

PROJECT REPOR
SMART WASTE MANAGEMENT SYSTEM FOR
METROPOLITAN CITIES

TEAM ID:PNT2022TMID44233

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1 INTRODUCTION

1.1Project 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.

1.2Purpose:

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: IoT Based Waste Management
for Smart City

AUTHOR NAME: Parkash Tambare,
Prabu Venkatachalam

PUBLICATION YEAR: 2016

DESCRIPTION:

In the current situation, we frequently observe that the trash cans or dust cans that are located in public spaces in cities are overflowing due to an increase in the amount of waste produced each day. We are planning to construct “IoT Based Waste Management

for Smart Cities” to prevent this from happening because it makes living conditions for people unsanitary and causes unpleasant odours in the surrounding area. There are numerous trash cans scattered throughout the city or on the campus that are part of the proposed system. Each trash can is equipped with a low-cost embedded device that tracks the level of the trashcansand anindividual ID that will enable it to be trackedand identified.

PAPER 2:

AUTHOR NAME: Mohammad Aazam,Marc St-Hilaire,

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PUBLICATION YEAR: 2016

DESCRIPTION:

Each bin in the Cloud SWAM system that Mohammad Aazam et al suggested has sensors that can detect the amount of waste inside. There areseparate bins for organic, plastic/paper/bottle/glass, and metal waste. This way, each form of waste is already divided, and it is known how much and what kind of waste is collected thanks to the status. Different entities and stakeholders may benefit from theaccessibility of cloud-stored data in different ways. Analysisand planning can begin as soon as garbage is collected and continue through recycling and import/export-related activities. Timely garbage collection is provided via

the Cloud SWAM system. A timely and effective method of waste collection improves health, hygiene, and disposal.

PAPER 3:

TITLE: Arduino Microcontroller Based Smart
Dustbins for SmartCities

AUTHOR NAME: K. Suresh, S. Bhuvanesh
and B. KrishnaDevan

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:

AUTHOR NAME: Mohd Helmy Abd Wahab, Aeslina Abdul Kadir,

Mohd Razali Tomari and Mohamad Hairol Jabbar

PUBLICATION YEAR: 2014

DESCRIPTION:

Proposed a smart recycle bin that can handle the recycling of plastic, glass, paper, and aluminium cans. It generates a 3R card after automatically determining the value of the trash thrown away. The recycle system makes it possible to accumulate points for placing waste into designated recycle bins. By allowing the points to be redeemed for goods or services, such a system promotes recycling activities. The system keeps track of information on disposal procedures, materials disposed of, user identification, and points accrued by the user. To use the recycle bin, the user must tap his card to the designated RFID reader. Doors to recycling bins are opened, and rubbish is placed one by one.

Problem Solution fit:

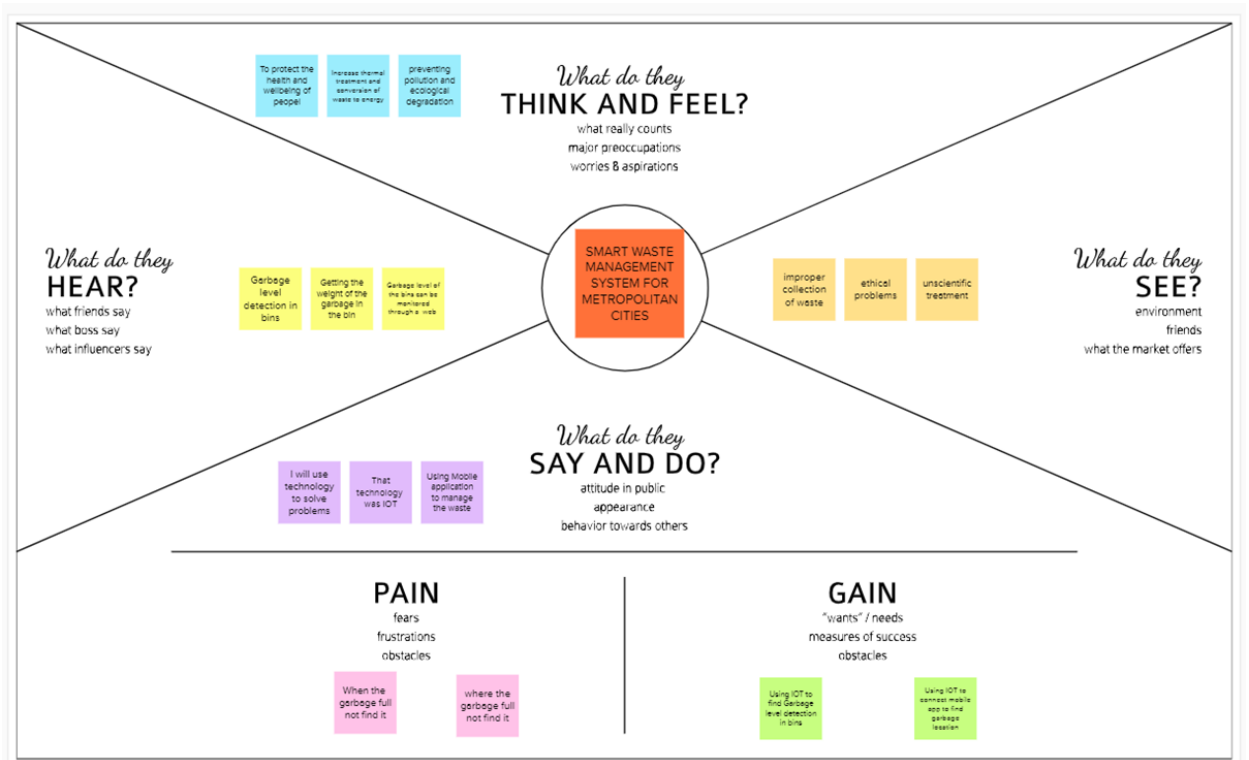
Problem Statement (PS)	I am (Customer)	I am trying to	But	Because	Which makes me feel

