PROJECT REPORT ON:

SMART WASTE MANAGEMENT IN METROPOLITAN CITIES

TEAM ID: PNT2022TMID29748

TEAM LEADER: VIDHYALAKSHMI

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                PREETHI V

1.INTRODUCTION

1.1Project Overview

❖ 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.

❖ Smart city waste management technology allows crews to empty bins before they become overflowing with trash or recycling, and before infestation becomes an issue. Smart waste sensors can also alert crews when bins develop unpleasant smells which can then be treated to eliminate odors.

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.

1.2 PURPOSE

- Garbage level detection in bins.
- Getting the weight of the garbage in the bin.
- Alert 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

A literature review is a survey of scholarly sources (such as books, journal articles, and theses) related to a specific topic or research question. It is often written as part of a thesis, dissertation, or research paper, in order to situate your work in relation to existing knowledge.

We collected the relevant information on our Smart waste management in metropolitan cities and we existed the solutions. We all gathered together and referred the following points through research publications.

Publication year: 07, July-2022.

Author name: Prameya R Hegde, Ashok Kumar A R.

Journal name: International Journal of Engineering Research & Technology (IJERT).

Publication year: May – June 2020.

Author name: Venkata Chennareddy, Ramanayagam S.

Journal name: International Journal of Scientific Research and Engineering Development

(IJSRED).

Publication year: August 2020.

Author name: Nikita S.Sapike, Prof.S.S.Sambare.

Journal name: Journal of Emerging Technologies and Innovative Research(JETIR)

Publication year: Dec 2018.

Author name: B. Devika, B. Ananthi.

Journal name: International Research Journal of Engineering and Technology (IRJET).

Publication year: May-June-2021.

Author name: Pallavi Shankarrao Mahore, Dr. Aashish A. Bardekar.

Journal name:International Journal of Scientific Research in Computer Science, Engineering and Information Technology.

Publication year: May 2019.

Author name: Rajesh Kumar Maurya, Sanjay Kumar Yadav, Tarun Kumar Sharma.

Journal name: International Journal of Innovative Technology and Exploring Engineering (IJITEE).

Publication year: 19 January 2022.

Author name: Alexandros Oikonomidisa, Cagatay Catalb and Ayalew Kassahuna.

Journal name: New Zealand Journal of Crop and Horticultural Science.

2.1 Existing problems

The current process of waste management starts with the waste being created by people in the cities and disposed in trash bins near its creation point. The disposed trash is collected by municipality or private company trucks at the predefined times and transferred to temporary collection centers. The trash at the collection centers is then sent for recycling.

2.3 References

1.Doron A., Jeffery R. (2018) Waste of a Nation Garbage growth in India: Harvard University Press Cambridge, Massachusetts, and London, England pp.1-441
2.Joseph, K. (2002). Perspectives of solid waste management in India. In an international symposium on the technology and management of the treatment and reuse of the municipal solid waste, Shanghai, China pp. 15-20.
3.Kaushal, R. K.,Varghese G.K.,Chabukdhara M (2012). Municipal
solid waste management in India-current state and future challenges: a review. International Journal of Engineering Science and Technology, 4(4), pp.1473-1489.
4.Pamnani A., Srinivasarao M. (2014), Municipal Solid waste management in India: A review And some new results Volume 5, Issue 2 pp. 01-08
5.Srivastava, P. K. ,Kulshreshtha K, Mohanty CS, Pushpangadan P,Singh A. (2005). Stakeholder-based SWOT analysis for successful municipal solid waste management in Lucknow, India. Waste management, 25(5), pp.531-537.
6.Talyan, V., Dahiya R.P., Sreekrishnan T. R. (2008). State of municipal solid waste management in Delhi, the capital of India. Waste Management, 28(7), pp. 1276-1287
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2.4 PROBLEM STATEMENT

Problem-solution essays consider the problems of a particular situation, and give solutions to those problems. They are in some ways similar to cause and effect essays, especially in terms of structure (see below). Problem-solution essays are actually a sub-type of another type of essay, which has the following four components:

- Situation
- Problem
- Solution
- Evaluation

By this problem statement we found some problems faced by the people like customers, students, merchant and weaver etc

Example are as follows:

*I'm a Merchant I'm trying to sell my goods and products in online,but customers hesitate to buy because the website is prone to fraudulent activity.

