



SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES

IBM-Project-30933-1660192950

**NALAIYA THIRAN PROJECT BASED LEARNING ON
PROFESSIONAL READLINESS FOR INNOVATION, EMPLOYNMENT
AND ENTREPRENEURSHIP**

A PROJECT REPORT

G. AISHWARIYA	950819106001
M.KAVERI	950819106027
U. KAVISHA	950819106029
B. VARSHANA MUKI	950819106702

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING
Government College of Engineering, Tirunelveli– 627007

INTRODUCTION:

PROJECT OVERVIEW

- 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 user 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.

PURPOSE

The purpose of the Smart Waste Management System for Metropolitan Cities are:

- To alert the respective person to collect the overflow bins from the location using mobile application. The bin level can be monitored and tracked in mobile and there is no need to check the places often hence time consumes effectively.
- Update about the locations where the bin is placed will be sent to the respective person through mobile application.

LITERATURE SURVEY

EXISTING PROBLEM

- **Uncollected waste can lead to flooding, insects, rodents, and diseases.** Improper disposal of waste can pollute water and air, making it an important environmental challenge.
- This has serious environmental impacts like **water pollution, methane emissions, and soil degradation.** The average density of Indian municipal waste at the point of collection varies from 400 to 600 kg per cubic metre. At the landfill site, however, the density is much higher because of compaction and putrefaction.

REFERENCES

- **"Development of automatic smart waste sorter machine",** Mahmudul Hasan Russel, Mehdi Hasan Chowdhury, Md Shekh Naim Uddin, Ashif Newaz, Md Mehdi Masud Talukder at International Conference on Mechanical, Industrial and Materials Engineering 1, 2013.
- **"Smart waste management using Internet of Things",** A survey KN Fallavi, V Ravi Kumar, BM Chaithra 2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud)(I-SMAC), 60-64, 2017.
- **"IoT enabled smart waste bin with real time monitoring for efficient waste management in metropolitan cities",** Manju Mohan, R Chetty, Vijay ram Sriram, Mohd Azeem, P Vishal, G Pranav International Journal of Advanced Science and Convergence 1 (3), 13-19, 2019.
- **"Smart Garbage Monitoring System",** Vijayaganth Sanjaykumar D, Ravi Varma K, Yukisedhu R.

PROBLEM STATEMENT DEFINITION

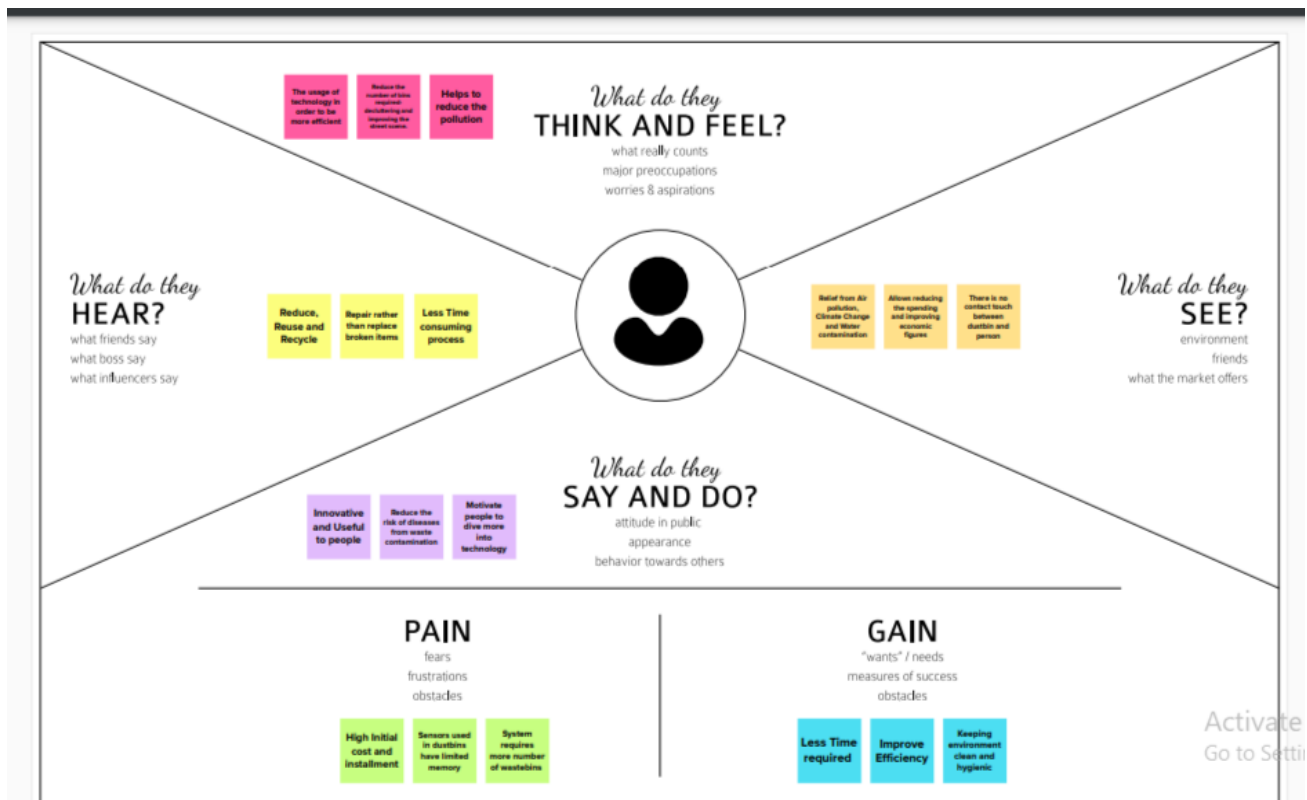
Overflowing Garbage Bins: There is a chance that some days, a few garbage bins are full before their collection date which leads to overflowing.