PS-1	Householder	Dispose the vegetable waste and other household waste	It increases the land pollution and contaminate ground water	To keep the surroundings clean and healthy.	Difficult
PS-2	Industrialist	Dispose the chemical waste and recycle for future use.	It contaminates wildlife's habitats and endangers the life of people at large.	To avoid risk for both environment and human health.	Unpleasant.



3 IDEATION & PROPOSEDSOLUTION:

3.1 Empathy map canvas:



3.2 Ideation & Brainstorming:

Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

TID
You can select a single row
and fix the parallelism of
certain SQL statements.

Group Ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you can break it up into smaller sub-groups.

20 minutes

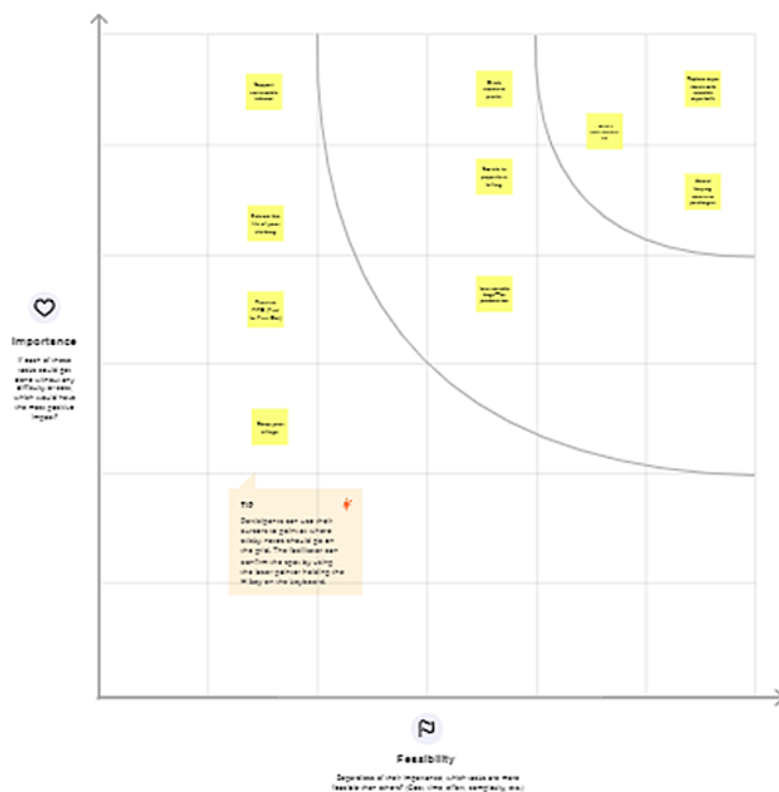
Let your visible signs of stress
help you make it easier to find
stress, anger and
anxiety important ideas on
them within your mind.



Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

30 minutes



After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick actions

- Share the mural**
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.
- Export the mural**
Export a copy of the mural as a PNG or PDF to attach to emails, insert in slides, or save in your drive.

