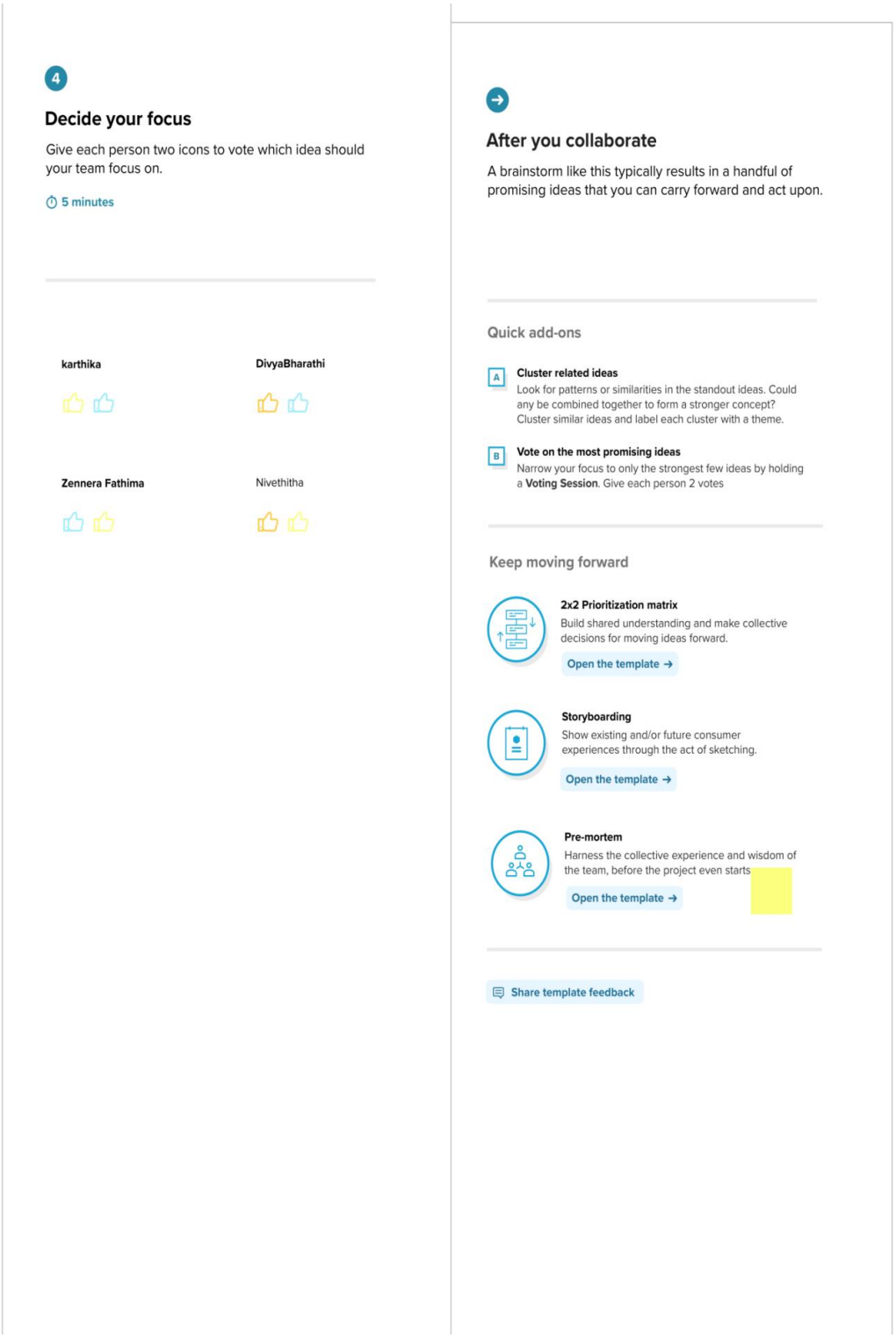
Have everyone move their ideas into the "group sharing space" within the template and have the team silently read through them. As a team, sort and group them by thematic topics or similarities. Discuss and answer any questions that arise. Encourage "Yes, and..." and build on the ideas of other people along the way.

