SPECIMEN

SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

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ABSTRACT

This Waste management is one of the serious challenges of the cities, the system now used in cities, we continue to use an old and outmoded paradigm that no longer serves the entail of municipalities, Still find over spilled waste containers giving off irritating smells causing serious health issues and atmosphere impairment.

The Smart Waste Management System will simplify, with the Web applications and mobile phone, the solid and hydric waste inspecting process, and the management system of this presentation's total collection process.

The proposed system is a GPS based. The suggested device and implementation will track waste storage and monitor the vehicle's waste driver.

This method helps to make the customer aware of accountability behind the job such as the system for solid waste inspection and management, integrating communications technology for truck control systems such as GPS

LIST FIGURES

CHAPTER 1

INTRODUCTION

1.1 PROJECT OVERVIEW:

With population growth, there are tons of flats and apartments which have been built in the rapid urbanization areas like in Nairobi, Kenya. This is due to rural to urban migration in a quest to make ends meet for most inhabitants. There are several issues faced by the inhabitants of the flats. One of them is the issue of the domestic solid waste disposal, which cause pollutions. Unlike landed houses, the flats' waste disposal bins are shared among residents which live in the same building, and thus, the bins tend to be filled very quickly. Thus, an unsystematic and inefficient disposal waste management may cause the bins to be always full with of garbage, and further littering from the residents will cause the garbage piles to be scattered outside the bins.

Besides, there are also problems regarding the attitudes of each inhabitant of the flats. There are cases where some irresponsible residents, who normally live at the higher levels of the building, littered or simply threw their domestic waste directly from the floor which they live into the bins.

Implementation of environmental conservation and management system is of no doubt the solution to the major problems that are currently faced when it comes to proper disposal of waste and management.

Indiscriminate disposal of solid waste is a major issue in urban centers of most developing countries and it poses a serious threat to healthy living of the citizens. Access to reliable data on the state of solid waste at different locations within the city will help both the local authorities and the citizens to effectively manage the menace. In this paper, an intelligent solid waste monitoring system is developed using Internet of

Things (IoT) and cloud computing technologies. The fill level of solid waste in each of the containers, which are strategically situated across the communities, is detected using ultrasonic sensors. A Wireless Fidelity (Wi-Fi) communication link is used to transmit the sensor data to an IoT cloud platform known as ThingSpeak. Depending on the fill level, the system sends appropriate notification message (in form of tweet) to alert relevant authorities and concerned citizen(s) for necessary action. Also, the fill level is monitored on ThingSpeak in real-time. The system performance shows that the proposed solution may be found useful for efficient waste management in smart and connected communities.

1.2 PURPOSE:

A waste management system is the strategy an organization uses to dispose, reduce, reuse, and prevent waste. Possible waste disposal methods are recycling, composting, incineration, landfills, bioremediation, waste to energy, and waste minimization.Using technology and innovation to optimize current systems will enable cities to become smarter, more efficient and save resources.

Due to the growing population, the amount of waste being produced is vast and rapidly increasing. The management of this waste is therefore a significant area for much-needed improvement.

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!

CHAPTER 2

LITERATURE SURVEY

2.1 EXISTING PROBLEM:

The problem in the management of urban waste occurs due to the imbalance between the production and the capability to manage it; the waste volume continues to increase in line with the population growth, changes in the quality of life and the dynamics of community activities.

There are significant safety challenges facing the waste/recycling industry. They include chemical exposure, combustible dust explosions, machine guarding hazards, and exposure to powerful equipment with moving parts.

Most recycling operations are affected sooner or later by poorly trained, under-motivated work staff. The fact is, many of these people have never been properly managed, and don't understand the expectations or even the basics of their job. That's why a reputable labor team supplier should always clearly explain job expectations and then actually manage workers.

Waste management in cities is often times the most expensive item of investment as it involves both the collection of waste and its transportation for appropriate disposal. Poor waste management - ranging from non-existing collection systems to ineffective disposal -causes air pollution, water and soil contamination. Open and unsanitary landfills contribute to contamination of drinking water and can cause infection and transmit diseases.

When cities take a zero-waste approach – minimising, recovering, and treating waste, rather than disposing of waste in landfill or incinerators – they save money, protect the local environment, create jobs, build resilience, reduce emissions and promote community.

Over the last couple of years, technologies have been created for smart waste management to improve the collection and disposal of waste. Waste bins equipped with sensors now provide data on waste disposal, allowing cities to save resources and

costs. These are seemingly effective ways to manage waste yet it challenges are still rife.

The waste management process begins with the disposal of waste into trash bins provided near the point of creation. Then the trash is picked up by trucks and sent over to the temporary collection sites. From these sites, the trash is sent for recycling. The implementation of this process seems easy enough, however, it is only a partial solution and creates other problems.

Some of the problems created are :-

- Misunderstanding of the operations of smart sensors
- Setting up the smart sensor
- Non-optimized truck routes
- Recycling
- Non-uniform waste distribution of waste in bins

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[12] Tejashree Kadus1, Pawankumar Nirmal2, Kartikee Kulkarni3 Department of Mechanical Engineering MIT Academy of Engineering, Pune Savitribai Phule University

2.3 PROBLEM STATEMENT DEFINITION:

A problem statement is important to a process improvement project because it helps clearly identify the goals of the project and outline the scope of a project. It also helps guide the activities and decisions of the people who are working on the project. The problem statement can help a business or organization gain support and buy-in for a process improvement project. A good problem statement can be created by identifying and answering several questions related to the problem.

This process involves identifying what the problem is, why it is a problem, when and where the problem was identified, who the problem impacts, how they are impacted by the problem and how much of an impact the problem has. Creating a problem statement to understand customer's point of view. The below shown block diagram is a perfect example for our topic

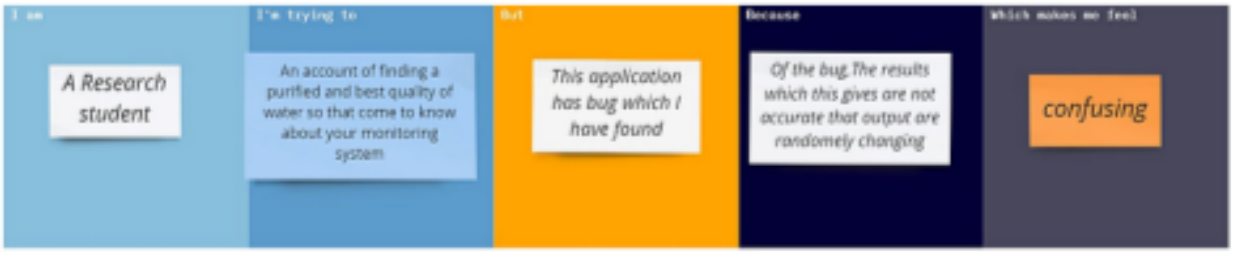


Fig1. Problem Statement

CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS:

Empathy maps are an efficient tool used by designers to not only understand user behaviour, but also visually communicate those findings to colleagues, uniting the team under one shared understanding of the user. Essentially, an empathy map is a square divided into four quadrants with the user or client in the middle. Each of the four quadrants comprises a category that helps us delve into the mind of the user. The four empathy map quadrants look at what the user says, thinks, feels, and does.

With the user at the centre and the categories in each of the four surrounding quadrants, an empathy map arranges all of your research about the user into an easy-to-read visual.