*I'm a customer I'm trying to buy products through online platform but it asking me to fill the bank details because payment is done through online.It makes me to feel reluctance.
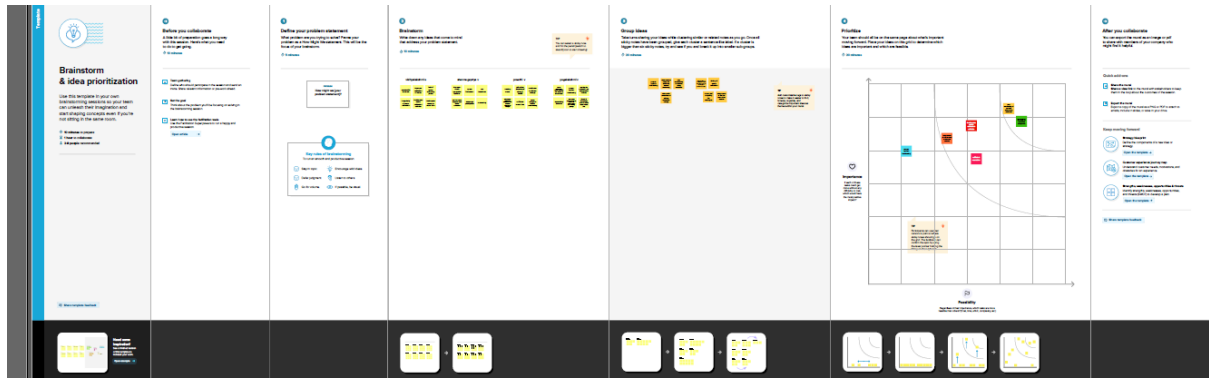
3. IDEATION & PROPOSED SOLUTION

3.1Empathy map
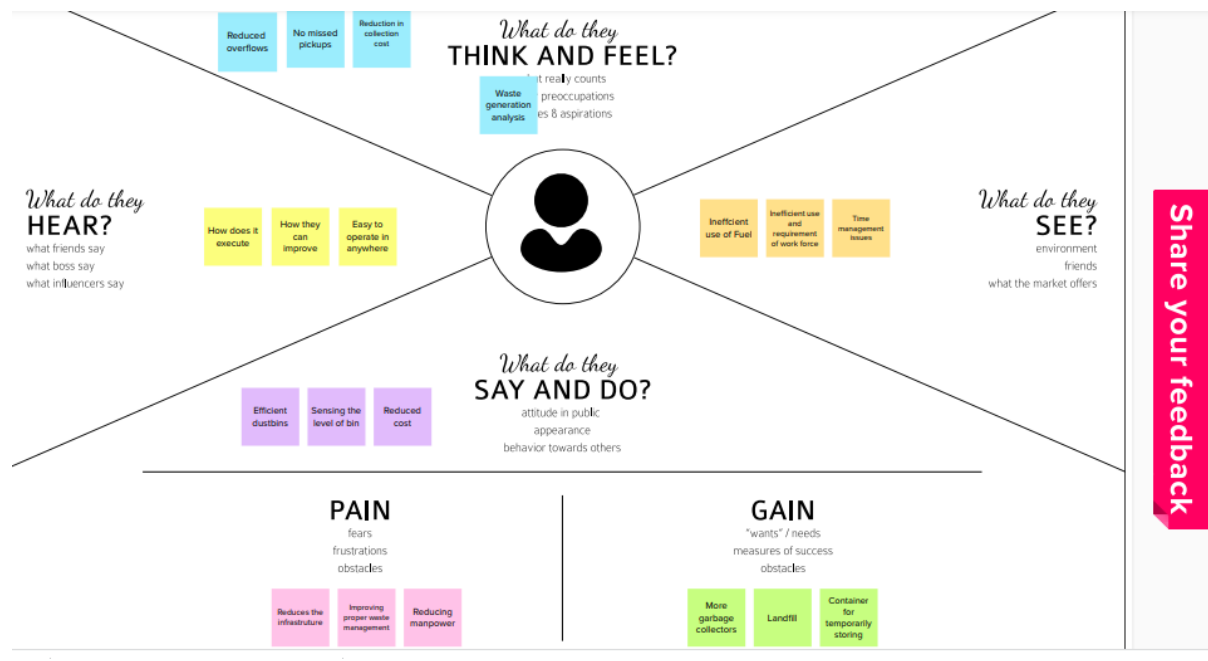
3.2 BRAIN STROMING

Brainstorming is part design thinking. You use it in the ideation phase. It's extremely popular for design teams because they can expand in all directions.