What does the problem affect?	Overflowing waste causes air pollution and respiratory diseases . One of the outcomes of overflowing garbage is air pollution, which causes various respiratory diseases and other adverse health effects as contaminants are absorbed from lungs into other parts of the body.
What are the boundaries of the problem?	Contamination of Surface Water – Liquid household waste from overflowing trash cans seeps into the ground and impacts the chemical composition of the water.
What is the issue?	One of the outcomes of overflowing garbage is air pollution , which causes various respiratory diseases and other adverse health effects as contaminants are absorbed from lungs into other parts of the body.

	<p>The toxic substances in air contaminated by waste include carbon dioxide, nitrous oxide and methane.</p>
When does the issue occurs?	<p>Overflows can happen when heavy rainfall overloads the sewer system and also because of damage to pipes, power outages, or an equipment malfunction.</p>
Where is the issue occurring?	<p>HYDERABAD: Amid the looming threat of Covid-19 and other vector-borne diseases, heaps of a long the roads and <u>overflowing drains</u> pose risk to the health of people of Old City.</p>
Why is it important that we fix problem?	<p>Overflowing dumpsters and bulky trash piles are breeding grounds for nasty bacteria. As waste decomposes, it creates microbes that can cause diseases and other health issues like gastroenteritis, malaria, typhoid, cholera, as well as stomach pains, vomiting, and chronic diarrhoea.</p>

IDEATION & PROPOSED SOLUTION

EMPATHY MAP CANVAS



IDEATION AND BRAINSTORMING

Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

- 10 minutes to prepare
- 1 hour to collaborate
- 2-3 people to collaborate

[View template feedback](#)

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

- Team gathering**
Gather all stakeholders in the session and send an invite. Share session information or go with a small group.
- Set the goal**
Think about the problem you're looking to solve in the brainstorming session.
- Learn how to use the facilitation tools**
Check the Facilitation Tools page for a helpful and productive session.

[Open article](#)

Define your problem statement

What problem are you trying to solve? Frame your problem as a clear, specific statement. This will be the focus of your brainstorm.

5 minutes

Problem

This project helps people to know that a rubbish bin is full and alert them at night time.

Key rules of brainstorming
To run an smooth and productive session

- Stay on topic
- Encourage wild ideas
- Quantity over quality
- Don't criticize
- Build on others' ideas
- Be open to ideas

Brainstorm

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

10 minutes

Advantage A	Reason R	Benefit B	Outcome O
1. Reduces the number of bins needed	1. Reduces the number of bins needed	1. Reduces the number of bins needed	1. Reduces the number of bins needed
2. Reduces the number of bins needed	2. Reduces the number of bins needed	2. Reduces the number of bins needed	2. Reduces the number of bins needed
3. Reduces the number of bins needed	3. Reduces the number of bins needed	3. Reduces the number of bins needed	3. Reduces the number of bins needed
4. Reduces the number of bins needed	4. Reduces the number of bins needed	4. Reduces the number of bins needed	4. Reduces the number of bins needed
5. Reduces the number of bins needed	5. Reduces the number of bins needed	5. Reduces the number of bins needed	5. Reduces the number of bins needed

Group ideas

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

10 minutes

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.

10 minutes

Importance

Feasibility

Smart bins are an intelligent waste management system.

Reduce the number of bins needed, reducing and improving the waste management.

Encourage reporting on the go, by allowing them to report when they're full, and the system to alert them when they're full.

Reduce the number of bins needed, reducing and improving the waste management.

After you collaborate

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

Quick add-ons

- Share the board**
Share a link to the board with stakeholders to keep them in the loop about the outcomes of the session.
- Export the board**
Export a report of the board as a PDF or PPT to share in articles, reports or slides, or save to your drive.

Keep moving forward!

- Strategy Manager**
Define the components of a new idea or strategy.
- Customer experience journey map**
Understand customer needs, expectations, and behavior for an experience.
- Strengths, weaknesses, opportunities & threats**
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.