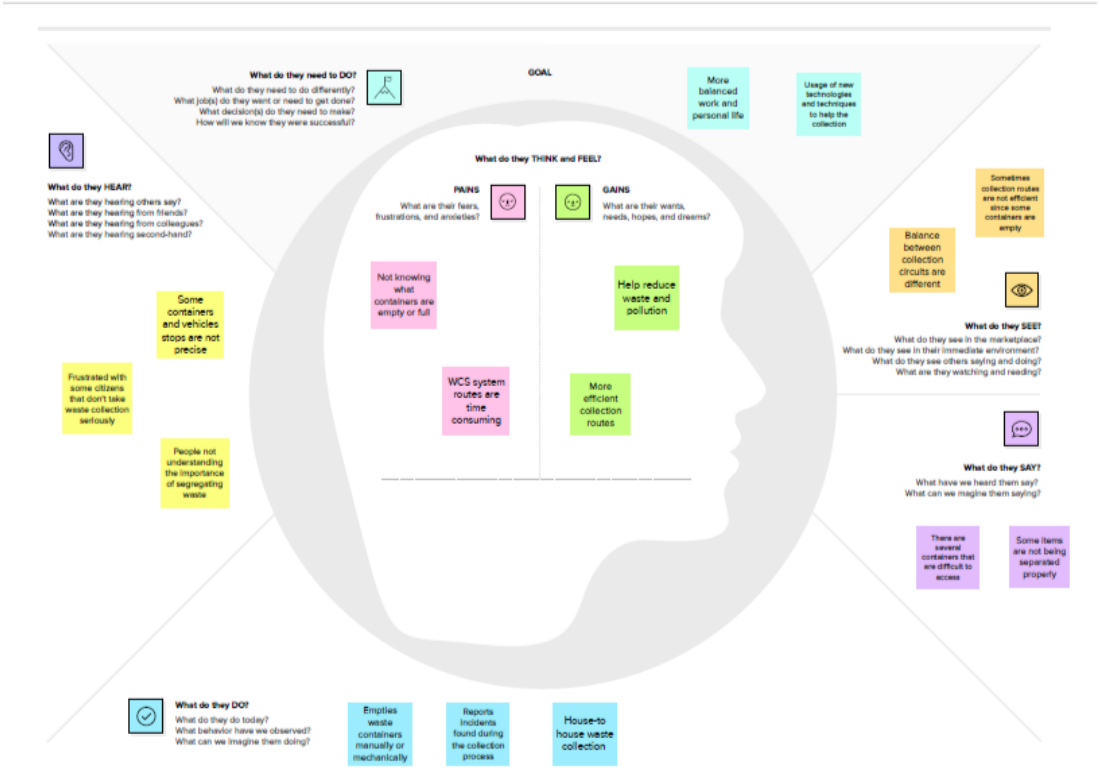


Fig2. Empathy Map

3.2 IDEATION & BRAINSTORMING

Brainstorming is a method design teams use to generate ideas to solve clearly defined design problems. Brainstorming is a method of generating ideas and sharing knowledge to solve a particular commercial or technical problem, in which participants are encouraged to think without interruption. Brainstorming is a group activity where each participant shares their ideas as soon as they come to mind. At the conclusion of the session, ideas are categorised and ranked for follow-on action.

When planning a brainstorming session it is important to define clearly the topic to be addressed. A topic which is too specific can constrict thinking, while an ill-defined topic will not generate enough directly applicable ideas. The composition of the brainstorming group is important too. It should include people linked directly with the subject as well as those who can contribute novel and unexpected ideas. It can comprise staff from inside or outside the organisation.

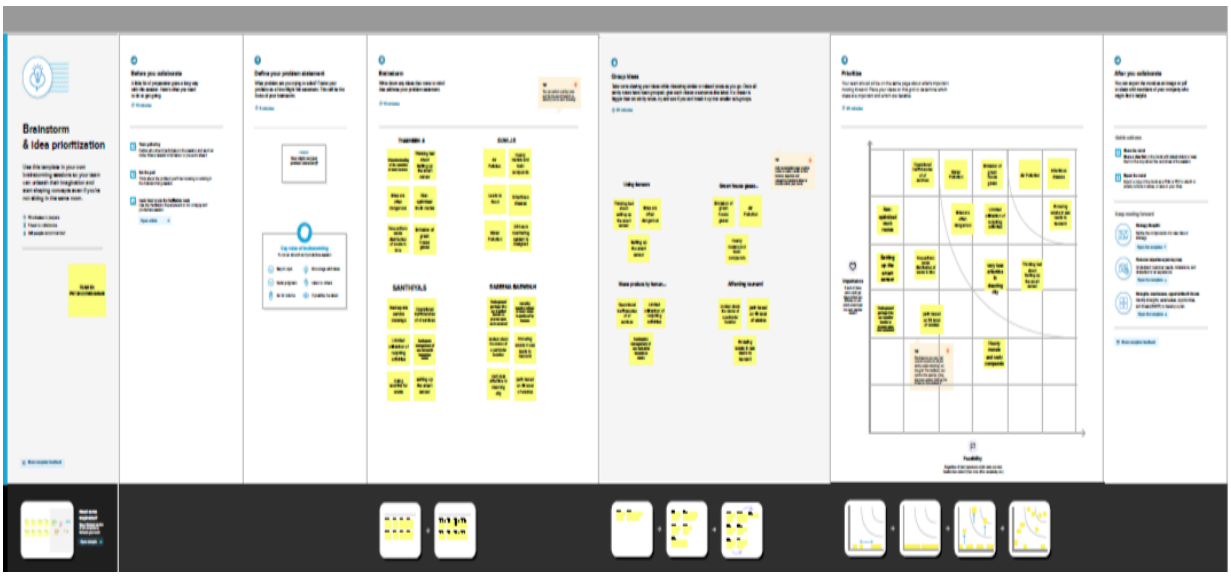


Fig3.Brainstorming

3.3 PROPOSED SOLUTION:

Proposed Solution means the technical solution to be provided by the Implementation agency in response to the requirements and the objectives of the Project.

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-toenergy 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 IoTbased 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:

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.

CHAPTER 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-bin discharge 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.

4.2 NON FUNCTIONAL REQUIREMENTS:

FR No.	**Non-Functional Requirement**	**Description**
NFR-1	Usability	IOT device verifies that usability is a special and important perspective to analyse user requirements, which can further improve the design quality. 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, behaviour and experience
NFR-2	Security	Use a reusable bottles Use reusable grocery bags Purchase wisely and recycle Avoid single use food and drink containers.
NFR-3	Reliability	Smart waste management is also about creating better working conditions for waste collectors and drivers. Instead of driving the

		same collection routes and servicing empty bins, waste collectors will spend their time more efficiently, taking care of bins that need servicing.
NFR-4	Performance	The Smart Sensors use ultrasound technology to measure the fill levels (along with other data) in bins several times a day. Using a variety of IOT networks ((NB-IOT, GPRS), the sensors send the data to Sense one's Smart Waste Management Software System, a powerful cloud-based platform, for data driven daily operations, available also as a waste management app. Customers are hence provided data-driven decision making, and optimization of waste collection routes, frequencies, and vehicle loads resulting in route reduction by at least 30%.
NFR-5	Availability	By developing & deploying resilient hardware and beautiful software we empower cities, businesses, and countries to manage waste smarter.
NFR-6	Scalability	Using smart waste bins reduce the number of bins inside town, cities coz we able to monitor the garbage 24/7 more cost effect and scalability when we moves to smarter.

CHAPTER 5
PROJECT DESIGN

5.1 DATA FLOW DIAGRAM:

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 gather in your bins into actionable insights to help you improve your waste services. You can receive data on metric such as:

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

The Data Flow Graph of our proposed solution is shown below:

