SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES

PROJECT REPORT

Submitted by

AARTHI M **(712819104704)**

ALEXANADEVI P **(712819104703)**

HEMALATHA P **(712819104725)**

RAGAVENDAR S P **(712819104728)**

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COIMBATORE 641402

ANNAUNIVERSITY:CHENNAI 600025

1.INTRODUCTION

1.1 PROJECT OVERVIEW

With the increasing population and industrialization of nations throughout the globe, waste has become a great concern for all of us. Over years, researchers figured that only waste management is not enough for its proper treatment and disposal techniques to preserve our environment and keeping it clean in this era of globalization. With the help of technology researchers have, introduced IoT based Smart Waste Management solutions and initiatives that ensures reduced amount of time and energy required to provide waste management services and reduce the amount of waste generated. Unfortunately, developing countries are not being able to implement those existing solutions due to many factors like socio-economic environment. Therefore, in this research we have concentrated our thought on developing a smart IoT based waste management system for developing countries like INDIA that will ensure proper disposal, collection, transportation and recycling of household waste with the minimum amount of resources being available

1.2 PURPOSE

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.

2.LITERATURE SURVEY

1. Cloud based smart waste management for smart cities

https://ieeexplore.ieee.org/document/8645576
Authors: Mohammad Aazam, Marc St-Hilaire, Chung-Horng Lung, Ioannis Lambadaris

This paper focuses on waste management in urban cities,With increasing population and also changes in lifestyle municipal solid waste generation is increasing significantly.Hence waste management is a challenge in urban cities.The overall waste management involves three main types of entities,they are people who generate waste,waste collectors/city admin,stakeholders. Most of the waste is of organic matter, comprising 44.4%.These data of contents in the waste management is sent to stakeholder using cloud and also in order to have a complete waste management mechanism, it is very important to have a smart way of notifying the quantity of each type of waste and involve the stakeholders effectively. They say that we can perform big data analysis on the data gathered from waste management.These analysis of the overall waste management can then be used to create further services from the cloud and analyze it in a more depth way to perform waste recycling..The methodologies that were mentioned in this paper were hadoop cluster and also performing analytics on the database from hadoop cluster.

2. Smart Waste Management System for Crowded area Makkah and Holy Sites as a Model

https://ieeexplore.ieee.org/document/8389897
Authors: Dr. Rasha Elhassan, Dr. Mahmoud Ali Ahmed, Mrs. Randa Abdalhalem

This paper focuses on how to handle waste in holy sites and makah as a model .During waste management there are three key challenges we face here , small area, short period of time and the increasing of the Pilgrimages' member.The system proposed by them will use sensors inside the container to separate the waste into 4 categories (food, plastics, papers, and metal) and use actuator at a top level to inform the management system to collect the container. The main technologies used and proposed by them was Internet of Thing,Sensor, Big Data.The different sensors used for categorize the waste are Capacitive proximity sensors separate papers and plastic inside the trash can, the metal sensor is used to detect metal,the infrared sensor detects glass.Then after categorizing the waste through GSM/GPRS the Arduino IDE system sends SMS to the waste vehicle through Radio Frequency receiver when the trash can is full.

3. **Optimal Route Recommendation for Waste Carrier Vehicles for Efficient Waste Collection:A Step Forward Towards Sustainable Cities - 15.04.2020**
https://ieeexplore.ieee.org/document/9068215
Authors: Shabir Ahmad , Imran , Faisal Jamil , Naeem Iqbal , And Dohyeun Kim

In this paper the focus is carried out on the real world solid waste of Jeju Island, South Korea. It contributes to the generation of optimized routes for the waste carrier vehicles. The existing data of the residential grids are utilized to predict the behavior of people in waste disposal. A prediction model is built with all the data collected from the grid by optimizing and pre-processing the raw data and the output of the predicted system is the total waste weights.

4. **An Internet of Things Based Smart Waste Management System Using LoRa and Tensorflow Deep Learning Model - 12.08.2020**
https://ieeexplore.ieee.org/document/9165744
Authors: Teoh Ji Sheng , Mohammad Shahidul Islam , (Graduate Student Member, Ieee), Norbahiah Misran , (Senior Member, Ieee), Mohd Hafiz Baharuddin , (Member, Ieee), Haslina Arshad , Md. Rashedul Islam , Muhammad E. H. Chowdhury, (Member, Ieee), Hatem Rmili , (Senior Member, Ieee), And Mohammad Tariqul Islam, (Senior Member, Ieee)

The traditional waste management system is replaced with smart sensors embedded into the system to perform real time monitoring and better waste management. The aim of this research is to develop a smart waste management system using the LoRa communication protocol and TensorFlow based deep learning model. LoRa sends the sensor data and Tensorflow performs real time object detection and classification. The bin consists of several compartments to segregate the waste including metal, plastic, paper, and general waste compartments which are controlled by the servo motors.