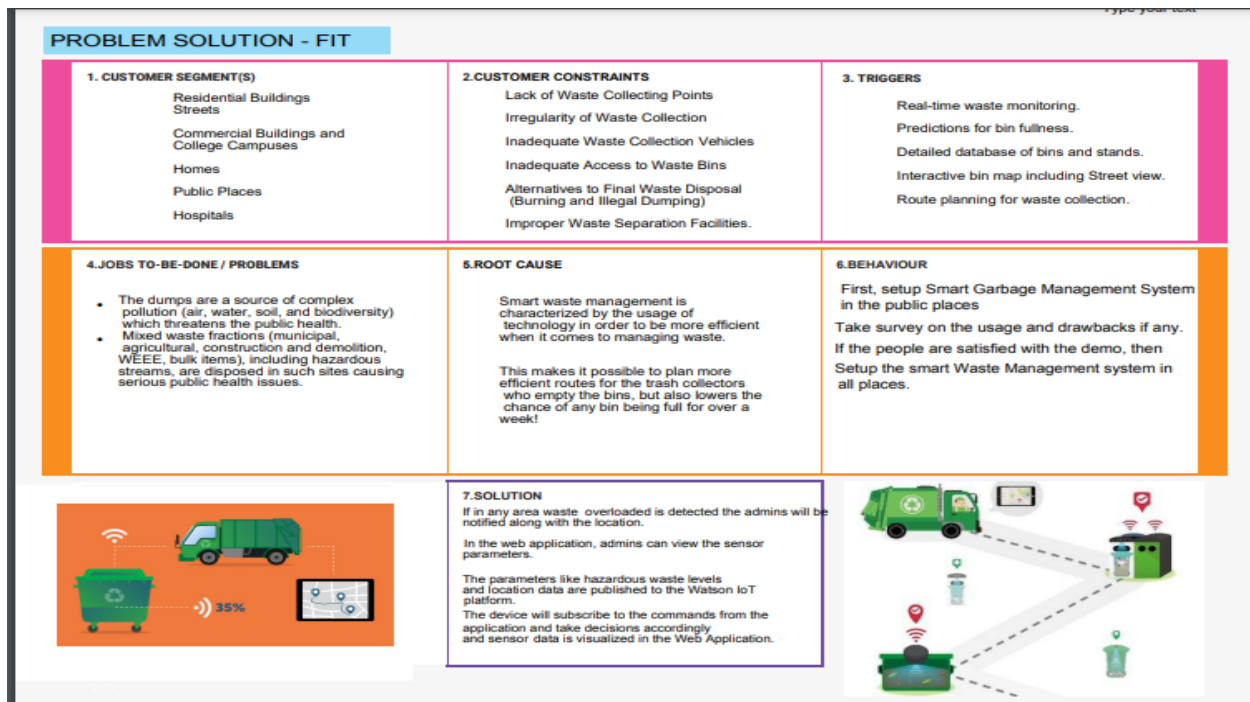
[View template feedback](#)

PROPOSED SOLUTION

S. NO	PARAMETERS	DESCRIPTION
1.	Problem Statement (Problem to be solved)	World faces major environmental challenges associated with waste generation and inadequate waste collection, transport, treatment and disposal . Current systems cannot cope with the volumes of waste generated by an increasing urban population, and this impacts on the environment and public health.
2.	Idea / Solution description	The solution is a method in which waste management is automated. Waste management using IoT is an innovative way that will help to keep the cities clean and healthy.
3.	Novelty / Uniqueness	IoT enables companies to automate processes and reduce labor costs . It also cuts down on waste and improves service delivery, making it less expensive to manufacture and deliver goods, as well as offering transparency into customer transactions.
4.	Social Impact / Customer Satisfaction	IoT improves the total efficiency of waste collection and recycling . The most common use in waste management is route optimisation, which reduces fuel

		consumption.
5.	Business Model (Revenue Model)	Smart Waste Management generates revenue through the provision of various waste management and disposal services and recycling solutions to residential, commercial, industrial, and municipal clients. They generate revenue by means of collecting fee.
6.	Scalability of the Solution	Scalability issues can be sorted out using IoT provided that the wireless network is wide range with high data speed and flexible software infrastructure.

PROBLEM SOLUTION FIT



REQUIREMENT ANALYSIS

FUNCTIONAL REQUIREMENTS

Following are the functional requirements of the proposed solution.

FR.NO	FUNCTIONAL REQUIREMENTS	SUB REQUIREMENTS
1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIn
2	User Confirmation	Confirmation via Email Confirmation via OTP
3	Authentication	<i>The system sends an approval request after the user enters personal information.</i>
4	User Interface	It should be the connector between the various systems or between other part or unit of the system.
5	Software interface	This includes embedded application that will used in supporting the various functions of the system Eg: GPS, Web Server and Database

Non-functional Requirements

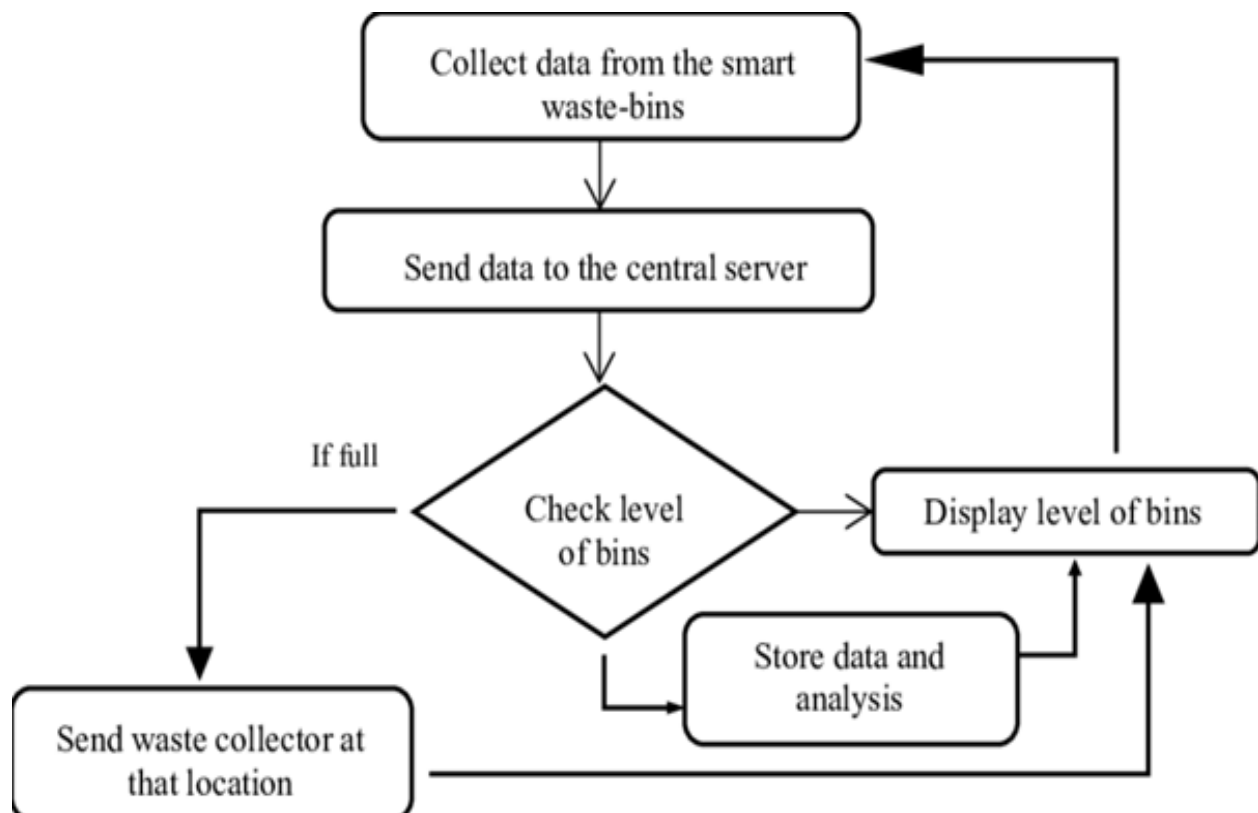
Following are the non-functional requirements of the proposed solution.