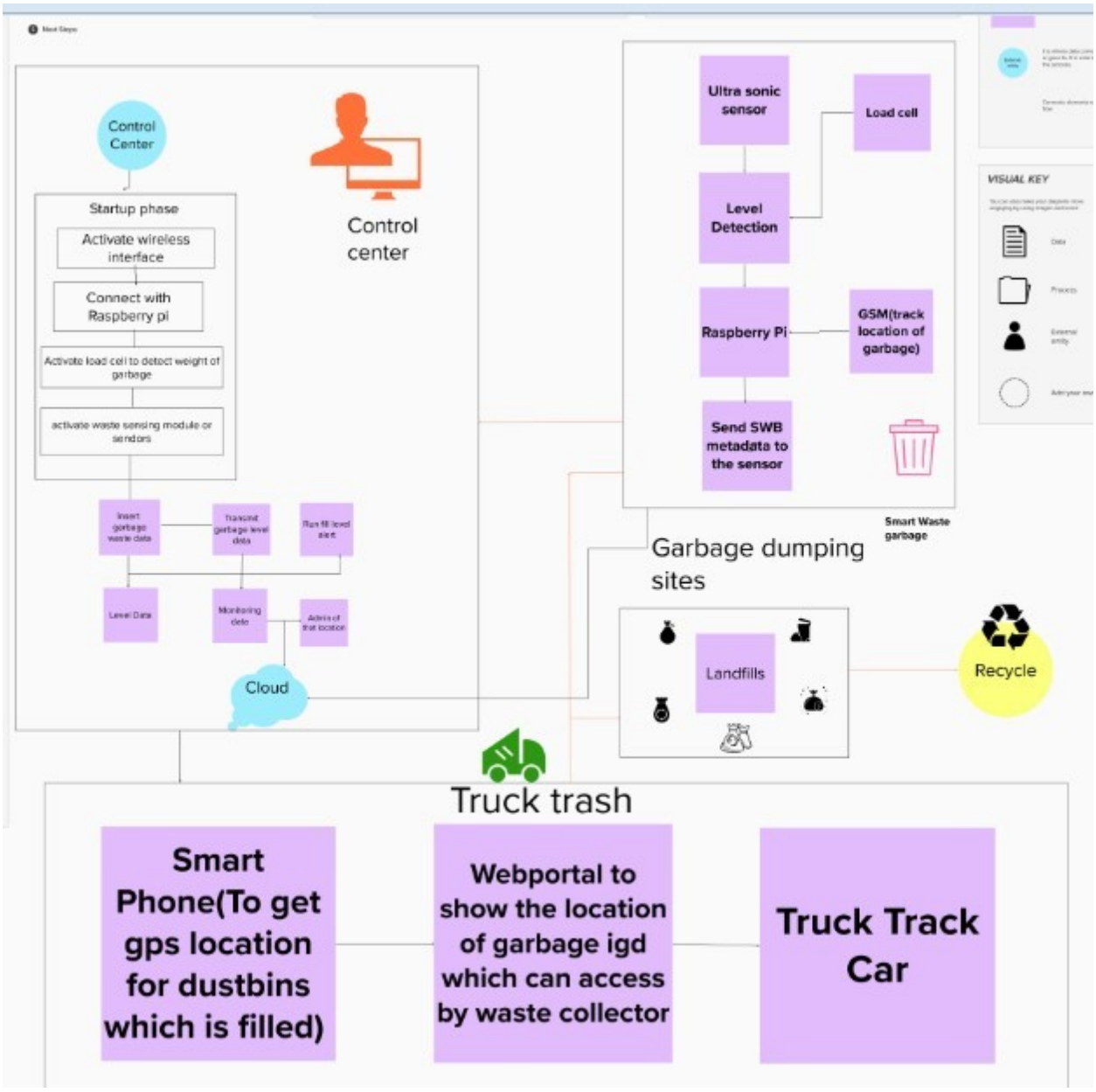


Fig4. Data Flow Diagram

5.2 SOLUTION & TECHNICAL ARCHITECTURE

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.

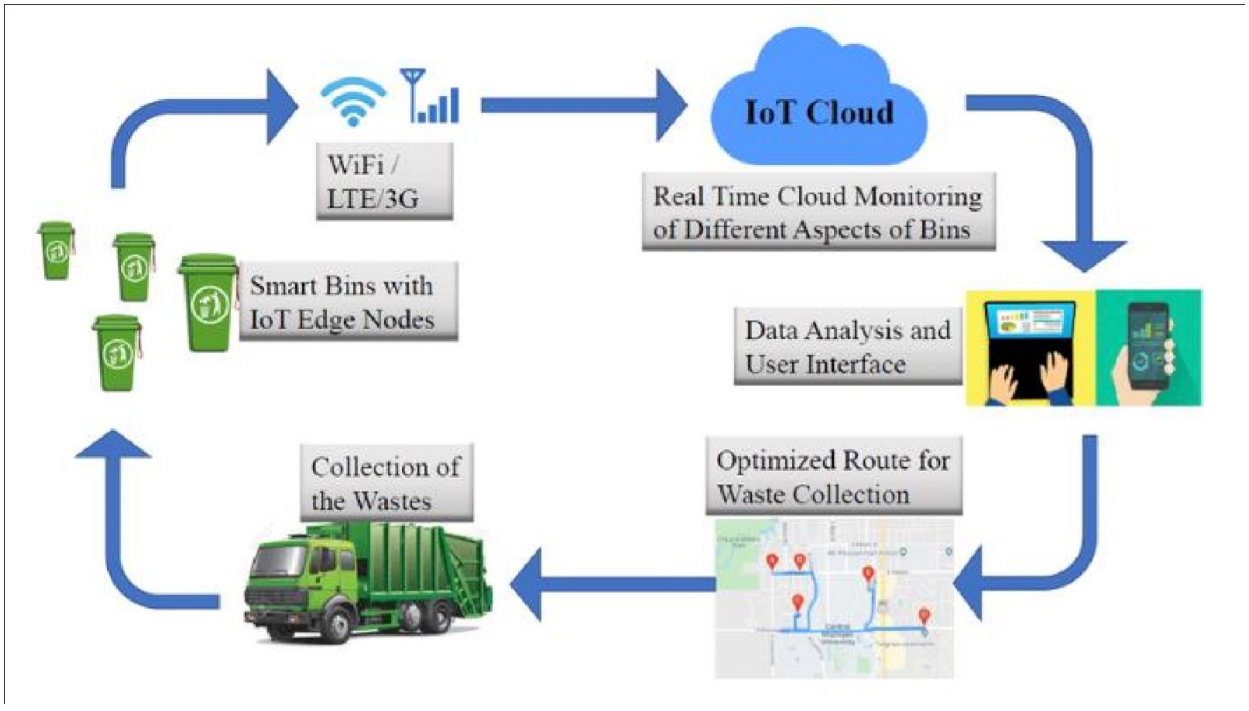


Fig5.Solution Architecture

For Technical Architecture

Technical architecture—which is also often referred to as application architecture, IT architecture, business architecture, etc.—refers to creating a structured software solution that will meet the business needs and expectations while providing a strong technical plan for the growth of the software application through its lifetime. IT architecture is equally important to the business team and the information technology team.

Technical architecture includes the major components of the system, their relationships, and the contracts that define the interactions between the components. The goal of technical architects is to achieve all the business needs with an application that is optimized for both performance and security. IT architects plan for things they know are coming in the future and for things they don't yet envision or dream. Taking the time to design the architecture at the start will prevent major design changes, code refactoring, and expensive rework later in the project.

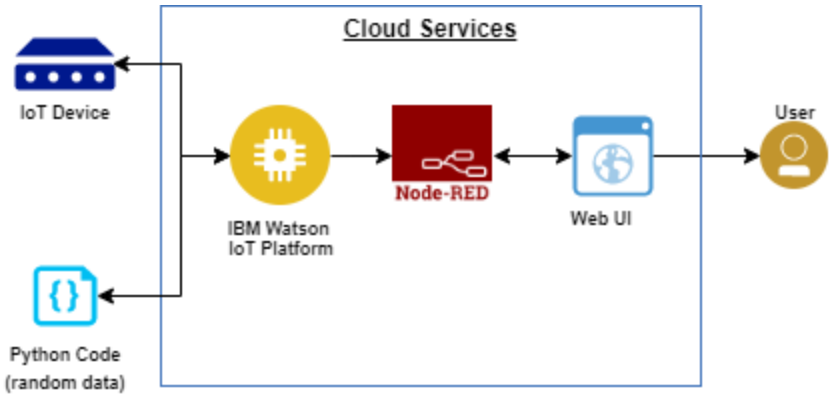


Fig6.Technical Architecture

5.3 USER STORIES:

A user story is an informal, general explanation of a software feature written from the perspective of the end user. Its purpose is to articulate how a software feature will provide value to the customer. It's tempting to think that user stories are, simply put, software system requirements. But they're not.

A key component of agile software development is putting people first, and a user story puts end users at the center of the conversation. These stories use non-technical language to provide context for the development team and their efforts. After reading a user story, the team knows why they are building, what they're building, and what value it creates. User stories are one of the core components of an agile program. They help provide a user-focused framework for daily work — which drives collaboration, creativity, and a better product overall.