Object detection and waste classification is done in the TensorFlow framework with a pre-trained object detection model. This object detection model is trained with images of waste to generate an inference graph used for object detection which is done through a camera connected to the Raspberry Pi 3 Model B+ as the main processing unit. Ultrasonic sensor is embedded into each waste compartment to monitor the filling level of the waste. A GPS module is integrated to monitor the location and real time of the bin. LoRa communication protocol is used to transmit data about the location, real time and filling level of the bin. The RFID module is embedded for the purpose of waste management personnel identification. The camera module is connected to Raspberry Pi to capture the waste which is thrown for object detection and identification, based on the object the Raspberry Pi will actuate the opening or closing of the garbage bin. Only authorized personnel are allowed to access the garbage bins using RFID. An ultrasonic sensor is used to detect the level of the garbage in the bins and GPS is used to get the location of the bins in real-time. Thelimitations are, this model is not ideal for household garbage collection, filling of individual compartments require it to be disposed at different times which is not an efficient way.

5. **NN-Based Smart Waste Management System Using TensorFlow Lite and LoRa-GPS Shield inA C Internet of Things Environment - 15.11.2021**
   https://ieeexplore.ieee.org/document/9615047
   Authors: Nicholas Chieng Anak Sallang , Mohammad Tariqul Islam , (Senior Member, Ieee), Mohammad Shahidul Islam , (Member, Ieee), And Haslina Arshad

   Another Smart Garbage System designed where the top compartment stores most of the electronic components, the remaining compartments are used to store different types of waste . Tensor Flow Lite is chosen to be used on a low power mobile platform to detect the model, the CNN architecture of MobileNetV2 is designed to have classification performance on low power mobile devices

6. **Optimal Policy-Making for Municipal Waste Management Based on Predictive Model Optimization**
   https://ieeexplore.ieee.org/document/9284435
   Authors: Shabir Ahmad, Imran , Naeem Iqbal , Faisal Jamil , And Dohyeun Kim

   It is to define policy in terms of the number of waste collection human resources cost, waste carrier's vehicle cost and fuel cost. Thus, the paper aims to suggest the number of resources whichlead to a minimum cost and also ensure a certain level of hygiene in the area. The analysis is carried out on the solid waste dataset of 2017-2019 generated from different residential grids in Korea.The sensors installed on bin record the time of the waste hit, the amount of waste and other information such as grid ID in which the bin is placed. This information is sent to municipal authorities to collect grid statistics such as population of grid, male and female members, grid coordinates, the waste amount for weekdays, and monthly data for 2017 to 2019 in a periodic manner.

7. **'IOT Based Smart Waste Management System' 2021**
   https://ieeexplore.ieee.org/document/9528293
   Authors: Gayathri N , Divagaran A R, Akhilesh C D, Aswiin V M, Charan N

   They have designed a smart waste management system that monitors the amount of food waste in a particular organization. RFID technology is used by the user to scan and open the bin thereby allowing to keep track of every individual's food wastage and a load cell is used to measure the amount of food wastage. Thus this project allows an organization to keep track of waste generated, an individual's contribution and an analysis report is generated.

8. ‘Recycle.io: An IoT-Enabled Framework for Urban Waste Management 2018’

https://ieeexplore.ieee.org/document/8622117

Authors: Eyhab Al-Masri, Ibrahim Diabate, Richa Jain, Ming Hoi Lam and Swetha Reddy Nathala

They have designed an Internet of Things (IoT)-enabled waste management system called recycle.io, that alerts of real time waste segregation violation and aims to manage waste in a cost efficient manner. It makes use of an edge computing device which includes the Raspberry pi, ultrasonic sensor and an IR camera. The sensor triggers the camera to take pictures of the disposed waste item and is processed by the edge devices before it is sent to the cloud for further advanced analytics like dynamic scheduling and dynamic routing. The proposed system improves the network traffic since all the processing is done locally before it is sent to the cloud and also boasts a ‘serverless technology’.

9. ‘IoT-Aware Waste Management System Based on Cloud Services and Ultra-Low-Power & RFID Sensor-Tags’

https://ieeexplore.ieee.org/abstract/document/9144506

Authors: Luca Catarinucci , Member, IEEE, Riccardo Colella , Senior Member, IEEE, Stefano Irno Consalvo, Luigi Patrono , Member, IEEE, Claudia Rollo, and Ilaria Sergi.

They have proposed a solution for door-to-door waste collection and management. It includes a RFID tag on the waste bin with a fitted sensor that collects the weight of the bin and a RFID reader band that picks up the readings and transmits to the cloud. This system improves the cost of overall waste collection and helps impose a fair waste tax collection system. The paper ‘A LoRaWAN IoT enabled Trash Bin Level Monitoring System’ by S.R. Jino Ramson, S. Vishnu, A. Alfred Kirubaraj, Theodoros Anagnostopoulos and Adnan M. Abu-Mahfouz, focuses on the development of a self-powered, LoRaWAN IoT enabled Trash Bin Level Monitoring System. It consists of various sensors and a microprocessor which is used for getting the level and geographical location of a trash bin, processes the data and transmits to a LoRaWAN gateway and is relayed to a server. The users can view and analyze the status of every bin and itsgeolocation by using a smart graphical user interface. The LoRaWAN based system improves on the life expectancy, battery charging and performance.