Brainstorming is a method design teams use to generate ideas to solve clearly defined design problems.

3.3 PROPOSED SOLUTION

Your proposed solution should relate the current situation to a desired result and describe the benefits that will accrue when the desired result is achieved. So, begin your proposed solution by briefly describing this desired result.

Proposed Solution Template

Date	19 September 2022
Team ID	PNT2022TMID29748
Project Name	Project – smart waste management in metropolitan cities
Maximum Marks	2 Marks

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)	Inadequate service coverage,operational inefficience of service,limited utilization of recycling activities
2.	Idea / Solution description	Reduce adverse effects of waste on human health,the environment ,planetary resourses and aesthetics
3.	Novelty / Uniqueness	More trash bins are used and provided by cities and remove and collect the garbage waste in efficient ways
4.	Social Impact / Customer Satisfaction	Some trash bins are overfilled while others are underfilled by the trash collection time,overfilled trash bins create unhygienic conditions
5.	Business Model (Revenue Model)	Generates revenue through the provision of various waste management and disposal services and recycling solutions to residential,commercial,industrial,and municipal clients
6.	Scalability of the Solution	The "smart bin" communicates information on fill levels and ensures collection only when the bin is full

3.4 PROBLEM SOLUTION FIT

This occurs when you have evidence that customers care about certain jobs, pains, and gains. At this stage you've proved the existence of a problem and have designed a value proposition that addresses your customers' jobs, pains and gains.

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) **CS** Who is your customer? i.e. working parents of 0-5 y.o. kids * Municipality * Hospital	6. CUSTOMER CONSTRAINTS **CC** What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices. the garbage collecting vehicle to collect the waste in twice and thrice in a week	5. AVAILABLE SOLUTIONS **AS** Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking more frequent food waste collection	Explore AS, differentiate
Focus on J&P, tap into BE, understand RC	2. JOBS-TO-BE-DONE / PROBLEMS **J&P** Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides. you will create and the plans in place to provide a reliable and efficient service for collection,transportation and disposal of waste	9. PROBLEM ROOT CAUSE **RC** What is the real reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the change in regulations. 1.lack of public awareness 2.refusal to learn about compliance 3.insuffficient investment in waste management	7. BEHAVIOUR **BE** What does your customer do to address the problem and get the job done? i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace) customer is expected to pay a critical and difficult to predict role in both generation and proper disposal of waste	Focus on J&P, tap into BE, understand RC
Identify strong TR & EM	3. TRIGGERS **TR** What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news. bad smell spreads and may cause illness to local people 4. EMOTIONS: BEFORE / AFTER **EM** How do customers feel when they face a problem or a job and afterwards? i.e. lost, insecure > confident, in control - use it in your communication strategy & design. they feel tough and then feel concerned	10. YOUR SOLUTION **SL** If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour. a reduction waste collection cost, trash and don't have to be emptied useless they reach certain levels enables city planners to optimize collection roots saving fuel time and money	8.CHANNELS of BEHAVIOUR **CH** **8.1 ONLINE** What kind of actions do customers take online? Extract online channels from #7 **8.2 OFFLINE** What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development. weekly twice go and collect the garbage	Identify strong TR & EM

4.REQIREMENT ANALYSIS:

Requirements analysis, also called requirements engineering, is the process of determining user expectations for a new or modified product. These features, called requirements, must be quantifiable, relevant and detailed. In software engineering, such requirements are often called functional specifications**.**

4.1 FUNTIONAL REQUIREMENT:

Functional requirements may involve calculations, technical details, data manipulation and processing, and other specific functionality that define what a system is supposed to accomplish. Behavioral

requirements describe all the cases where the system uses the functional requirements, these are captured in use cases.

4.2 NON-FUNCTIONAL REQUIREMENT:

Nonfunctional Requirements (NFRs) define system attributes such as security, reliability, performance, maintainability, scalability, and usability. They serve as constraints or restrictions on the design of the system across the different backlogs.