Keep moving forward

- Strategy blueprint**
Define the components of a new idea or strategy.
[Open the template](#)
- Customer experience journey map**
Visualize customer needs, motivations, and obstacles for an experience.
[Open the template](#)
- Strengths, weaknesses, opportunities & threats**
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
[Open the template](#)

[Show template feedback](#)

3.3 Problem solution fit:

1.CUSTOMER SEGMENT(S) CS <ul style="list-style-type: none"> Metropolitan City citizens People whose house near the trashcans. Municipal Officers Trashvan Drivers & Workers 	6.CUSTOMER CONSTRAINTS CC <ul style="list-style-type: none"> Internet is necessary to use the web app The device may send wrong information 	5.AVAILABLE SOLUTIONS AS <p>The citizens can send the message about the smart dumpsters if any damage on the IoT device occurred.</p>
2.JOBS TO BE DONE/PROBLEMS J&P <ul style="list-style-type: none"> The dustbins need to empty after it got filled. The overflowing needs to avoid. Clean India should be maintained 	9.PROBLEM ROOT CAUSE RC <ul style="list-style-type: none"> High population in cities. Poor waste mangement system High amount of wastages produced by people 	7.BEHAVIOUR BE <p>The sensors senses the amount of waste in trashcans and the device sends the notification to the head office, they will come and collect the wastages.</p>
3.TRIGGERS TR <ul style="list-style-type: none"> To keep the city clean Hygienic environment 	10.OUR SOLUTION SL <p>Monitoring the dumpsters and send the information about the garbage level to the authenticated person to empty the trashcans using arduino device.</p>	8.CHANNELS of BEHAVIOUR CH <p>8.1 ONLINE Sends the information to the head office.</p>
4.EMOTIONS BEFORE/AFTER EM <ul style="list-style-type: none"> Before:Unhealthy environment After:Clean city and healthy environment 		<p>8.2 OFFLINE Trashvan collects the garbage from trash cans.</p>

3.4Functional 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	User waste categories.	User decay User non-decay
FR-4	User dustbin	User size User capacity
FR-5	Eliminate inefficient picks.	Eliminate the collection of half-empty bins. The sensors recognize picks
FR-6	Plan waste collection routes.	The tool semi-automates waste collection route planning

Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	1. IoT device verifies that usability is a special and important perspective to analyze user requirements, which can further improve the design quality. 2. 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.
NFR-2	Security	1. Use a reusable bottles 2. Use reusable grocery bags 3. Purchase wisely and recycle

4 PROJECT DESIGN:

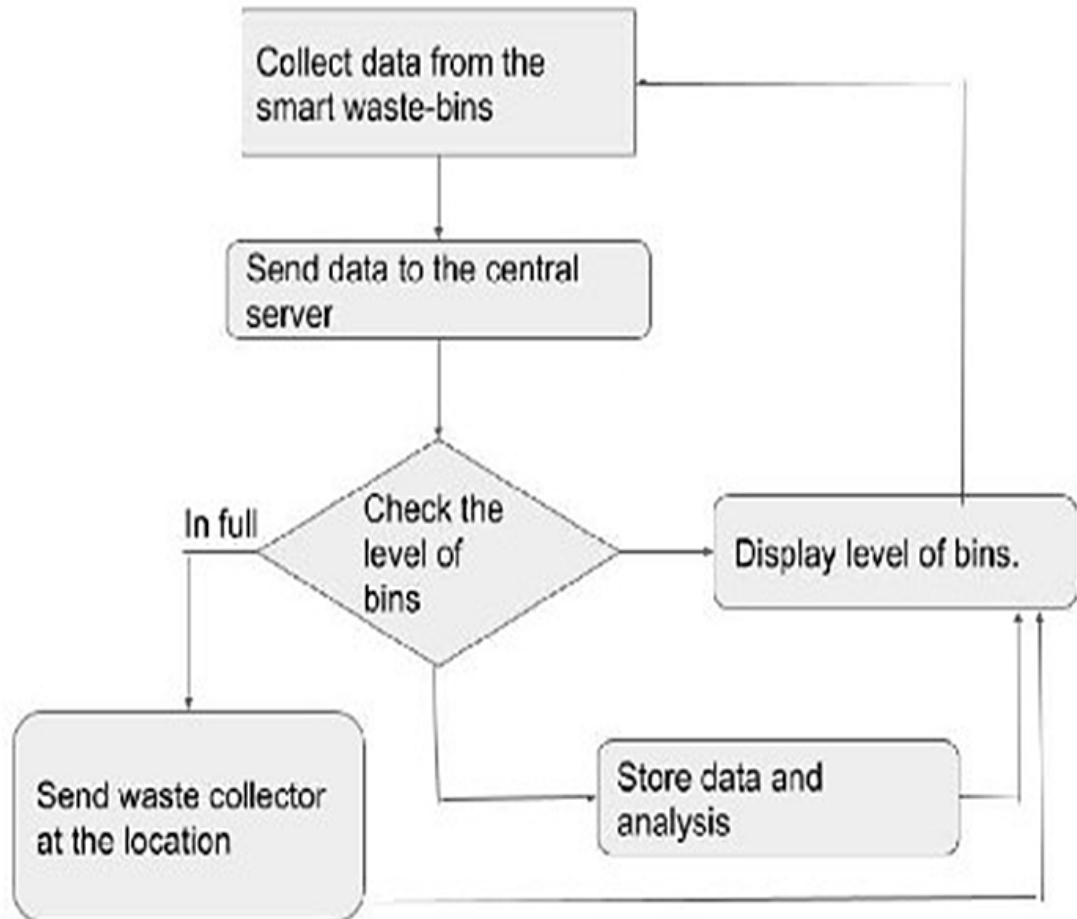
4.1 Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored. A smart waste management platform uses analytics to translate the data gathered in your **bins into actionable insights to help you improve your waste services**. You can receive data on metrics such as:

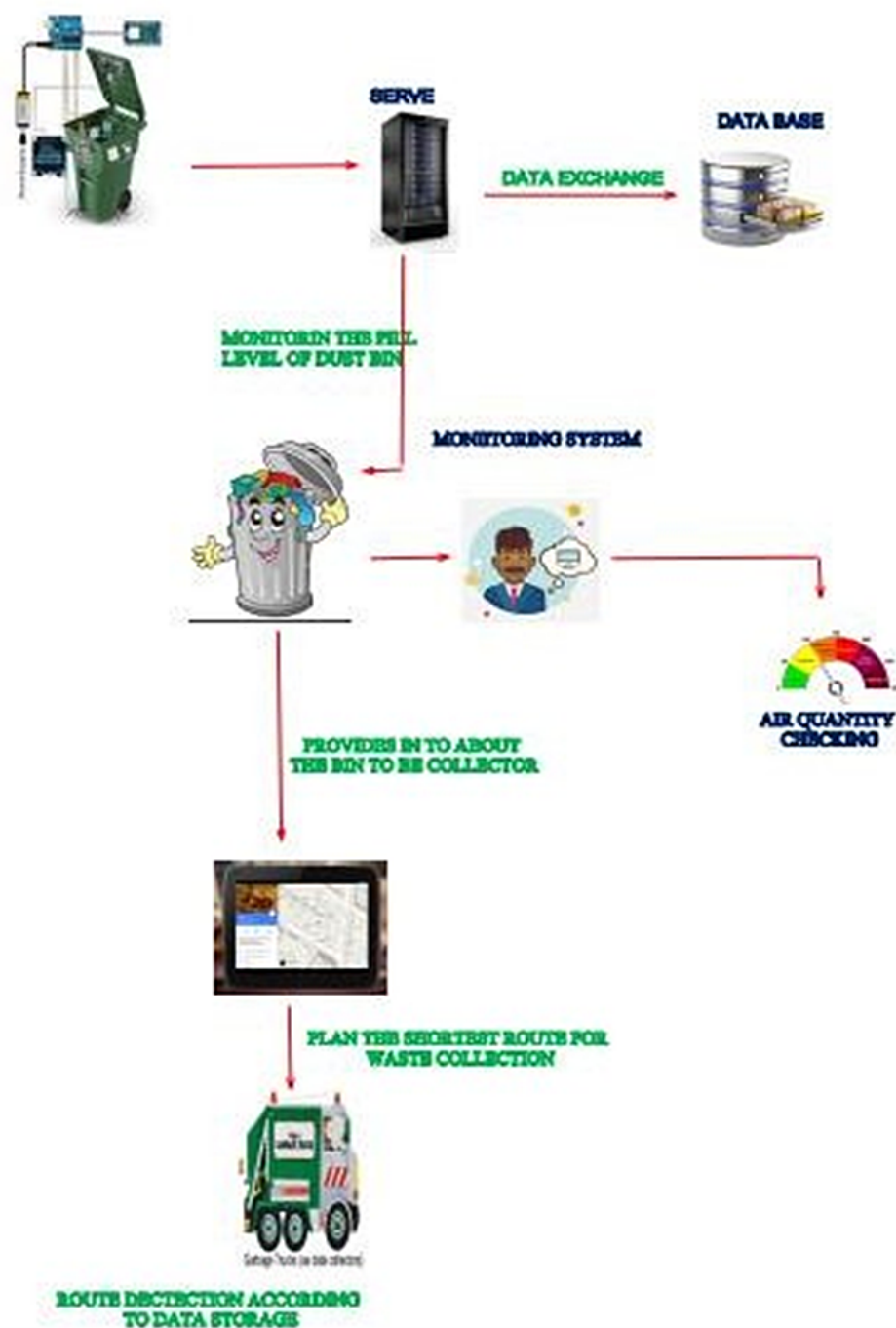
1. The first test conducted is the situation where the garbage bin is empty or its garbage level is very low
2. Then, the bin is filled with more garbage until its level has surpassed the first threshold **value, which is set to 80% then the first warning SMS is being sent, as depicted**
3. The first notification SMS sent by the system, once the waste reaches the level of 85% full
4. The second notification SMS sent by the system, indicating that bin is at least 95% full and **the garbage needs to be collected immediately**
5. Locations prone to overflow
6. The number of bins needed to avoid overflowing waste
7. The number of collection services that could be saved
8. The amount of fuel that could be saved
9. The driving distance that could be saved