NFR. NO	NON FUNCTIONAL REQUIREMENTS	EXPLANATION
1	Usability	Ease with which the user is able to learn, operate and prepare inputs and interpret outputs through interaction with the system.
2	Security	Extend to which the system is safeguarded against deliberate and intrusive faults from internal and external sources.
3	Reliability	Extend to which the software systems consistently perform the specified functions without any failures.
4	Performance	System performance of handling capacity, throughput and response time.
5	Availability	Degree to which the users can depend on the system to be up during normal operating times.
5	Scalability	Degree to which the system is able to expand its processing capabilities upward and outward with business growth.

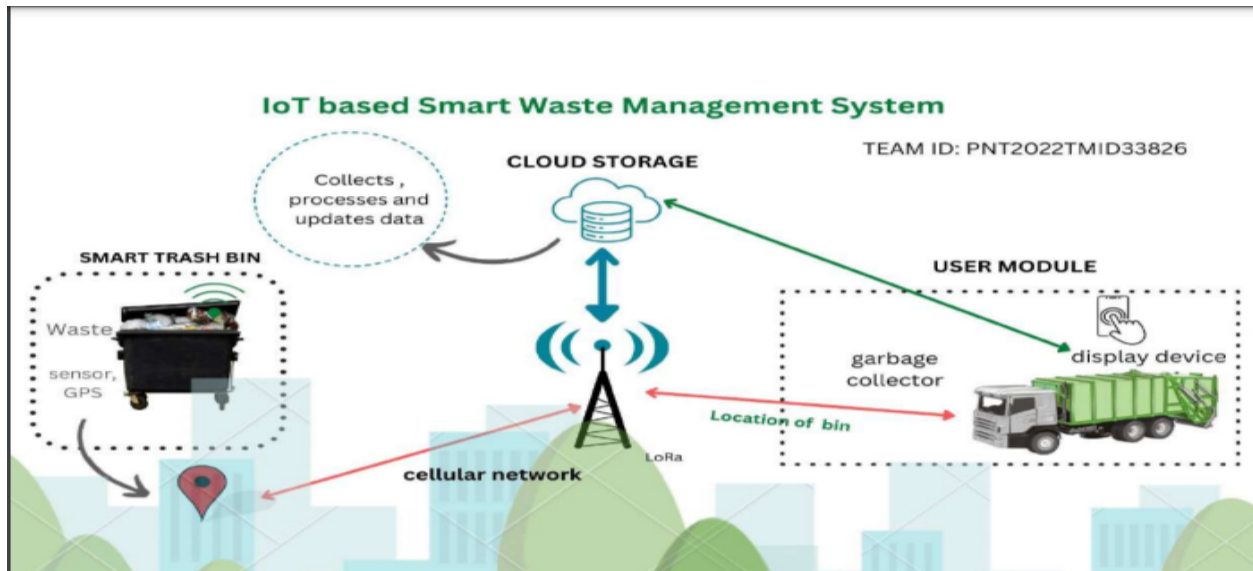
PROJECT DESIGN

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.



SOLUTION & TECHNICAL ARCHITECTURE



USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Storey Or Task	Acceptance Criteria	Priority	Release
Customer	Registration	USN-1	As a user I can register	I can access my account	High	Spirit-1

			for the product Throgh mail.			
		USN-2	As a user I can say demerits of product		Medium	Spirit-1
		USN-3	As a user I can access procedure to use product		High	Spirit-1
		USN-4	As a user I can register via face book and whatsapp	I can register & access the dashboa rd with Face book Login	Low	Spirit-2

		USN-5	As a user i can get my own password to access dashboard	I can receive confirmation email & click confirm	High	Spirit-1
Customer (Web User)						
Customer Care Executive						
Administrator						