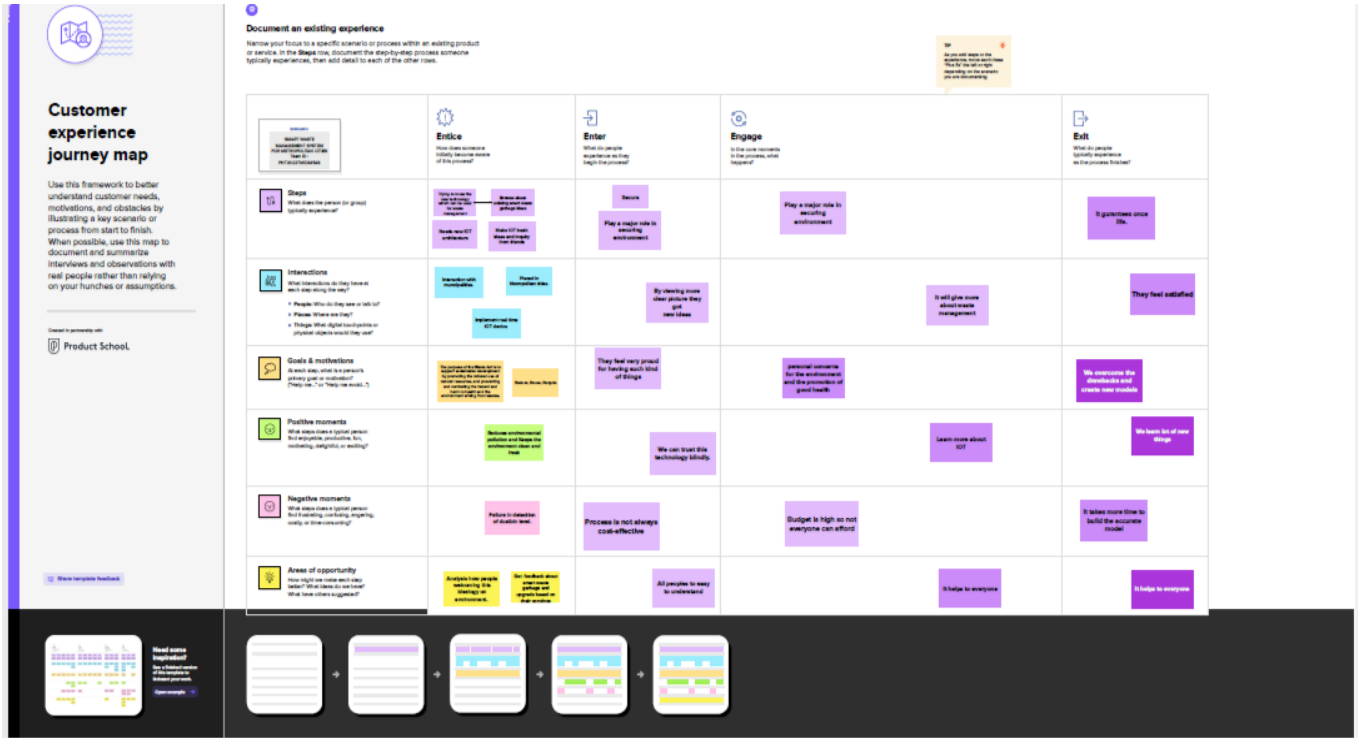


Fig7.Customer Journey

CHAPTER 6

PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & 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	Thasneem
Sprint-1	Login	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	10	High	Sumi J.R.
Sprint-2	Dashboard	USN-3	As a Truck	20	Low	Raseena

			Driver, I'll follow Co-Admin's Instruction to reach the filling bin in short roots and save time			
Sprint-3	Dashboard	USN-4	As a Local Garbage Collector, I'll gather all the waste from the garbage, load it onto a garbage truck, and deliver it to Landfills	20	Medium	Santhiya
Sprint-4	Dashboard	USN-5	As a Municipality officer, I'll make sure everything is proceeding as planned and without any problems	20	High	Sumi J.R.