5.PROJECT DESIGN

Project design is an early phase of the project lifecycle where ideas, processes, resources, and deliverables are planned out. A project design comes before a project plan as it's a broad overview whereas a project plan includes more detailed information.
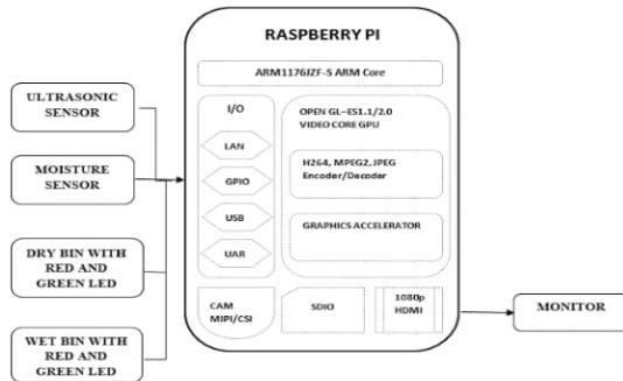
5.1 DATA FLOW DIAGRAMS:

A data-flow diagram is a way of representing a flow of data through a process or a system. The DFD also provides information about the outputs and inputs of each entity and the process itself. A data-flow diagram has no control flow — there are no decision rules and no loops.

Project Design Phase-II
Data Flow Diagram & User Stories

Date	16 October 2022
Team ID	PNT2022TMID29748
Project Name	Project-Smart Waste Management System For Metropolitan Cities
Maximum Marks	4 Marks

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.

User Stories

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

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can download the application	I can view the data sent by hardware	High	Sprint-3
Customer (web user)	Registration	USN-1	As a user, I can view the application web page	I can view the data sent by hardware	High	Sprint-3
Customer (Data types)	Data viewing	USN-1	As a user, I can view garbage level monitoring	Data by the hardware	High	Sprint-1
		USN-2	As a user, I can view the level of wastage	Data by the hardware	High	Sprint-1
		USN-3	As a user, I can view the level of dustbin is detected	Data by the hardware	High	Sprint-1
Customer	Actions	USN-1	As a user I can receive notification appears in the phone	I receive notification	Medium	Sprint-2
		USN-1	As a user I need sensor Access which connected to mobile	Based on the sensor the level of the garbage will monitored	Medium	Sprint-2
Administrator	Storage	USN-1	As an administrator I can store the data	All the data are stored in cloud database	High	Sprint-4

5.2 SOLUTION &TECHNICAL ARCHITECTURE

Solution architecture, term used in information technology with various definitions such as; "A description of a discrete and focused business operation or activity and how IS/IT supports that operation"

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Solution Architecture:

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.

- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.

- Define features, development phases, and solution requirements.

- Provide specifications according to which the solution is defined, managed, and delivered.

Example - Solution Architecture Diagram:

5.3 USER STORIES

A user story is a short, simple description of a feature told from the perspective of the person who desires the new capability, usually a user or customer of the system.

| Notification during over flow of garbage	Entice	Enter	Engage	Exit	Extend
Steps	Municipalities can also deploy and maintain smart city infrastructure like capacity sensor in waste bin and wireless for Data transferring	Departure of correct place.	**Receive Notification of onboard**	**Receive Notificat -ion of alight**	**Notification appears in the Phone**
Interactions	Active	useful	Good		Well developed method
Goal and motivations	Reduce overflow and manpower	Onboard notification correctly.	Alight notification	Reach information at correct time	Without delay
Positive moments	Time save	Cost reduction and resource optimization	Does not need any external help	Happy	🙂

6.PROJECT PLANNING &SCHEDULING

The process of planning primarily deals with selecting the appropriate policies and procedures in order to achieve the objectives of the project. Scheduling converts the project action plans for scope, time cost and quality into an operating timetable.

6.1 SPRINT PLANNING &ESTIMATION

Activity List:

Sprint planning is an event in scrum that kicks off the sprint. The purpose of sprint planning is to define what can be delivered in the sprint and how that work will be achieved. Sprint planning is done in collaboration with the whole scrum team.
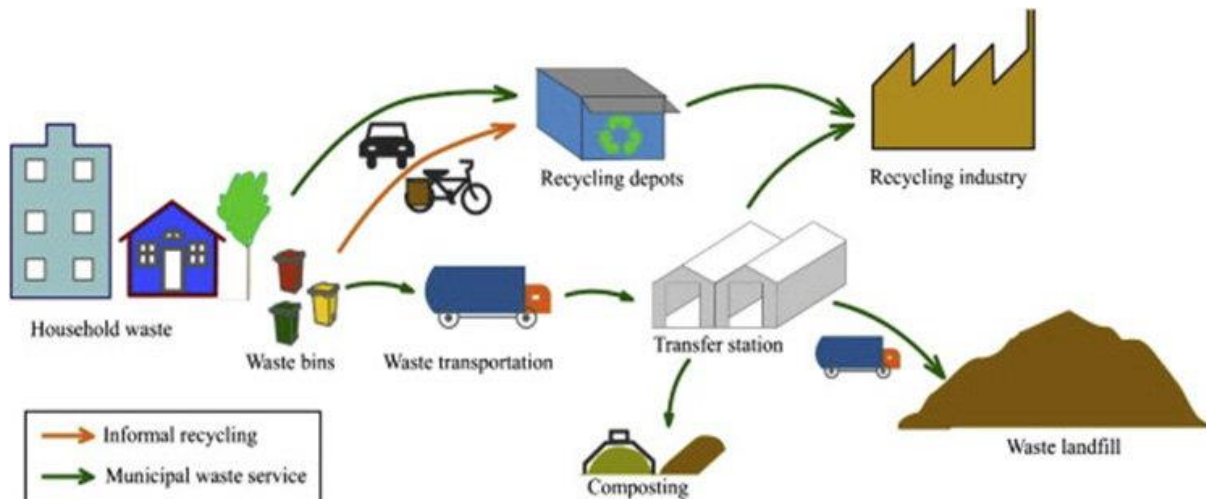
6.2 SPRINT DELIVERY SCHEDULE

Since sprints take place over a fixed period of time, it's critical to avoid wasting time during planning and development. And this is precisely where sprint scheduling enters the equation.

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	low	Vidhyalakshmi s Shanmugapriya v
Sprint-1	Login Credentials	USN-2	As a user, I will receive confirmation email once I have registered for the application	1	Low	Yogalakshmi v Preethi v
Sprint-1	Login	USN-3	As a user, I can register for the application through Facebook	2	Low	Shanmugapriya v Preethi v
Sprint-2	Dashboard	USN-4	As a user, I can register for the application through Gmail	2	Medium	Vidhyalakshmi s Yogalakshmi v
Sprint-2	Overall UI	USN-5	Non functional overall UI developed for userconvenience	1	High	Overall team
Sprint-2	Backend development	USN-6	Giving user semi functional UI of the application	2	Medium	Overall team
Sprint-3	Connecting application with cloud	USN-7	User can experience the semi functional working of the data(from cloud) with application	2	Medium	Overall team
Sprint-3	Connecting Devices /Gateways with cloud	USN-8	User can experience the semi functional working of iot device connected wit application	2	High	Overall team
Sprint-4	Debug and Testing	USN-9	Testing has been done for finding debugs	2	High	Overall team
Sprint-4	Testing and deployment	USN-10	Final testing deployment	2	High	Overall team

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	6	6 Days	24 Oct 2022	29 Oct 2022	To be updated (to be 6)	29 Oct 2022
Sprint-2	6	6 Days	31 Oct 2022	05 Nov 2022	To be updated (to be 6)	05 Nov 2022
Sprint-3	4	4 Days	07 Nov 2022	12 Nov 2022	To be updated (to be 4)	12 Nov 2022
Sprint-4	4	4 Days	14 Nov 2022	19 Nov 2022	To be updated (to be 4)	19 Nov 2022

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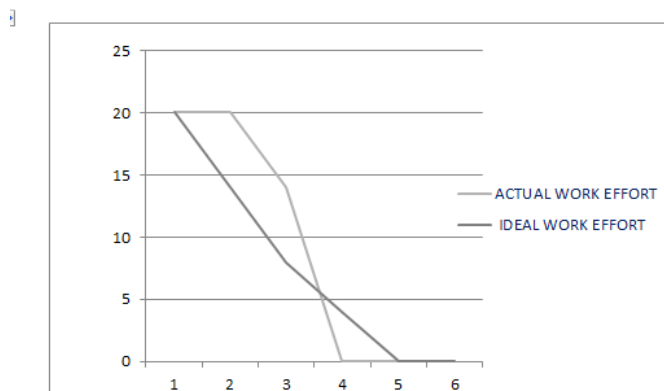
$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

6.3 REPORTS FROM JIRA

Burndown Chart:

A burndown chart is a graphical representation of work left to do versus time.