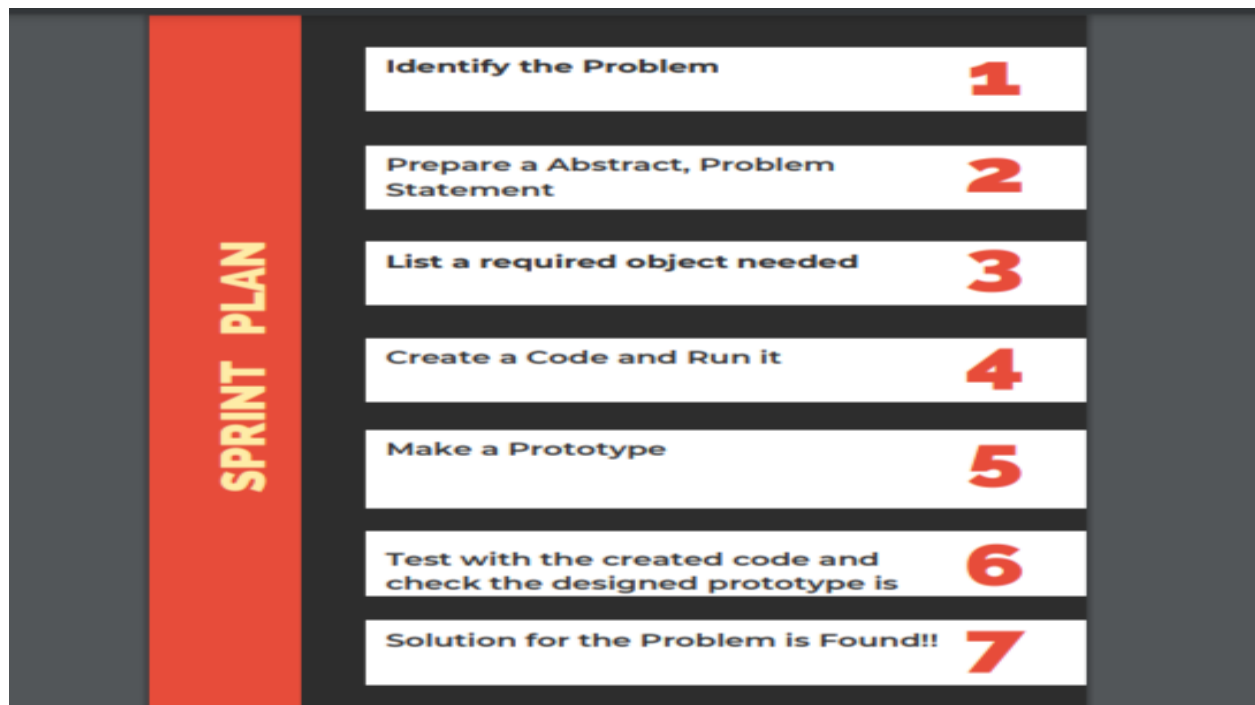
PROJECT PLANNING AND SCHEDULING

SPRINT PLANNING & ESTIMATION

Product Backlog, Sprint Schedule and Estimation:

Sprint	Functional Requirement	User Story Number	User Story /Task	Story Points	Priority	Team Members
Sprint-1	Registration	US1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Aishwariya G
Sprint-1		US2	As a user, I will receive confirmation email once I have registered for the application.	2	High	Kaveri M
Sprint-2		US3	As a user, I can register for the application through Facebook.	2	Low	Kavisha U
Sprint-1		US4	As a user, I can register for the application through Gmail.	2	Medium	Varshana Muki B
Sprint-1	Login	US5	As a user, I can log into the application by entering email & password.	2	High	Aishwariya G
Sprint-1	Dashboard	US6	As a user, I can easily navigate through dashboard and I can use the dashboard to get details about app and instruction to use the app.	2	High	Kaveri M
Sprint-1	Login and Dashboard	US7	As a web app user, I can login into application by using my email and password and I can access all resources same as mobile users.	2	High	Kavisha U
Sprint-1	Login	CCE1	As a CCE I can login to app using my id and password and I can interact with user.	2	High	Varshana Muki B
Sprint-1	Dashboard	CCE2	As a CCE I can access dashboard using id and password and I can see all user queries, explain app usage and attend their queries.	2	High	Aishwariya G
Sprint-1	Login and Dashboard	A1	As an administrator, I can login and access dashboard and manage and direct activities.	2	High	Kaveri M Kavisha U

SPRINT DELIVERY SCHEDULE



REPORTS FROM JIRA

	SEP	OCT
Sprints		WMUI S...
▼ WMUI-8 This is registration feature for the product.		
WMUI-10 As a user, I can easily n... IN PROGRESS		
WMUI-9 As a user, I can register f... IN PROGRESS		
WMUI-11 As a CCE I can login to... IN PROGRESS		

CODING & SOLUTIONING

FEATURE 1:

SOURCE CODE:

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = "3f3tah"
deviceType = "sensor"
deviceId = "123456"
authMethod = "token"
authToken = "1234567890"

# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
```

```

if status=="binfull":

    print ("----EMPTY THE BIN IMMEDIATELY----")

#print(cmd)

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()

# Connect and send a datapoint "hello" with value "world" into the cloud as
an event of type "greeting" 10 times

deviceCli.connect()

while True:

    #USING RANDOM FUNCTIONS TO SIMULATE BINLEVEL

    binlevel=random.randint(10,100)

    locationId=random.randint(1,5)

    district="Tirunelveli"

    state="Tamilnadu"

    country="India"

    if locationId == 1:

        latitude=8.7060581

```

```
longitude=77.7633162
village="VM Chathiram"
elif locationId == 2:
    latitude=8.7066676
    longitude=77.732578
    village="Perumalpuram"
elif locationId == 3:
    latitude=8.7199159
    longitude=77.725674
    village="Palayamkottai"
elif locationId == 4:
    latitude=8.7282671
    longitude=77.7180244
    village="Vannarpettai"
elif locationId == 5:
    latitude=8.7289086
    longitude=77.6745726
    village="Nellai Town"
else:
    print("No location Found!!")