6.2 SPRINT DELIVERY SCHEDULE:

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

6.3 REPORTS FROM JIRA:

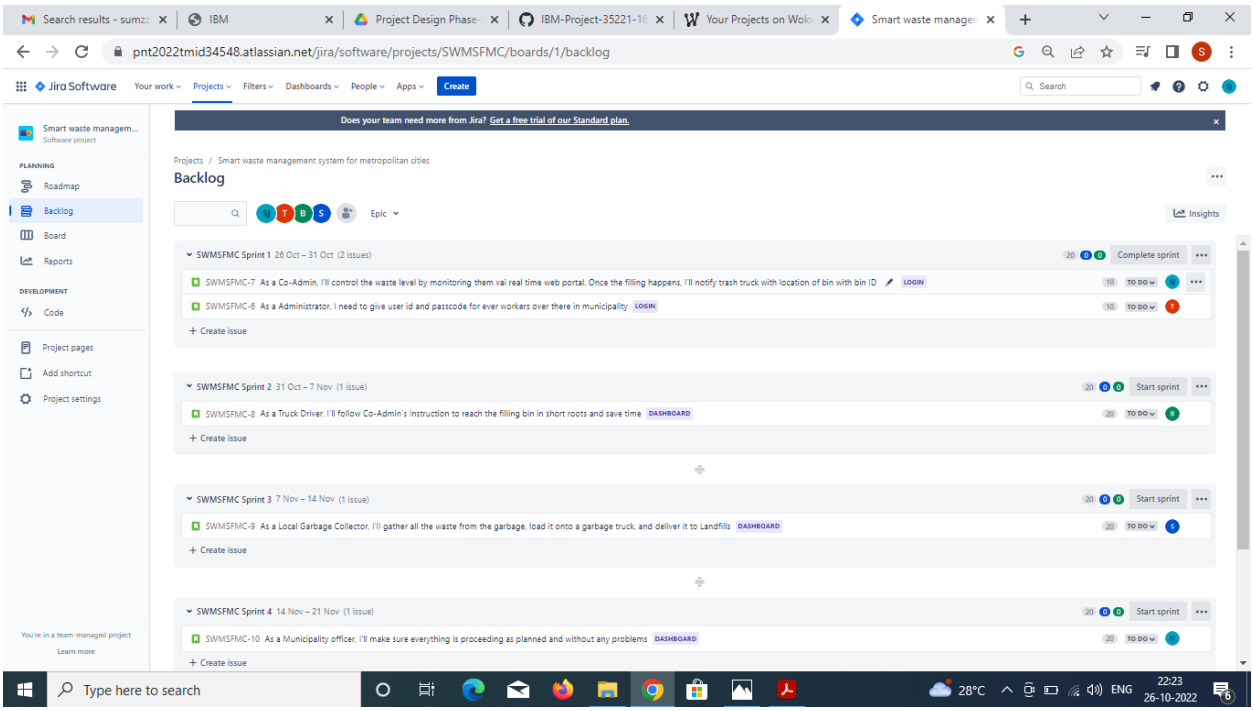


Fig8. Sprint Assigned Page

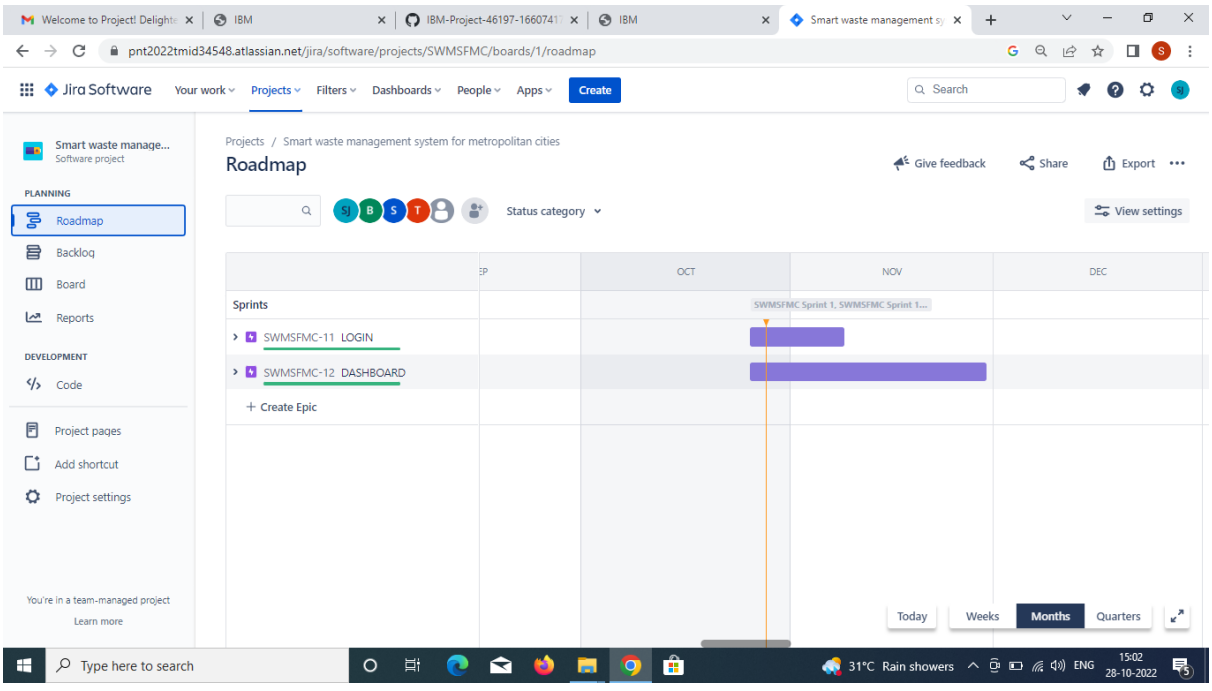


Fig9. First Road Map

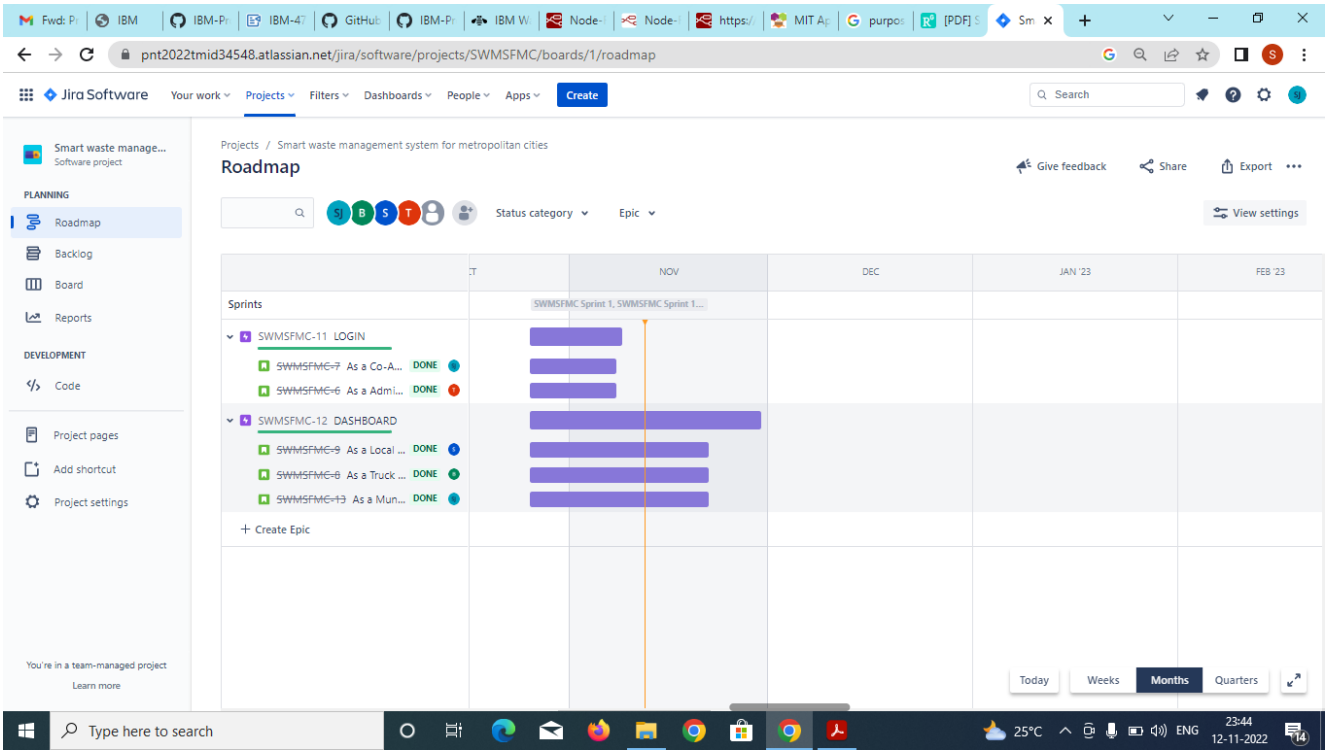


Fig10. Road Map After Tasks Done

CHAPTER 7

CODING & SOLUTIONING

7.1 FEATURE 1

IBM WATSON IoT PLATFORM

The very first process in this project section is to develop the IBM IoT Platform. This IoT platform is the core formula for all the conection process. As the only way of connecting several applications is the basic work of the cloud platform.The process of signing in to the cloud process is the large process which carriesverfication segments too. After creating the Cloud Profile, lets move to device creation part.

Device Creation:

Now the next step is to create a device, we have created a device with following details

Device Type : 123

Device Id : 1234567

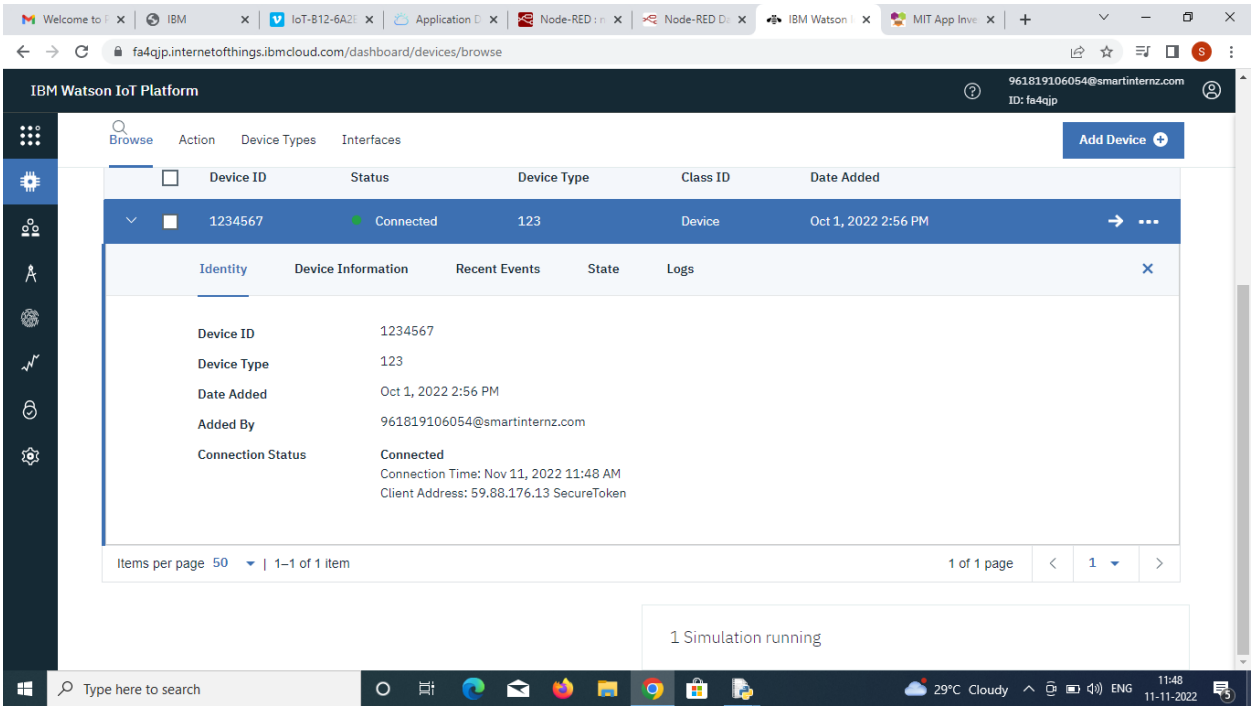


Fig11.Created Device

NODE-RED SERVICE

After registering to the IBM IoT Platform and created the device, now we move on to the Node-Red Service, in this here we can create the Web user interface and the Web Application by designing the circuit. Our Node-Red Circuit designing are as follows.

The first step is to install the IBM IOT block from the node-red service and we have set four functions namely, bin value , latitude, longitude, location these four functions processess bin value with corrseponding location of that bin, whenever the value get maximum. And the four functions are connected to the msg.payload button. At seperately the functions are designed in the wave of chart,where the bin value are designed in the level chart.

After this, we set one button "alert message". This button is pressed by the user whenever the bin get full that time the message is go to the python code as to empty the bin immediately.