10.Survey on waste management monitoring System based on IOT

https://www.ijirts.org/volume8issue3/IJIRTS204202.pdf

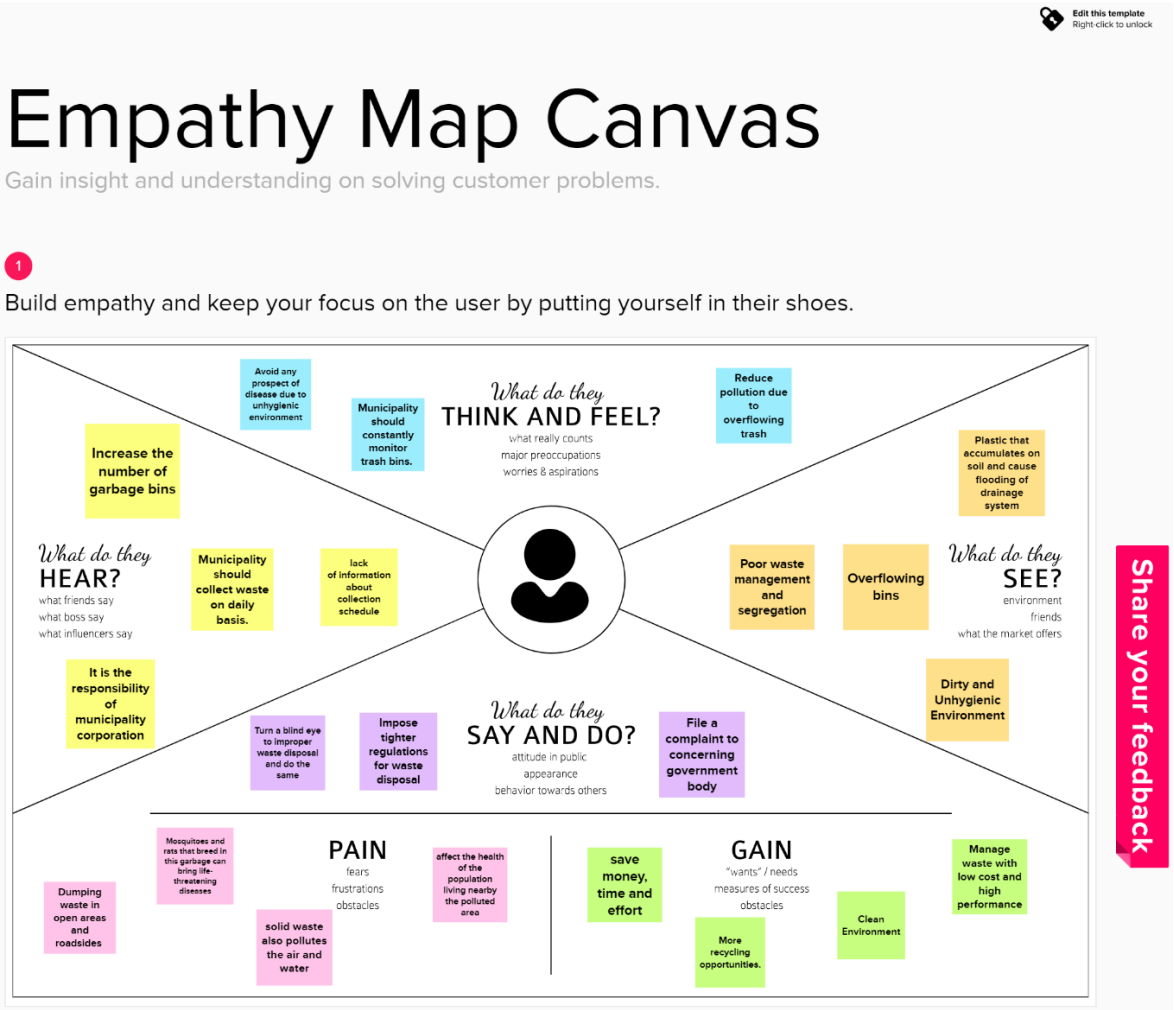
Authors: Kuhu Vaish, Shivani Kashyap, Shivani Nagar, Swati Goel Department of Computer Science and Engineering, Krishna Engineering College, Ghaziabad, India

Solid waste management is the collecting, treating and disposing of solid material that