DAYS	0	6	12	16	24
ACTUAL WORK EFFORT	20	20	14	0	0
IDEAL WORK EFFORT	20	14	8	4	0

7.CODING & SOLUTION

7.1 FEATURE 1

Python script

import time

import sys

```python
import ibmiotf.application
import ibmiotf.device
import random


organization="7lnn7p"
devicetype="preethi"
deviceid="1436"
authMethod="token"
authToken="09876543211"


def myCommandCallback(cmd):
    print("Command received:%s"%cmd.data['command'])
    status=cmd.data['command']
    if status =="lighton":
        print("led in on")
    else:
            print("led is off")
try:

deviceOptions={"org":organization,"type":devicetype,"id":deviceid,"auth-method":authMethod,"auth-token":authToken}
    deviceCli=ibmiotf.device.Client(deviceOptions)
except Exception as e:
    print("Caught exception connecting device:%s"%str(e))
    sys.exit()
```

```python
deviceCli.connect()
while True:
    time.sleep(5)
    Ultrasonic=random.randint(0,80)
    Weight=random.randint(0,100)
    lat=round(random.uniform(11.03,11.50),6)
    long=round(random.uniform(76.80,76.90),6)
    GPS=str(lat)+str(',')+str(long)
    myData={'Ultrasonic':Ultrasonic,'Weight':Weight,'GPS':GPS}
    def myOnpublishCallback():
        print("Published Ultrasonic=%sCm"%Ultrasonic,"Weight:%s kg"%Weight,"GPS:%s"%GPS)


    success=deviceCli.publishEvent("IoTSensor","json",data=myData,qos=0,on_publish=myOnpublishCallback)
    if not success:
        print("Not connected to IoTF")
    time.sleep(1)
    deviceCli.commandCallback=myCommandCallback
deviceCli.disconnect()
```

8. TESTING

8.1 TEST CASES

Test case description	Required input	Information and related requirements	Test case status indicating pass or fail
The user or concerned service provider should register with the required details	User input details for registration	User Name, Email ID, Phone Number, and Security Password	Pass
The user or concerned service provider tried to log in to the monitoring portal with registered details	User login details	User Name, Security Password	Pass or Fail
Monitoring website portal indicating home, user, SGB status	User monitoring home screen should be display	The developed prototype for Smart Garbage Bin must be kept 'ON.'	Pass