15 minutes

TIP

You can use the **Voting session** tool above to focus on the strongest ideas.

Step-3: Idea Prioritization

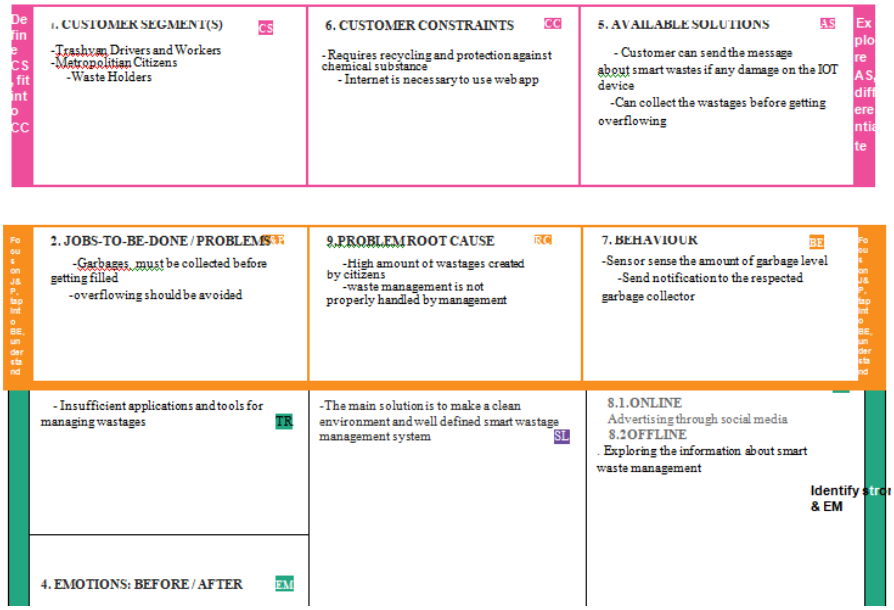


3.3 Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	✓ The manual monitoring of wastes in waste bins is a cumbersome process and utilises more human effort, time and cost. ✓ Irregular disposal of wastes causing trouble to people. ✓ Foul smell around the place with uncollected wastes or garbage.
2.	Idea / Solution description	✓ This process is achieved by using a ultrasonic sensor to know the levels of garbage bin through cloud connection. ✓ Creating an app, there by the corporation of a particular locality inside a metropolitan city can check the garbage bins whether they are filled or not.
3.	Novelty / Uniqueness	✓ Unlike the conventional methods for collecting garbage bins, this method tells us to use the transport only in required places ✓ To reduce the human-effort and difficulty in monitoring the garbage bins.
4.	Social Impact / Customer Satisfaction	✓ People can experience a clean environment. ✓ Reduces the human effort involving in the garbage disposal process. ✓ This idea will be very much beneficial for a city corporation for monitoring the cleanliness of various parts of the city.
5.	Business Model (Revenue Model)	✓ This reduces a huge fuel cost to the city corporations by reducing the unwanted

		transport expenses to unnecessary places. ✓ This project aims to support the municipal corporations. ✓ Provide a clean environment.
6.	Scalability of the Solution	✓ A huge time is saved from frequent monitoring of garbage bins through human labours. ✓ It can be updated to automated garbage collection through vehicles. ✓ There is no need of new establishment of things. ✓ Already present garbage bins are modified slightly.