data = { 'latitude' : latitude, 'longitude': longitude,'binlevel':
```

```

binlevel,'village':village,'district':district,'state':state,'country':country }

#print data

def myOnPublishCallback():

    print ("Published Latitude = %s " % latitude, "Longitude = %s %% " %
longitude, "Binlevel = %s" % binlevel,"village = %s " % village,"district= %s" %
district,"state = %s" % state,"country = %s " % country, "to IBM Watson\n")

    if binlevel >= 90:

        data={'Latitude':latitude, 'Longitude':longitude, 'Binlevel':binlevel,
'Village':village, 'District':district, 'State':state,'Country':country}

        print("!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!BIN IS FULL
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!\n")

        print("-----EMPTY THE BIN IMMEDIATELY-----
-----\n")

        deviceCli.commandCallback = myCommandCallback

        time.sleep(5)

    else:

        print("BIN IS IN NORMAL LEVEL\n")

        time.sleep(5)

success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)

if not success:

    print("Not connected to IoTF")

# Disconnect the device and application from the device

Cli.disconnect()

```

FEATURE 2:

OUTPUT SCREEN

```
Python 3.7.0 Shell
File Edit Shell Debug Options Window Help
Python 3.7.0 (v3.7.0:1bf9cc5093, Jun 27 2018, 04:59:51) [MSC v.1914 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: C:/Users/ADMIN/Downloads/Finalproject.py =====
BIN IS IN NORMAL LEVEL
2022-11-16 14:35:24,495 ibmiotf.device.Client INFO Connected successfully: d:3f3tah:sensor:123456
Published Latitude = 8.7066676 Longitude = 77.732578 & Binlevel = 65 village = Perumalpuram district= Tirunelveli state = Tamilnadu country = India to IBM Watson
BIN IS IN NORMAL LEVEL
Published Latitude = 8.7066676 Longitude = 77.732578 & Binlevel = 61 village = Perumalpuram district= Tirunelveli state = Tamilnadu country = India to IBM Watson
BIN IS IN NORMAL LEVEL
Published Latitude = 8.7282671 Longitude = 77.7180244 & Binlevel = 41 village = Vannarpettai district= Tirunelveli state = Tamilnadu country = India to IBM Watson
BIN IS IN NORMAL LEVEL
Published Latitude = 8.7199159 Longitude = 77.725674 & Binlevel = 70 village = Palayamkottai district= Tirunelveli state = Tamilnadu country = India to IBM Watson
BIN IS IN NORMAL LEVEL
Published Latitude = 8.7066676 Longitude = 77.732578 & Binlevel = 34 village = Perumalpuram district= Tirunelveli state = Tamilnadu country = India to IBM Watson
BIN IS IN NORMAL LEVEL
Published Latitude = 8.7060581 Longitude = 77.7633162 & Binlevel = 61 village = VM Chathiram district= Tirunelveli state = Tamilnadu country = India to IBM Watson
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!BIN IS FULL!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
-----EMPTY THE BIN IMMEDIATELY-----
|