Data flow diagram:

FLOW DIAGRAM:



4.2 Solution & Technical Architecture:



4.2 Userstories:

User type	Functional Requirement (EPIC)	User story Number	User story/Task	Acceptance criteria	priority	Release
Admin (who manage web server)	login	USN-1	Ass an admin,I gave user id and pass word for ever workers and manage them.	I can manage web account/dashboard	medium	Sprint-2
Co admin	login	USN-2	ASa Co admin.I am manage garbageget filling alert I will post	I can manage garbage monitoring	high	Sprint-1

			location and garbage id to trash truck			
Truck driver	login	UNS-3	A struck driver,I am follow the route sebd by CO admin to reach the filling garbage.	I can drive to reach the garbage filled route in pulled to	medium	Sprint- 2
Local garbage collector	login	UNS-4	As a waste collector, I am collect all there trash from garbage and load into garbage truck and send them to landfillt	I can collect trach and pulled to truck and send off	High	Sprint- 2
municipality	login	UNS-5	As municipality, I am check the process are happening In disciplinemanner without any any issues.	I can manage all these process going good.	High	Sprint- 2

5.PROJECT PLANNING & SCHEDULING:

5.1Sprint Planning & Estimation:

PHASE	TITLE	DESCRIPTION
Ideation Phase	Literature Survey &	Literature survey on the
	Information Gathering	selected project & gathering information by referring the, technical papers, research publications etc.
	Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements
	Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.

Phase-1	Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.
	Problem Solution Fit	Prepare problem - solution fit document.
	Solution Architecture	Prepare solution architecture document.

Phase-2	Customer Journey	Prepare the customer journey map to understand the user interactions & experiences with the application (entry to exit).
	Functional Requirement	Prepare the functional and Nonfunctional requirement document.
	Data Flow Diagrams	Draw the data flow diagrams and submit for review.
	Technology Architecture	Prepare the technology architecture diagram.
Project planning phase	Prepare Milestone & Activity List	Prepare the milestones & activity list of the project.

Project developme ntphase	Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developedcode by testing it.
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5.4 Sprint Delivery Schedule:

Sprint	Functional Requirement (Epic)	Task	Story Points	Priority	Team Members
Sprint-1	Registration	As a team lead , I can enrolled for the project byentering my email, password and within that I can enter my team members name and their email.	2	High	MURALIDHARAN N
Sprint-1		As a team lead , I will receive confirmation email once , I have enrolled for the project with team id and along with team members name.	2	High	JEYACHANDHIRAN S
Sprint-2	Login	As a team member, I can login to the IBM portal by entering email & password	1	Medium	MURALIDHARAN N
Sprint-3		As a team member, I can login to the IBM portal by entering email & password	1	Medium	DINESHKUMAR M
Sprint-3		As a team member, I can login to the IBM portal by entering email & password	1	Medium	DINESHKUMAR M

		password			
Sprint-4		As a team member, I can login to the IBM portal by entering email & password	1	Medium	ASHOKKUMAR P

Project Tracker, Velocity& Burndown Chart:

Sprint	Total Story Points	Duration	Sprint StartDate	Sprint End Date(Planned)	Story Points Completed (ason Planned End Date)	Sprint Release Date(Actual)
Sprint-1	20	6 Days	22 Oct 2022	27 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	30	30 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	49	06 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	50	07 Nov 2022

6. ADVANTAGES &

DISADVANTAGES

ADVANTAGES:

1. Reduction in Collection Cost
2. No Missed Pickups
3. Reduced Overflows
4. Waste Generation Analysis
1. CO2 Emission Reduction

DISADVANTAGES:

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

7. 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.

8. 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

GETUPLINK :

<https://github.com/IBM-EPBL/IBM-Project-42876-1660710730>