3.4 Problem solution fit:



4. Requirements

4.1 Functional Requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Expensive bins	✓ As we are making up bins with sensors and other costly devices , this is somewhat expensive architecture to built. ✓ And so this requires more security settings as it requires more cost if we need to rebuilt it.
FR-2	Implementing proper monitoring system	✓ All bins can be seen on the map, and you can visit them at any time via the Street View feature from Google. Bins are visible on the map as green, orange or red circles. ✓ You can see bin details in the Dashboard capacity, waste type, last measurement, GPS location and collection schedule or pick recognition.
FR-3	Separation of different kind of wastes	✓ Separation of different kind of wastes involves people responsibility too and so, proper education need to be provided. ✓ And bins should be implemented accordingly in each locations. ✓ And especially medical wastes should be disposed in a proper manner.
FR-4	Routing the pickup of trash	✓ Route planning for rubbish pickup is semi- automated using the tool. ✓ You are prepared to act and arrange for garbage collection based on the levels of bin fill that are now present and forecasts of approaching capacity.

		✓ To find any discrepancies, compare the planned and actual routes.
FR-5	Get rid of ineffective picks	✓ Get rid of the collection of half-empty trash cans. ✓ Picks are recognised by sensors. ✓ We are able to show you how filled the bins you collect are by utilizing real-time data on fill- levels and pick recognition. ✓ The report details the bin's initial level of brimmingness. ✓ Any picks below 80% full that are inefficient are seen right away.

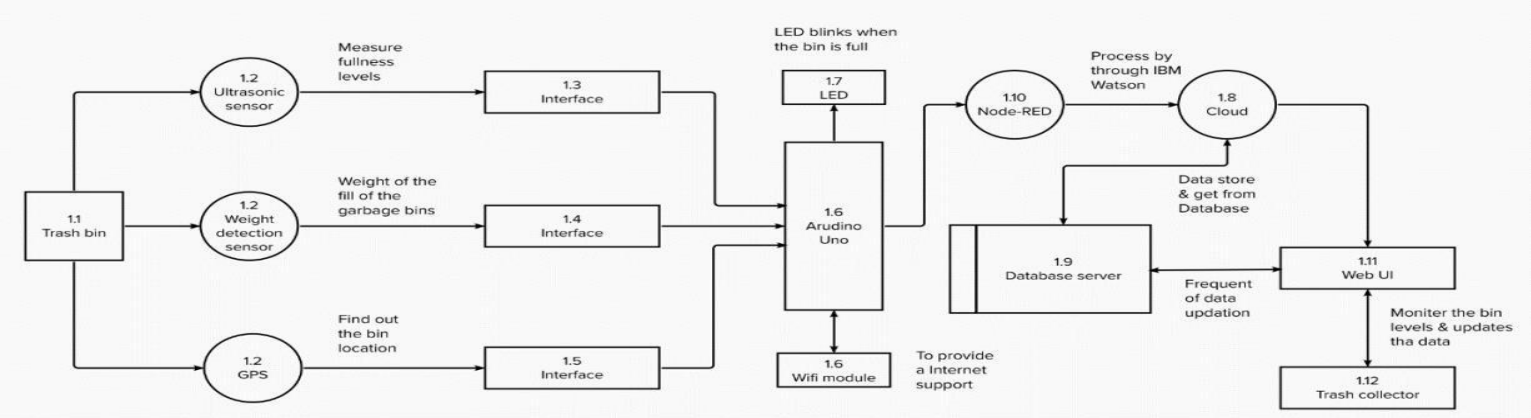
4.2 Non-Functional Requirements

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	✓ The study of customers' product usability can help designers better understand users' possible demands in waste management, behavior, and experience during the design process, which places a focus on the user experience.
NFR-2	**Security**	✓ Security ensures the level of assurance in data collection, processing and conveying. ✓ As this is totally depend upon cloud service we need to make security more particular without channel crash.