Activate Windows
Go to Settings to activate Windows.
```

TEST CASES

[illegible]

Testcases Report [Protected View] - Excel (Product Activation Failed)

File Home Insert Page Layout Formulas Data Review View Tell me what you want to do... Sign in Share

PROTECTED VIEW Be careful—files from the Internet can contain viruses. Unless you need to edit, it's safer to stay in Protected View. Enable Editing

G8 User ID:Admin

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	BUG ID	Executed By
1												
2												
3												
4												
5	LogInPg_LC_O4	LogIn page	Verify user is able to log into application with valid credentials	1. Click APP and click go 2. Enter login id in login id textbox 3. Enter password in password textbox 4. Click the submit button which is in green colour 5. If either user id or password is wrong it will show "Check your login credentials"	User ID:Admin password:12345678	Application should show "Incorrect login id or password" validation message.						
10	DurbIn Detail Page	DurbIn details page	Make user to get into next page	1. Click APP and click go 2. Enter login id in login id textbox 3. Enter password in password textbox 4. Click the submit button which is in green colour 5. If either user id or password is wrong it will show "Check your login credentials" 6. Click "DurbIn details"	User ID:Admin password:12345678	Application will get into next page	Working as expected	Pass	Steps are clear to follow	Y		App inventor myself
11	DurbIn Detail Page	DurbIn details page	Make user to get into next page or make user to logout	1. Click APP and click go 2. Enter login id in login id textbox 3. Enter password in password textbox 4. Click the submit button which is in green colour 5. If either user id or password is wrong it will show "Check your login credentials" 6. Click "DurbIn details" or click "Logout"	User ID:Admin password:12345678	Application will get into next page or may logout	Working as expected	Pass	Steps are clear to follow	Y		App inventor myself
12	GurbIn info page	GurbIn info page		1. Click APP and click go 2. Enter login id in login id textbox 3. Enter password in password textbox 4. Click the submit button which is in green colour 5. If either user id or password is wrong it will show "Check your login credentials"	User ID:Admin password:12345678	It will show bin details	Working as expected	Pass	Steps are clear to follow	Y		App inventor myself

Shopenzor Testcases Testscenarios

Ready Type here to search

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Testcases Report [Protected View] - Excel (Product Activation Failed)

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1												
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4												
9	DurbIn Detail Page	DurbIn details page	Make user to get into next page or make user to logout	1. Click APP and click go 2. Enter login id in login id textbox 3. Enter password in password textbox 4. Click the submit button which is in green colour 5. If either user id or password is wrong it will show "Check your login credentials" 6. Click "DurbIn details" or click "Logout"	User ID:Admin password:12345678	Application will get into next page or may logout	Working as expected	Pass	Steps are clear to follow	Y		App inventor myself
12	GurbIn info page	GurbIn info page		1. Click APP and click go 2. Enter login id in login id textbox 3. Enter password in password textbox 4. Click the submit button which is in green colour 5. If either user id or password is wrong it will show "Check your login credentials"	User ID:Admin password:12345678	It will show bin details	Working as expected	Pass	Steps are clear to follow	Y		App inventor myself
13	GurbIn info page	GurbIn info page	Make user to find what info is going to get	1. Click APP and click go 2. Enter login id in login id textbox 3. Enter password in password textbox 4. Click the submit button which is in green colour 5. If either user id or password is wrong it will show "Check your login credentials"	User ID:Admin password:12345678	It will show bin details such as "latitude", "longitude", "location" and "bin details"	Working as expected	Pass	Steps are clear to follow	Y		App inventor myself
15	GurbIn info page	GurbIn info page	Make user to find what info is going to get	1. Click APP and click go 2. Enter login id in login id textbox 3. Enter password in password textbox 4. Click the submit button which is in green colour 5. If either user id or password is wrong it will show "Check your login credentials"	User ID:Admin password:12345678	It will show bin details such as "latitude", "longitude", "location" and "bin details"	Working as expected	Pass	Steps are clear to follow	Y		App inventor myself
16	GurbIn info page	GurbIn info page	Make user to find what info is going to get	1. Click APP and click go 2. Enter login id in login id textbox 3. Enter password in password textbox 4. Click the submit button which is in green colour 5. If either user id or password is wrong it will show "Check your login credentials"	User ID:Admin password:12345678	It will show bin details such as "latitude", "longitude", "location" and "bin details"	Working as expected	Pass	Steps are clear to follow	Y		App inventor myself

Shopenzor Testcases Testscenarios

Ready Type here to search

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USER ACCEPTANCE TESTING

Purpose of Document:

The purpose of this document is to briefly explain the test coverage and open issues of the **Smart Waste Management System for Metropolitan Cities** project at the time of the release to User Acceptance Testing (UAT).

1.Defect Analysis:

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	4	0	0	4
Client Application	3	0	0	3

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Sub Total
By Design	5	9	6	7	27
Duplicate	10	7	6	7	30
External	6	5	3	5	19
Fixed	4	7	8	6	25

Not Reproduc ed	4	3	2	0	9
Skipped	5	4	3	0	12
Won't Fix	0	0	0	1	1
Totals	34	35	28	26	123

2.Test Case Analysis:

This report shows the number of test cases that have passed, failed, and untested

Security	3	0	0	3
Outsource Shipping	2	0	0	2
Exception Reporting	2	0	0	2
Final Report Output	4	0	0	4
Version Control	5	0	0	5

Performance Testing - Excel (Product Activation Failed)

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Cut Copy Paste Format Painter Clipboard Font Alignment Number Styles Conditional Formatting Cell Styles Insert Delete Format AutoSum Fill Sort & Find & Filter - Select - Clear - Editing

CS

NFT - Risk Assessment									
S.No	Project Name	Scope/Feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volumen Changes	Risk Score	Justification
1	Smart Waste Management System	To prevent overflow	Low	No Changes	Moderate		>5 to 10%	ORANGE	As we have seen the changes
2									
3									
4									
5									
NFT - Detailed Test Plan									
S.No	Project Overview	NFT Test approach	Assumptions/Dependencies/R	Approvals/SignOff					
1	Smart Waste Management System	yes	Low	Yes					
2									
End Of Test Report									
S.No	Project Overview	NFT Test approach	NFR - Met	Test Outcome	GO/NO-GO decision	Recommendations	Identified Defects (Detected/Closed/Open)	Approvals/SignOff	
1	Preparation of test plan and test cases	Yes	Yes	Through the test the test defects, test cases and test cases	Represent		Closed	Yes	
2	Execution of test cases of NFR	Yes	Yes	Get reviewed into the test page	Represent		Closed	Yes	
3	Execution of test cases of NFR	Yes	Yes	Ask for input of test cases	Represent		Closed	Yes	
4	Execution of test cases of NFR	Yes	Yes	Ask for input of test cases	Represent		Closed	Yes	