Now for connecting to web we use "http" extention. And also, for connection to the Application we use MIT app application with get option function in Node-Red. The Node-Red website is copied and added "/sensor" to review the output.

For simulating the Node-Red Service, there appears "Deploy" button.

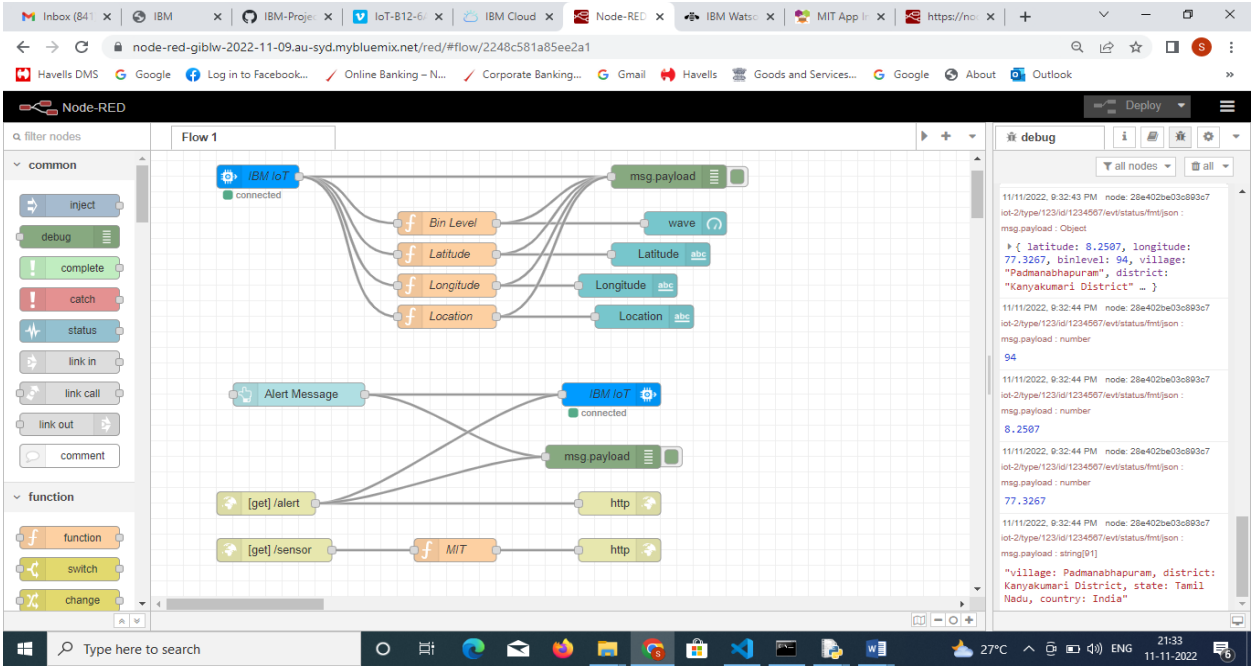


Fig12. Node-Red Circuit Design

USER INTERFACE

After the successful simulation of the Node-Red Service, User Interface is created. OurWeb UI includes a dashboard which has a bin level meter and the location of the particular bin and a alert message button.

Our Executed User Interface from the Node-Red is shown below.

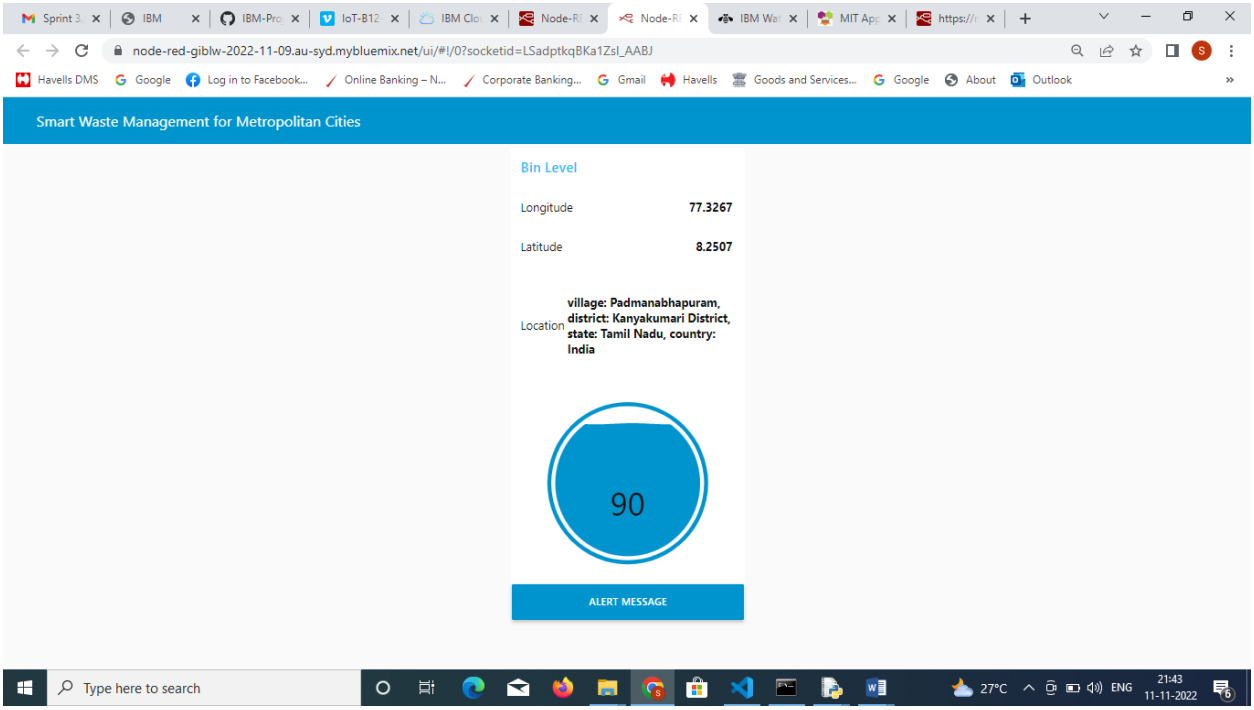


Fig13.Node-Red Page Web User Interface

MIT APP INVENTOR

This phase is the most priority requirement of our project. Using an application helps users to monitor in easy way. MIT App inventor helps to desgin our application. We have created 4 Screens for our App.

The First screen, lets you get started with the application. The Second Screen is the login Page.Through the respective screen the user can sign up with the application. Also we have place the notify condition, when the detalis goes wrong, it alerts "Check your Credentials". As the detalis are correct it moves on to the next screen. We have set the credentials as Admin for user name and 1234567 fpe password.

Here we display the Login Page of our Application

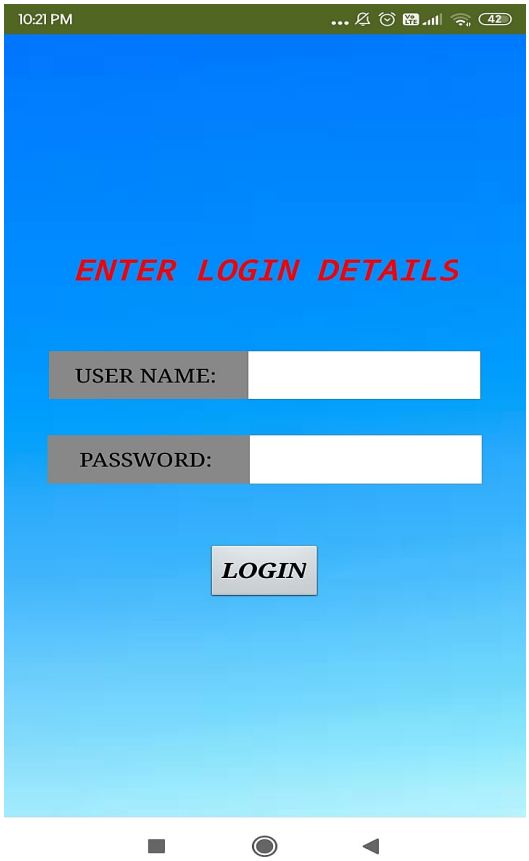


Fig14.Login Page

Following the Login Page, Selection of process is shown with two categories such as Dust bin details and Logout button.

When the category is selected the page moves on to the Output Display Page where we can see all the four results as the python code is made simulated.