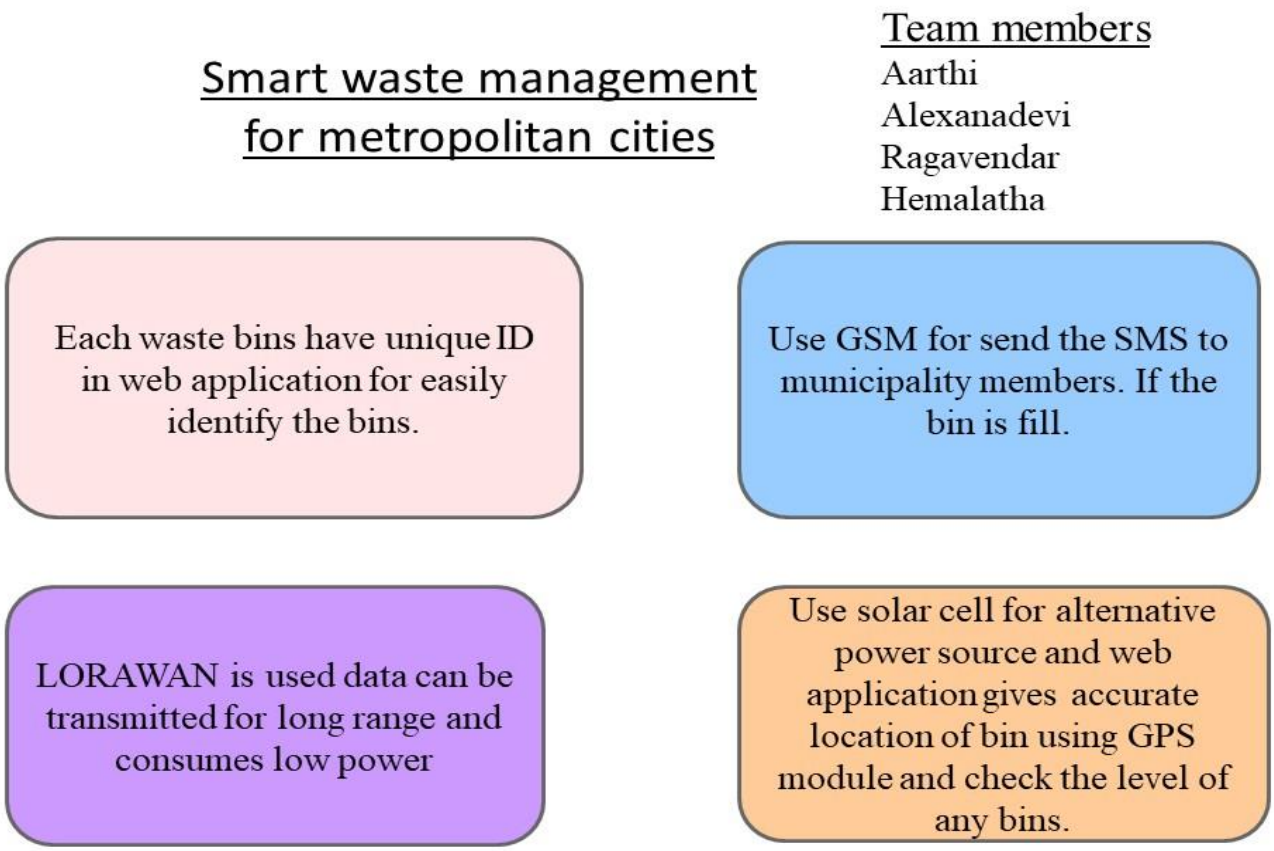
is discarded. As there are some improper disposal of municipal solid waste which can create unsanitary conditions. For evacuating purpose the bins been installed a continuous mountain of the waste levels. The location of the dustbins with the help of the GPRS VKE module which helps the Municipality to locate the Dustbins. With the help of GSM SIM module, the percentage of the dust bins filled will be sent to the truck driver to take the waste from the bins. Thus this project allows an organization to keep track of waste generated, an individual's contribution and an analysis report is generated.

3.IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP



3.2 IDEATION



3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	This project deals with the problem of waste management in smart cities, where the garbage collection system is not optimized. This project enables the organizations to meet their needs of smart garbage management systems. This system allows the authorised person to know the fill level of each garbage bin in a locality or city at all times, to give a cost-effective and time-saving route to the truck drivers.
2.	Idea / Solution description	The key research objectives are as follows: • The proposed system would be able to automate the solid waste monitoring process and management of the