5	Execution of test cases of NFR	Yes	Yes	Ask for input of test cases	Represent		Closed	Yes	
6	Execution of test cases of NFR	Yes	Yes	Ask for input of test cases	Represent		Closed	Yes	

Activate Windows
Go to Settings to activate Windows.

Ready NFT - RA DTP

Page No : 27

Performance Testing - Excel (Product Activation Failed)

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10		NFT - Detailed Test Plan				
11	Project Overview	NFT Test approach	umptions/Dependencies/R	Approvals/SignOff		
12	Smart Waste Management System	yes	Low	Yes		
13						
14		End Of Test Report				
15	Test Outcome	GO/NO-GO decision	Recommendations	Identified Defects (Detected/Closed/Open)	Approvals/SignOff	
16	Through the app the the bin details, latitude , longitude	Approved		Closed	Yes	
17	Get entered into the login page	Approved		Closed	Yes	
18	Ask for Login ID and passvord	Approved		Closed	Yes	
19	Ask to click either dustbin details or logout	Approved		Closed	Yes	
20	Eg clicking dustbin details shows the actual result	Approved		Closed	Yes	

Activate Windows
Go to Settings to activate Windows.

NFT- RA DTP

Ready

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ADVANTAGES

Reduction in Collection Cost

- The solution reduces waste collection frequency dramatically, enabling you to save on fuel, labor, and fleet maintenance costs. It has been seen that the solution has reduced the operational cost of municipalities up to 80%.

No Missed Pickups

- Using the solution, the managers, as well as the garbage truck drivers, can see which garbage containers are not picked up and needs to be picked. So, there will be no missed pickups, keeping the residents away from the disease which occurs due to bacteria, vermin and insects prosper from the garbage.

Reduced Overflows

- One of the ill effects of overflowing garbage containers is air pollution, which causes lung diseases and numerous health problems as contaminants are absorbed from lungs into other parts of a human body. Another malicious effect is on the waste collection staff and it is the risk of picking up and handling overflowing garbage which can cause them infections or chronic diseases.
- The solution takes care of this issue by allowing the waste collectors to keep track of every bin's fill status and schedule the pickup ontime.

Waste Generation Analysis

- The solution does not limit to allowing the managers to set up the pickup routes. The solution also features Advanced Data Analytics through which the waste collection managers can know the future waste generation and can plan the resources accordingly.

CO2 Emission Reduction

- The solution decreases the fuel consumption which ultimately reduces carbon emission by up to 70%. This is indeed a huge reduction both in terms of finance and environmental impact.

DISADVANTAGES

- System requires more number of waste bins for separate waste collection as per population in the city. This results into high initial cost due to expensive smart dustbins compare to other methods.
 - Sensor nodes used in the dustbins have limited memory size.
 - Wireless technologies used in the system such as zigbee and wifi have shorter range and lower data speed. In RFID based systems, RFID tags are affected by surrounding metal objects (if any).
- It reduces man power requirements which results into increase in

unemployments for unskilled people.

- The training has to be provided to the people involved in the smart waste management system.

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 increase.

FUTURE SCOPE

- The main aim of this project is to reduce human resources and efforts along with the enhancement of a smart city vision. We have often seen garbage spilling over from dustbins on to streets and this was an issue that required immediate attention.
- The proverb “Cleanliness is next to god and clean city is next to heaven” inspired us to conceptualized the project. Smart dustbin helps us to reduce the pollution. Many times garbage dustbin is overflow and many animals like dog or rat enters inside or near the dustbin. This creates a bad scene. Also some birds are also trying to take out garbage from dustbin.

- This project can avoid such situations. And the message can be sent directly to the cleaning vehicle instead of the contractor's office.

Swatch Bharat Abhiyan (English: Clean India Mission and abbreviated as SBA or SBM for "Swatch Bharat Mission") is a national campaign by the Government of India, covering 4,041 statutory cities and towns, to clean the streets, roads and infrastructure of the country. In our system, the Smart dustbins are connected to the internet to get the real time information of the smart dustbins.

- In the recent years, there was a rapid growth in population which leads to more waste disposal. So a proper waste management system is necessary to avoid spreading some deadly diseases.

APPENDIX

SOURCE CODE

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = "3f3tah"
deviceType = "sensor"
deviceId = "123456"
authMethod = "token"
authToken = "1234567890"

# Initialize GPIO

def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="binfull":
        print ("-----EMPTY THE BIN IMMEDIATELY-----")
```

```
#print(cmd)
```

```
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()
```

```
# Connect and send a datapoint "hello" with value "world" into the cloud as  
an event of type "greeting" 10 times
```

```
deviceCli.connect()
```

```
while True:
```

```
    #USING RANDOM FUNCTIONS TO SIMULATE BINLEVEL
```

```
    binlevel=random.randint(10,100)
```

```
    locationId=random.randint(1,5)
```

```
    district="Tirunelveli"
```

```
    state="Tamilnadu"
```

```
    country="India"
```

```
    if locationId == 1:
```

```
        latitude=8.7060581
```

```
longitude=77.7633162
village="VM Chathiram"
elif locationId == 2:
    latitude=8.7066676
    longitude=77.732578
    village="Perumalpuram"
elif locationId == 3:
    latitude=8.7199159
    longitude=77.725674
    village="Palayamkottai"
elif locationId == 4:
    latitude=8.7282671
    longitude=77.7180244
    village="Vannarpettai"
elif locationId == 5:
    latitude=8.7289086
    longitude=77.6745726
    village="Nellai Town"
else:
    print("No location Found!!")

data = { 'latitude' : latitude, 'longitude': longitude,'binlevel':
```

```

binlevel,'village':village,'district':district,'state':state,'country':country }

#print data

def myOnPublishCallback():

    print ("Published Latitude = %s " % latitude, "Longitude = %s %" % longitude, "Binlevel = %s" % binlevel,"village = %s " % village,"district= %s" % district,"state = %s" % state,"country = %s " % country, "to IBM Watson\n")

    if binlevel >= 90:

        data={'Latitude':latitude, 'Longitude':longitude, 'Binlevel':binlevel, 'Village':village, 'District':district, 'State':state,'Country':country}

        print("!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!BIN IS FULL
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!\n")

        print("-----EMPTY THE BIN IMMEDIATELY-----
-----\n")

        deviceCli.commandCallback = myCommandCallback

        time.sleep(5)

    else:

        print("BIN IS IN NORMAL LEVEL\n")

        time.sleep(5)

    success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)

    if not success:

        print("Not connected to IoTF")

```

```
time.sleep(1)
```

```
# Disconnect the device and application from the cloud
```

```
deviceCli.disconnect()
```

GITHUB LINK

<https://github.com/IBM-EPBL/IBM-Project-30933-1660192950>

PROJECT DEMO LINK

<https://drive.google.com/file/d/1BjtMuUAHXUxJETtPLiX4hgpH1oypMh3/view?usp=sharing>