And there is a alert message button to alert the truck drivers to empty the filled bin on time.

Fig15.Output Selection Page

7.2 FEATURE 2

PYTHON CODE

Our Python Code is very Simple and easy to understand. The programs carries our device detalis and the requirements of the project are kept defined. All conditions are made properly and the output is done successfully.

CODE:

```
#IBM Watson IOT Platform
#pip install wiotp-sdk
import wiotp.sdk.device
import time
import random
from geopy.geocoders import Nominatim
myConfig = {
    "identity": {
        "orgId": "fa4qjp",
        "typeId": "123",
        "deviceId":"1234567"
    },
    "auth": {
        "token": "12345678"
    }
}

# Initialize Nominatim API
geolocator = Nominatim(user_agent="geography")
def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['alert'])
    m=cmd.data['alert']
    if m =="binfull":
      print ("Empty the bin immediately")

client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()
while True:
    binlevel=random.randint(10,100)
    locationId=random.randint(1,5)
    if locationId == 1:
        latitude=8.2396
        longitude=77.3066
```

```
    elif locationId == 2:
        latitude=8.2114
        longitude=77.3031
    elif locationId == 3:
        latitude=8.3348
        longitude=77.2664
    elif locationId == 4:
        latitude=8.2507
        longitude= 77.3267
    elif locationId == 5:
        latitude=8.3022
        longitude=77.2231
    else:
        print("No Location Found!!")

    # Get location with geocode
    coordinates = str(latitude)+","+str(longitude)

    # print("coordinates",coordinates)
    location = geolocator.reverse(coordinates)
    address = location.raw['address']

    # Traverse the data
    village = address.get('village', '')
    district = address.get('state_district', '')
    state = address.get('state', '')
    country = address.get('country', '')

    if binlevel >= 90:
        myData={'latitude':latitude,
'longitude':longitude,'binlevel':binlevel,'village':village,'district':district,'state':state,'country':country}
        client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None)
        print("!!!!!!!!!BIN IS FULL!!!!!!!!!!  ",myData)
        client.commandCallback = myCommandCallback
        time.sleep(2)
    else :
        print("BIN IS IN NORMAL LEVEL")
        time.sleep(2)
       client.disconnect()
```

CHAPTER 8
TESTING

8.1 TEST CASES:

As the code is made to run, the system waits to connect with IoT platform. On account of coonection with the IBM Watson Platform, the code displays the output with relevant details. The output is shown in Cloud platform, the links to Node-Red also to the UI section. Finally when the Application is operated, the output is also displayed in it

The output of our Code is shown below,

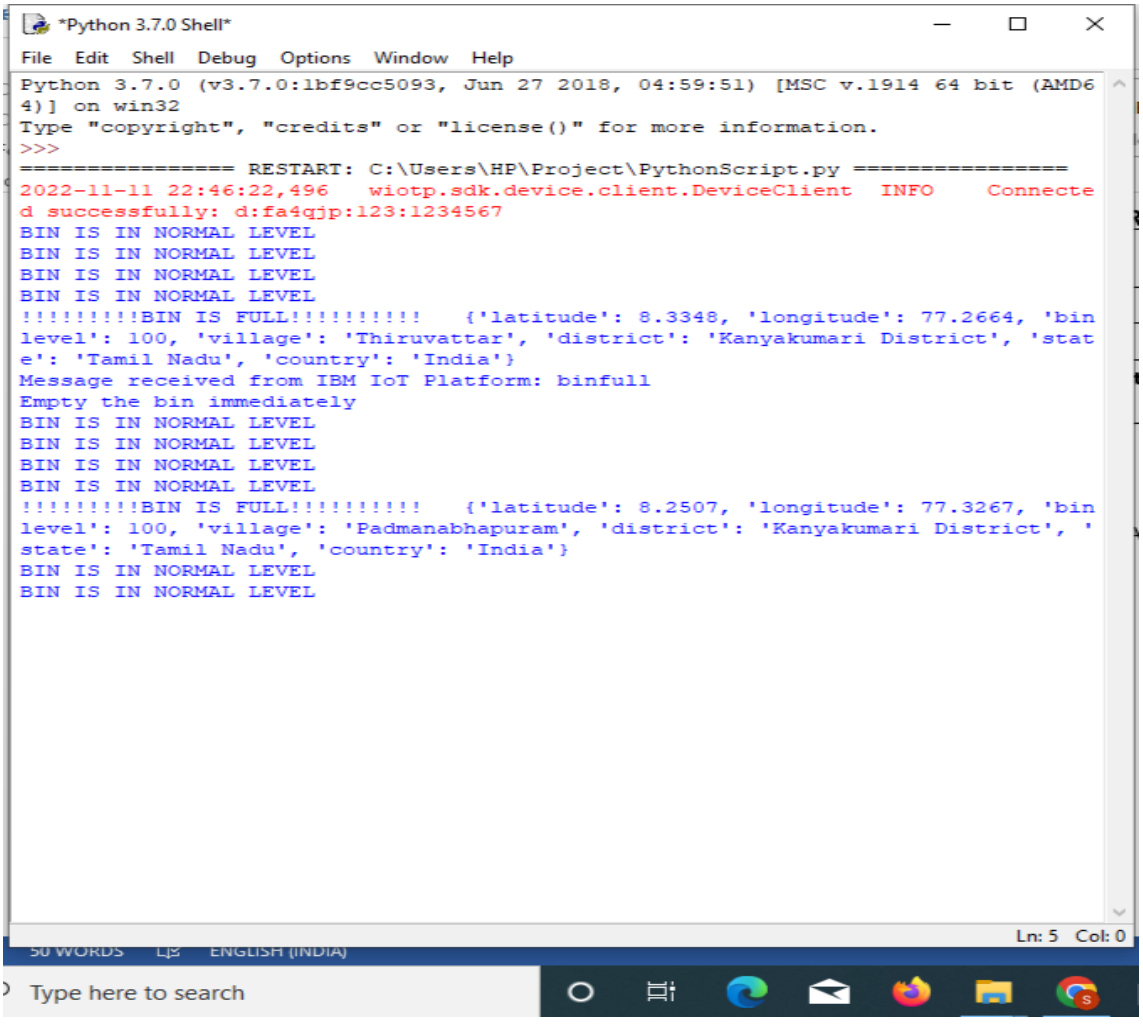


Fig16.Python Output

8.2 USER ACCEPTANCE TESTING:

As the completion of the application develeopment , the app should give as much support to the user. The developer must make sure of the avoidance of the disability in working of application by the user. All the appearance of the app should able to be configurable to the user. The usage of the application must satisfy the user at 100%. All the specifications must be simple and easy to use.

Fig17. Appplication Output

CHAPTER 9
RESULTS

9.1 PERFORMANCE METRICS:

The performance and the working of the code is ver quick and the results appears in quick succession. Our code is linked with the most used IBM Watson IoT Platform which works with much perfection. This cloud platform is very secure to use and configure easily. As the code is simulated within seconds the result appears. We have done lot of works using this IoT platform which is very simple and good user friendly platform. Below we display our connected IoT platform which delivers the results as the code is run.