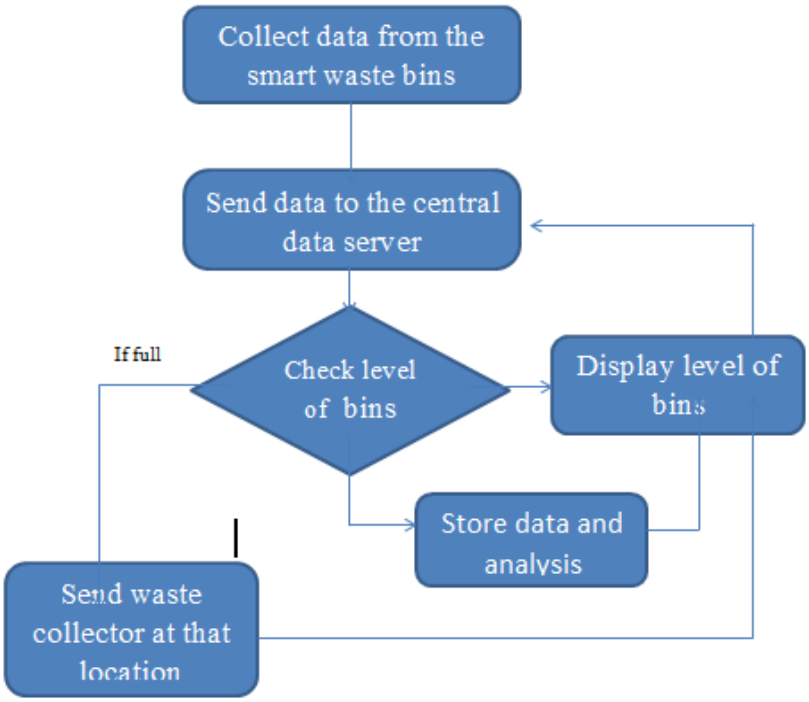
NFR-3	**Reliability**	✓ Creating better working conditions for waste collectors and drivers is another aspect of smart waste management. Waste collectors will use their time more effectively by attending to empty bins that need service rather than driving the same collection routes.
NFR-4	**Performance**	✓ The system consist of sensors to measure the weight of waste and the level of waste inside the bin. ✓ Customers are provided with required datadriven and decision making prototypes which would help uses to monitor its performance and encounter their quires.
NFR-5	**Availability**	✓ By creating and implementing durable hardware and gorgeous software, we enable cities, companies, and nations to manage garbage more intelligently.
NFR-6	**Scalability**	✓ We have to customize the number of bins in the town/city which we are going to monitor 24/7 a week and collect data. ✓ Smart waste management aims to optimize resource allocation, reduce running costs, and increase the sustainability of waste service. ✓ Analytics data to manage collection routes and the placement of bins more effectively.

5. Project Design

5.1 Data Flow Diagram



5.2 Solution & Technical Architecture



5.3 User Stories

User Type	Functional	User	User Story / Task	Acceptance criteria	Priorit	Release

	Requirement (Epic)	Story Number			y	
Admin (who manage web server)	Web server login	USN-1	As a admin, I have my user name and password foe every worker and co-workers to manage them.	I can manage web account and direct workers.	High	Sprint-1
Co-admin	Login	USN-2	As a co-admin, I'll manage other monitoring activities like garbage level monitoring, location accuracy, garbage separation and removal of waste within a scheduled time.	I can monitor garbage bins activities.	High	Sprint-1
Customer (Web user)	User	USN-3	Here comes the customer, he/she will have access to mobile apps or login webpages to view progress of bins and to report if any query found.	He/ she has the right to make a query if any	High	Sprint-2
Customer Care Executive	Worker	USN-4	The customer care executive, will try to rectify the queries from customers by contacting coadmin. If case of any critical/ emergency situation query can be conveyed to higher authority.	I can attend calls and respond people by rectifying the problem.	High	Sprint-4

Truck driver	Worker	USN-5	Here, truck driver is a worker who has particular assignments that he has to report when and where the garbage has been picked according to the daily schedule. And should update the happenings in the given website (Webpage login).	I can update my activities on site when the given task has been completed.	Medium	Sprint-5

6.Project Planning and Scheduling

6.1 Sprint Planning & Estimation