		overall collection process using IOT (Internet of Things). • The Proposed system consists of main subsystems namely Smart Trash System(STS) and Smart Monitoring and Controlling Hut(SMCH). • In the proposed system, whenever the waste bin gets filled this is acknowledged by placing the circuit at the waste bin, which transmits it to the receiver at the desired place in the area or spot. • In the proposed system, the received signal indicates the waste bin status at the monitoring and controlling system.
3.	Novelty / Uniqueness	We are going to establish SWM in our college but the real hard thing is that janitor (cleaner) don't know to operate these thing practically so here our team planned to build a wrist band to them, that indicate via light blinking when the dustbin fill and this is Uniqueness we made here beside from project constrain.
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: Solid Waste, comprising the Company's waste collection, transfer, recycling and resource recovery, and disposal services, which are operated and managed locally by the Company's various subsidiaries, which focus on distinct geographic areas; and Corporate and Other, comprising the Company's other activities, including its development and operation of landfill gas-to-energy facilities in the INDIA, and its recycling brokerage services, as well as various corporate functions.
6.	Scalability of the Solution	In this regard, smart city design has been increasingly studied and discussed around the world to solve this problem. Following this approach, this paper presented an efficient IoT-based and real-time waste management model for improving the living environment in cities, focused on a citizen perspective. The proposed system uses sensor and communication technologies where waste data is collected from the smart bin, in real-time,

		and then transmitted to an online platform where citizens can access and check the availability of the compartments scattered around a city.

3.4 PROBLEM SOLUTION FIT

Smart waste management system

Team ID :
PNT2022TMID42931

STEP 1

Problem Solving Cards

-Basic question

*Problem Statement

1 _ Whats most valuable to the customer?

2. What are we the best at?

3. Where are we looking to improve?

STEP 2

Framing Statements

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itself.