8.2 USER ACCEPTANCE TESTING:
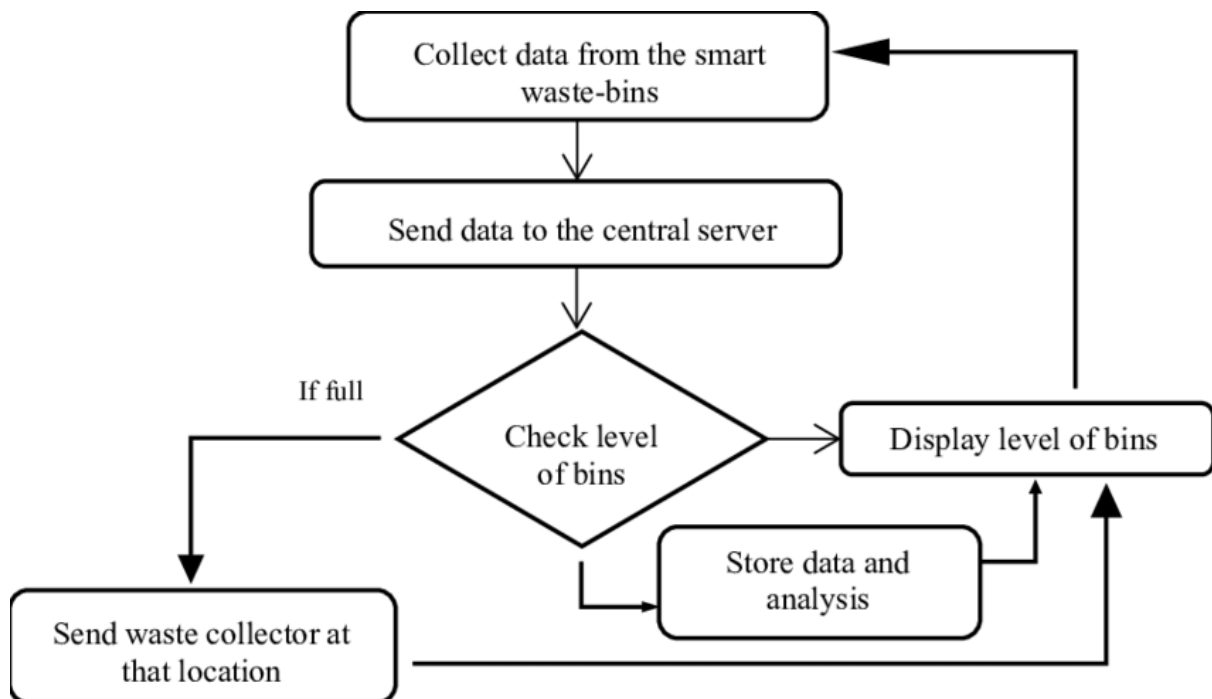
9.RESULTS

9.1 PERFORMANCE METRICS

In our project we used ultrasonic sensor to detect the weight of the bin and location and track the where the bin is placed in particular location with help of GPS

2022-11-19 07:35:41,877   ibmiotf.device.Client   INFO   Connected successfully: d:7lnn7p:preethi:1436
Published Ultrasonic=50Cm Weight:62 kg GPS:11.307878,76.818102
Published Ultrasonic=67Cm Weight:26 kg GPS:11.337927,76.831243
Published Ultrasonic=7Cm Weight:37 kg GPS:11.283821,76.85311
Published Ultrasonic=20Cm Weight:100 kg GPS:11.052519,76.871068
Published Ultrasonic=37Cm Weight:87 kg GPS:11.394791,76.835771
Published Ultrasonic=73Cm Weight:87 kg GPS:11.126017,76.813982
Published Ultrasonic=74Cm Weight:22 kg GPS:11.183094,76.886264
Published Ultrasonic=20Cm Weight:24 kg GPS:11.123936,76.885071
Published Ultrasonic=31Cm Weight:91 kg GPS:11.247399,76.804742
Published Ultrasonic=43Cm Weight:40 kg GPS:11.213357,76.830845
Published Ultrasonic=3Cm Weight:82 kg GPS:11.335982,76.88326
Published Ultrasonic=71Cm Weight:97 kg GPS:11.395248,76.848311
Published Ultrasonic=75Cm Weight:34 kg GPS:11.162933,76.85075

10 .ADVANTAGES AND DISADVANTAGES

10.1 ADVANTAGES:

➢ The "smart bin" communicates information on fill levels and ensures collection only when the bin is full.

➢ Fewer collection visits reduce congestion and traffic interruption, resulting also in cleaner and safer streets. Traffic reduction due to fewer collection visits helps reduce carbon dioxide and other emissions.

➢ While most of us are familiar with the frequently cited benefits of proper solid waste management

➢ conservation of natural resources, reduction of air, water and land pollution, support for community development

➢ The advantages go beyond simply protecting our health and environment.

10.2 DISADVANTAGES

❖ As the waste management sites include the landfills to
❖ to the author there may be several disadvantages such as increasing cost of the dustbin.
❖ For example, if there are three different levels then three sensors has to be placed; one sensor for each level. Also rough

action and usage recycling units under its aegis, these sites are highly susceptible to fungal and bacterial growth thereby leading to various diseases.

❖ According of the user may cause damages to the sensors.

11 .CONCLUSION

➢ The collection of waste is possibly the most important process for waste management systems.

➢ Route optimization could be the greatest point to be able to cut costs for the operation of managing solid waste.

➢ Operating costs like labor, fuel, and equipment can lower as efficiency increases. Hours of labor can be reduced along with mileage on service vehicles.

➢ Managing routes of waste collection efficiently is attributed to reliable systems put in place to detect locations that need service, and the data which can help you predict how often.

➢ IoT solutions enables cities to function smarter. We want to make sure we're here to cover any part of your journey in changing the world.

12.FUTURE SCOPE:

• In this report, smart bin is built on a microcontroller based platform Arduino - Uno board, which is interfaced with Ultrasonic sensor.
• It will stop overflowing of dustbins along roadsides and localities as smart Dustbins are managed in real time.

- Waste Management in India is basically all those activities, which are required to manage waste from its beginning to the final disposal.
- Waste Management majorly includes things like the collection, transport, treatment, and the ultimate disposal of waste with a high level of monitoring and regulation.