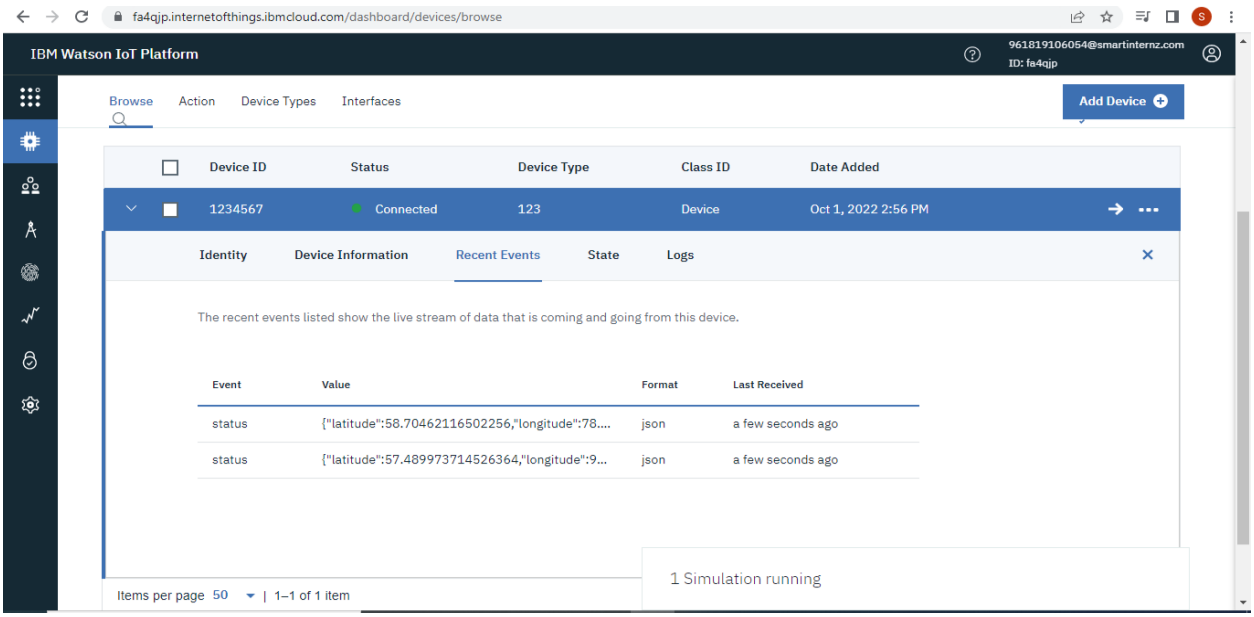


Fig18. IoT Platform Output

CHAPTER 10

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

By having a more convenient route garbage trucks spend less time on the road, therefore, congestion in smart cities can be decreased. With the huge increase in waste, more resources are allocated to waste collection and handling. If unnecessary collections are eliminated, public spending on waste management can be reduced. An optimized route and system for waste collection will eliminate this risk as well as improving air quality and minimizing CO2 emissions. Smart cities are all about using resources efficiently – achieving more by using less input. By routes being monitored, the opportunity of the misuse of owned assets is eliminated. Moreover, cities are encouraged to be transparent with their citizens by showing how waste is being managed. Smart cities infrastructure and intelligent waste solutions have the potential to lead the shift towards a more sustainable future.

DISADVANTAGES:

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 of the user may cause damages to the sensors.Some trash bins are overfilled while others are underfilled by the trash collection time. Overfilled trash bins create unhygienic conditions. Truck routes result in excessive fuel usage and environmental pollution and all collected trash is combined which complicates sorting at the recycling facility.

CHAPTER 11

CONCLUSION

The behaviour of generating garbage is too dangerous not only for today's generation, but also for future generations. It is critical to educate people and encourage them to practise Recycle, Reuse, and Reduce instead of producing waste. Waste disposal should be a priority for municipalities and governments.

This project is very effective in managing waste in any big city. Rather than using conventional periodic collection methods here priority system is used to the city is clean all the time without any overflowing dumpsters. It has been tested and verified properly to make sure all the different parts work together for a smooth function of the whole system.

CHAPTER 12

FUTURE SCOPE

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.

To sum up, Waste management's future includes turning waste into energy, IoT-enabled practices, improvement in monitoring systems, data collection, and much more technology-based advancements.

CHAPTER 13

APPENDIX

SOURCE CODE:

As we successfully developed and programmed our python code, lets this be the final code of execution.

```
#IBM Watson IOT Platform
#pip install wiotp-sdk

import wiotp.sdk.device
import time
import random
from geopy.geocoders import Nominatim


myConfig = {
    "identity": {
        "orgId": "fa4qjp",
        "typeId": "123",
        "deviceId":"1234567"
    },
    "auth": {
        "token": "12345678"
    }
}

# Initialize Nominatim API

geolocator = Nominatim(user_agent="geography")
```

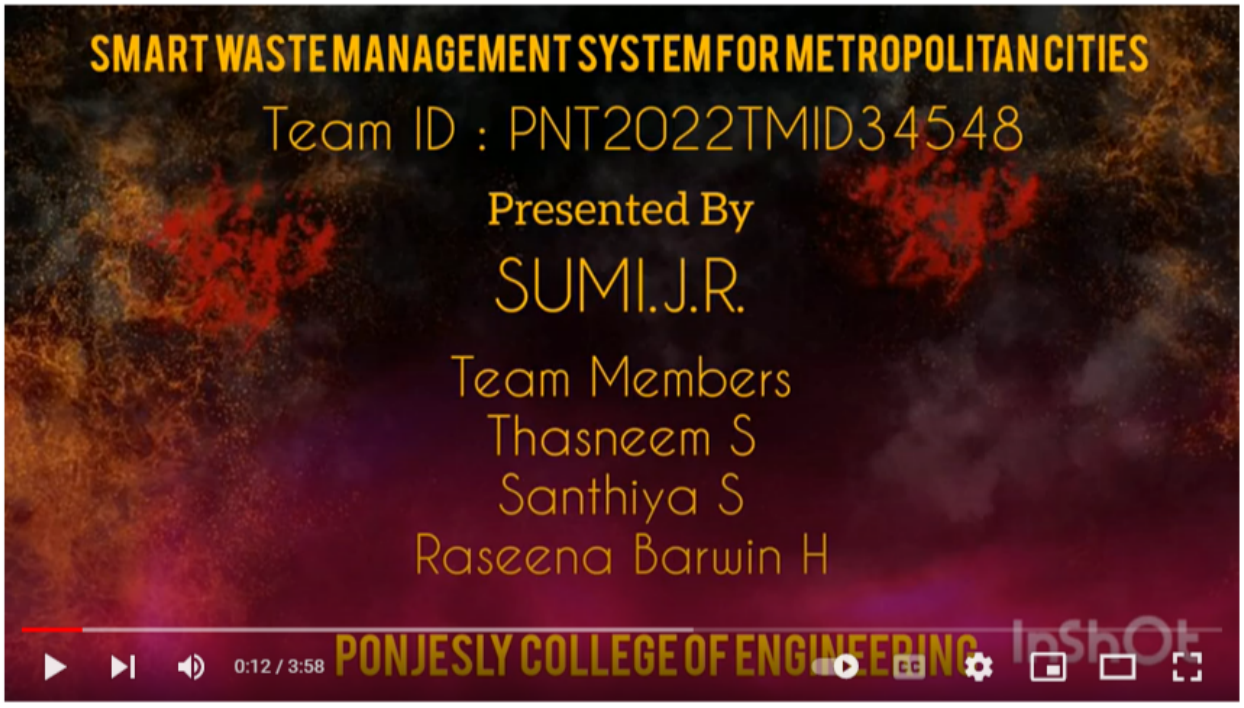
```
def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['alert'])
    m=cmd.data['alert']
    if m =="binfull":
      print ("Empty the bin immediately")

client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()



while True:
    binlevel=random.randint(10,100)
    locationId=random.randint(1,5)
    if locationId == 1:
        latitude=8.2396
        longitude=77.3066
    elif locationId == 2:
        latitude=8.2114
        longitude=77.3031
    elif locationId == 3:
        latitude=8.3348
        longitude=77.2664
    elif locationId == 4:
        latitude=8.2507
        longitude= 77.3267
    elif locationId == 5:
        latitude=8.3022
        longitude=77.2231
    else:
        print("No Location Found!!")

    # Get location with geocode

    coordinates = str(latitude)+","+str(longitude)
```

```
    # print("coordinates",coordinates)

    location = geolocator.reverse(coordinates)
    address = location.raw['address']

    # Traverse the data

    village = address.get('village', '')
    district = address.get('state_district', '')
    state = address.get('state', '')
    country = address.get('country', '')


    if binlevel >= 90:
        myData={'latitude':latitude,
'longitude':longitude,'binlevel':binlevel,'village':village,'district':district,'state':state,'country':
country}
        client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None)
        print("!!!!!!!!!BIN IS FULL!!!!!!!!!!  ",myData)
        client.commandCallback = myCommandCallback
        time.sleep(2)
    else :
        print("BIN IS IN NORMAL LEVEL")
        time.sleep(2)

client.disconnect()
```

PROJECT DEMONSTARTION VIDEO UPLOADED HERE

GITHUB LINK : https://github.com/IBM-EPBL/IBM-Project-47920-1660803303

PROJECT DEMO LINK : https://youtu.be/dQBFYfBV1KY



Smart waste management system for metropolitan cities project

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