4.REQUIREMENT ANALYSIS

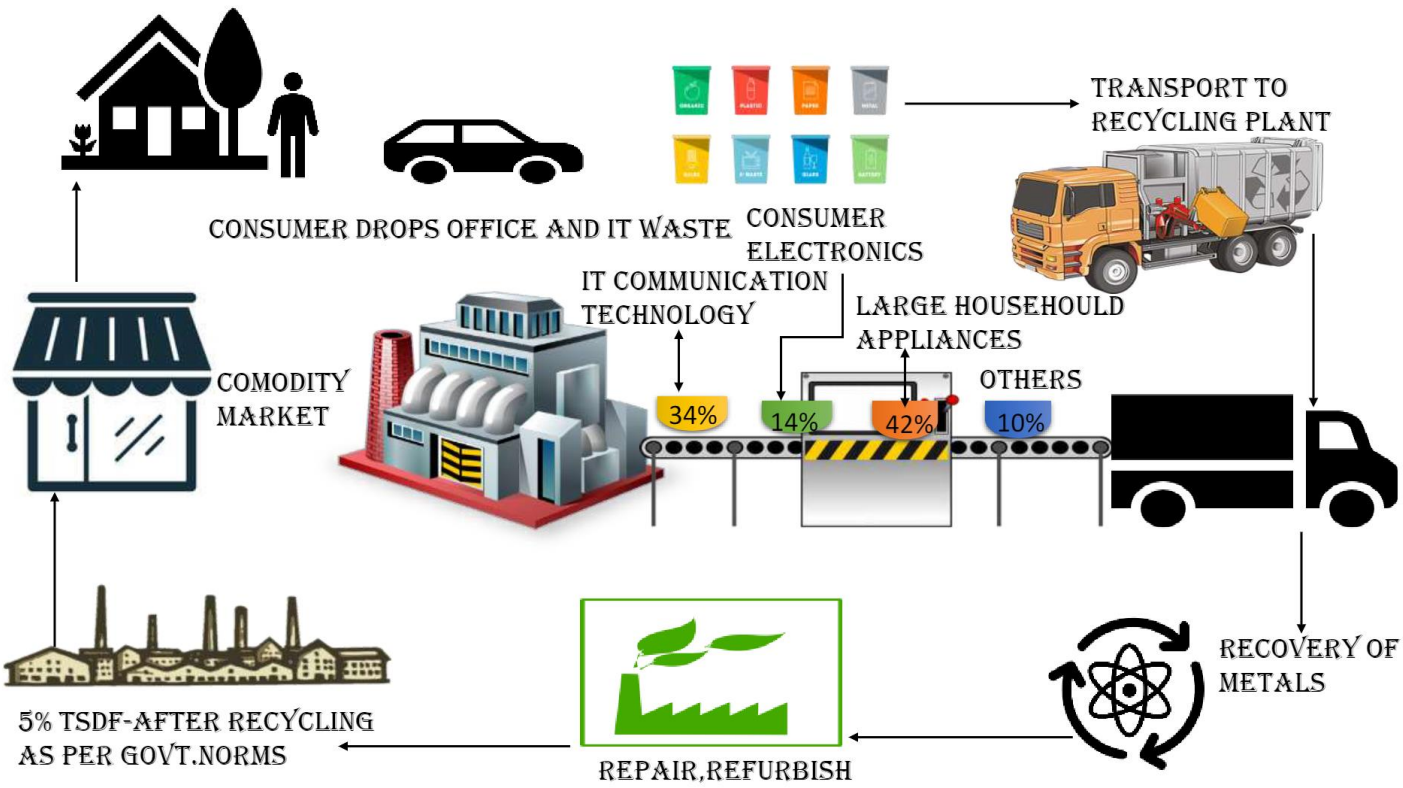
4.1 FUNCTIONAL REQUIREMENTS

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Detailed bin inventory.	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, last measurement, GPS location and collection schedule or pick recognition.
FR-2	Real time bin monitoring.	The Dashboard displays real-time data on fill-levels of bins monitored by smart sensors. In addition to the % of fill-level, based on the historical 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 last collected. With real-time data and predictions, you can eliminate the overflowing bins and stop collecting half-empty ones.
FR-3	Expensive bins.	We help you identify bins that drive up your collection costs. The tool calculates a rating for each bin in terms of collection costs. The tool considers the average distance depo-bindischarge in the area. The tool assigns bin a rating (1-10) and calculates distance from depo-bin discharge.
FR-4	Adjust bin distribution.	Ensure the most optimal distribution of bins. Identify areas with either dense or sparse bin distribution. Make sure all trash types are represented within a stand. Based on the historical data, you can adjust bin capacity or location where necessary.

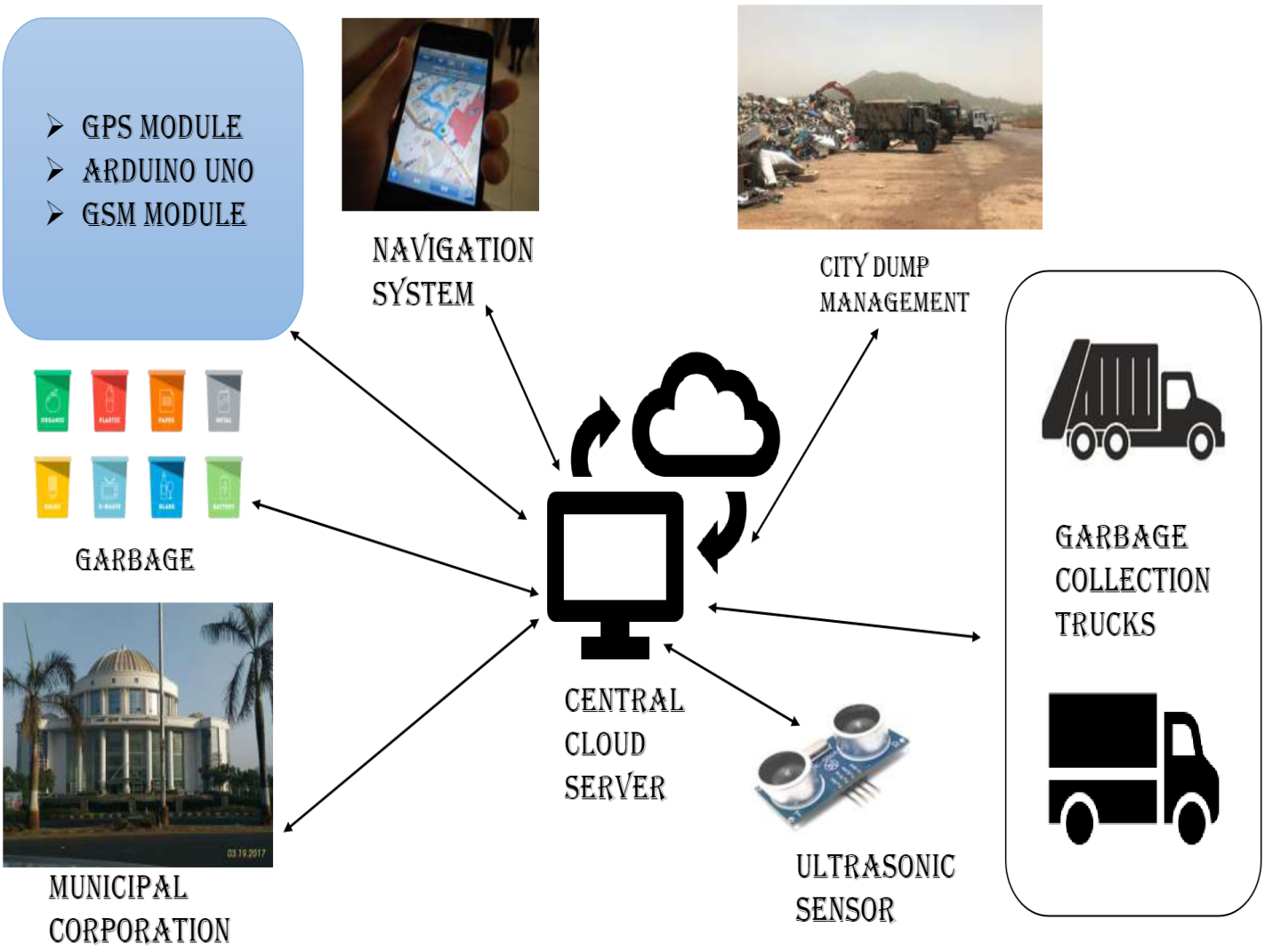
FR-5	Eliminate unefficient picks.	Eliminate the collection of half-empty bins. The sensors recognize picks. By using real-time data on fill-levels and pick recognition, we can show you how full the bins you collect are.
		The report shows how full the bin was when picked. You immediately see any inefficient picks below 80% full.
FR-6	Plan waste collection routes.	The tool semi-automates waste collection route planning. Based on current bin fill-levels and predictions of reaching full capacity, you are ready to respond and schedule waste collection. You can compare planned vs. executed routes to identify any inconsistencies.

5.PROJECT DESIGN

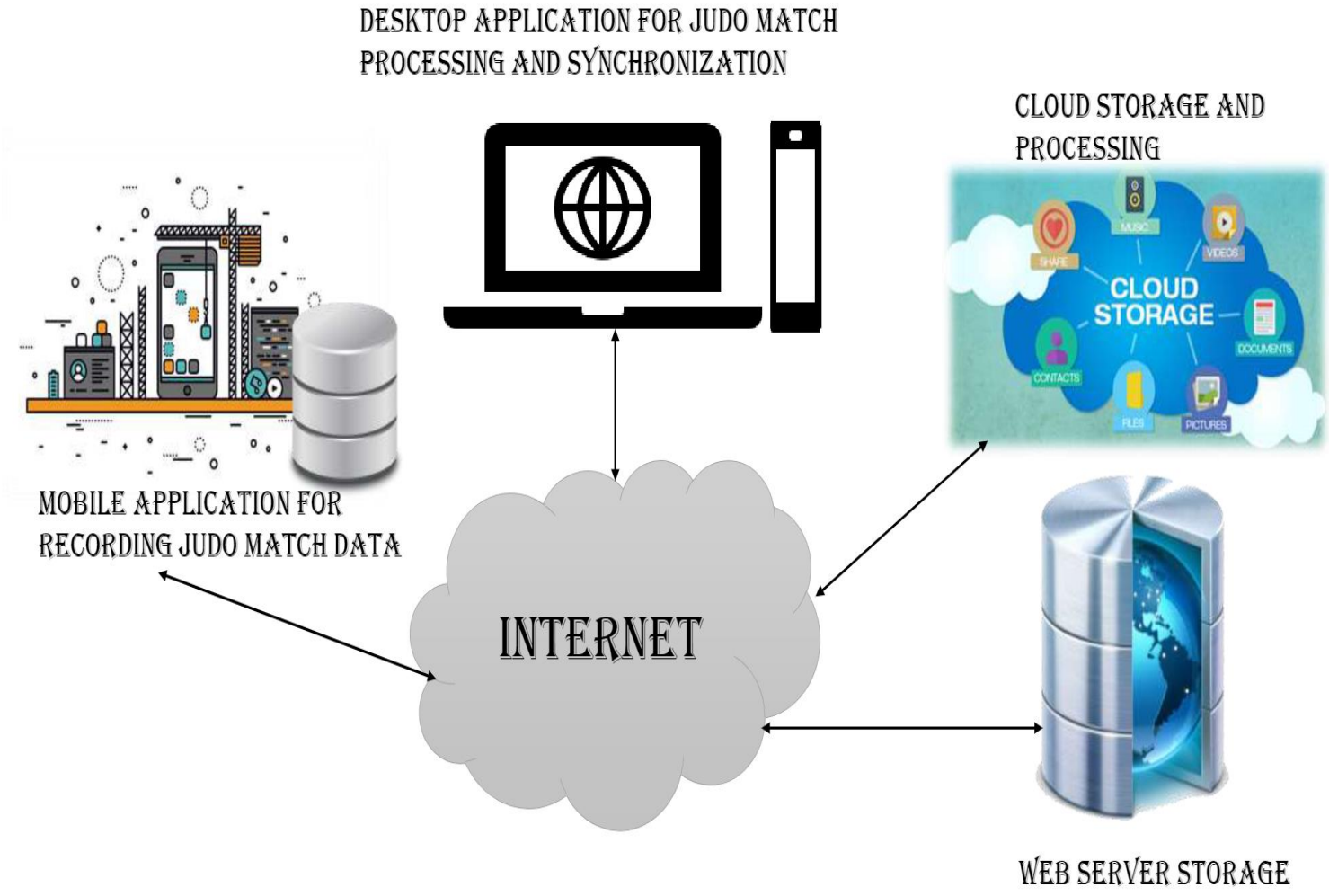
5.1 DATA FLOW DIAGRAM



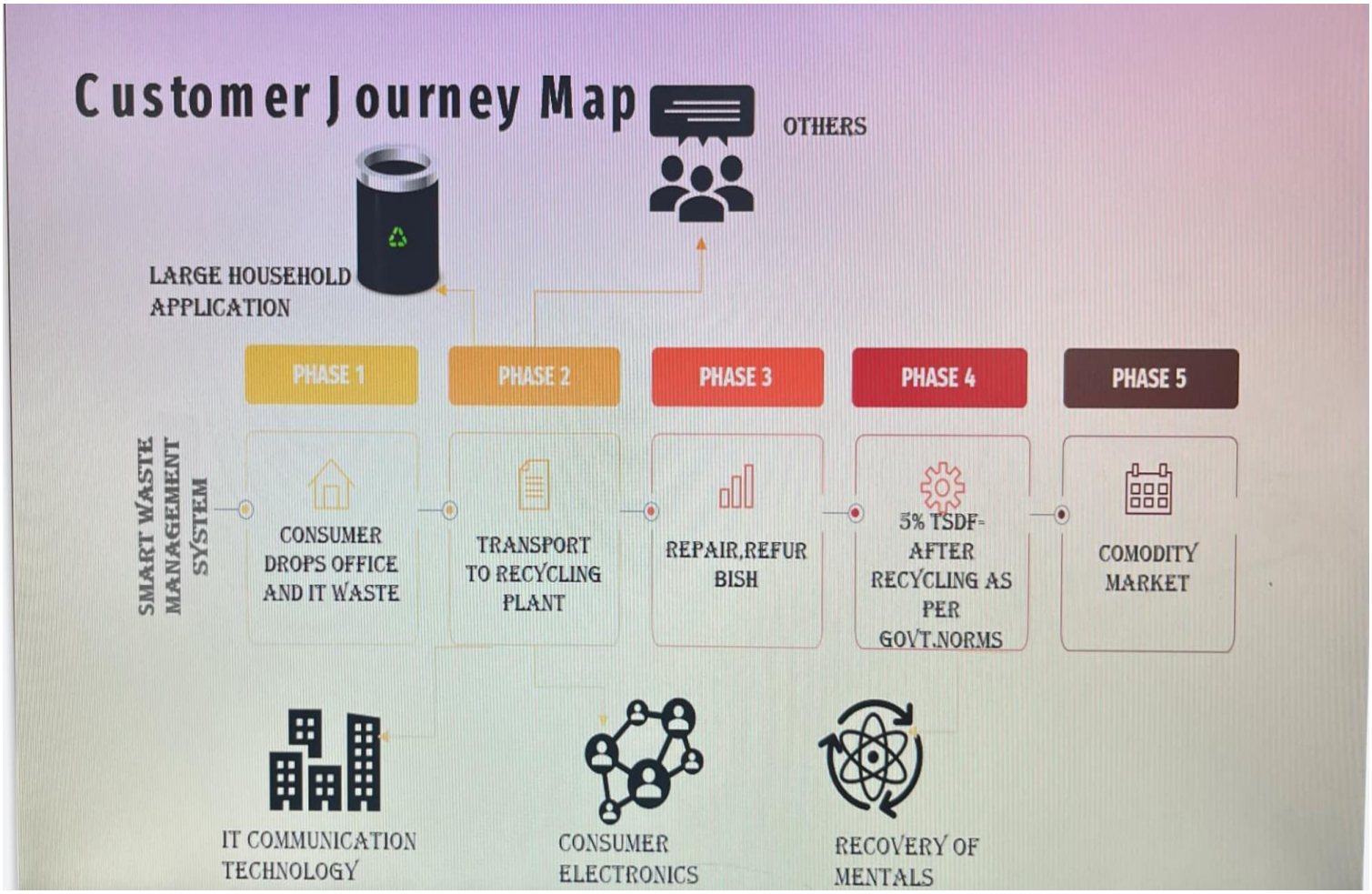
5.2 SOLUTION ARCHITECTURE



5.3 TECHNICAL ARCHITECTURE



5.4 CUSTOMER JOURNY MAP



6.PROJECT PLANNING &SCHEDULING

6.1 SPRINT SCHEDULE AND ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint 1	Login	USN-1	As a Administrator, I need to give user id and passcode for ever workers over there in municipality	10	High	aarthi

Sprint 1	Login	USN-2	As a Co-Admin, I'll control the waste level by monitoring them vai real time web portal. Once the filling happens, I'll notify trash truck with location of bin with bin ID	10	High	Alexanadevi
Sprint 2	Dashboard	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	Ragavender
Sprint 3	Dashboard	USN-4	As a Local Garbage Collector, I'II gather all the waste from the garbage, load it onto a garbage truck, and deliver it to Landfills	20	Medium	Hemalatha
Sprint 4	Dashboard	USN-5	As a Municipality officer, I'll make sure everything is proceeding as planned and without any problems	20	High	aarthi

Project Tracker, Velocity & Burndown Chart

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint 1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint 2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint 3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint 4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022