

**Vel Tech Multi Tech Dr. Rangarajan Dr. Sakunthala Engineering  
College**

**SMART WASTE MANGEMENT SYSTEM FOR  
METEROPOLITAN CITIES**

**TEAM ID:PNT2022TMID22430**

**TEAM MEMBERS:**

1. Jayasri S - 113119UG04039
2. Kalyanasundari V - 113119UG04042
3. Kethineni Sai sharanya - 113119UG04048
4. Yogarani S - 113119UG04117
5. Kotteshwari D -113119UG04051

## **Project Report Format**

### **1. INTRODUCTION**

1. Project Overview
2. Purpose

### **2. LITERATURE SURVEY**

1. Existing problem
2. References
3. Problem Statement Definition

### **3. IDEATION & PROPOSED SOLUTION**

1. Empathy Map Canvas
2. Ideation & Brainstorming
3. Proposed Solution
4. Problem Solution fit

### **4. REQUIREMENT ANALYSIS**

1. Functional requirement
2. Non-Functional requirements

### **5. PROJECT DESIGN**

1. Data Flow Diagrams
2. Solution & Technical Architecture
3. User Stories

### **6. PROJECT PLANNING & SCHEDULING**

1. Sprint Planning & Estimation
2. Sprint Delivery Schedule
3. Reports from JIRA

### **7. CODING & SOLUTIONING (Explain the features added in the project along with code)**

1. Python code

### **8. TESTING**

1. User Acceptance Testing
2. Test case analysis

### **9. RESULTS**

1. Performance Metrics

### **10. ADVANTAGES & DISADVANTAGES**

### **11. CONCLUSION**

### **12. FUTURE SCOPE**

### **13. APPENDIX**

Source Code, GitHub & Project Demo Link.

## **1. INTRODUCTION**

### **1.1 Project Overview**

The amount of waste produced everyday by the industries and the households is increasing at an appalling rate, and the major reason for this is soaring use of packaged items, textiles, paper, food, plastics, metals, glass etc, thus management of this refuse becomes a crucial part in our everyday life. In most of the developed countries there are many efficient techniques which are used for the proper management of this waste, but in some countries especially the developing ones the careless attitude of people towards maintaining clean surroundings, along with this many issues such as no stringent laws for using the biodegradable materials, no proper environmental policies, no laws for sustainable development are the seed for the fatal results of waste management. Due to the increasing waste, the public bins which are used for collecting this waste are overflowing, the locality is jumbled of trash, causing not only malodorous streets but also a negative impact on the health and environment. We segregate the waste at our homes for ease at processing and recycling. We observed trash vans come irregular to homes creating a despoliation of households. Due to this many civilians empty their overloaded dustbins in open spaces. This in turn increases environmental pollution. The waste is a great hassle for our health and the environment it has many effects which are dreadful. Trash is breeding ground for bacteria, insects, flies these flies are the same that roam around the eatable and drop the off springs. Thus they increase the risk with food poisoning, typhoid, gastroenteritis, salmonella, the insects cause malaria dengue etc. Here a waste management system is introduced in which each dumpster is embedded in a monitoring system which will notify the corresponding person if the dumpster is full. In this system, it is also possible to separate wet and dry waste into two separate containers. This system provides an effective solution to waste management problem.

### **1.2 Purpose**

1. To ensure the protection of the environment through effective waste management.
2. Ensure separation at source in all metropolitan and local municipalities.
3. Preventing pollution and ecological degradation.
4. To protect the health and wellbeing of people by providing an affordable waste collection service.

## 2.LITERATURE SURVEY

	Advantages and disadvantages of different smart waste management systems		
	Name of the paper	Advantages	Disadvantages
1	Cloud-based Smart Waste Management for Smart Cities	Timely waste collection, Route optimization Recycling and disposal, Resource management, Food industry planning Taxation, Big Data analytics Health care waste- based energy production	System requires number of waste bins for separate waste collection
2	IOT Based Smart Garbage alert system using Arduino UNO	It is transportable low price RFID tag. The system provides options for the customers to lodge their complaints in case of discrepancies.	Complex design of dustbin compared to other methods
3	RFID-based Real-time Smart Waste Management System (2007)	Waste disposal charge can be calculated and, can Track missing/ stolen bins quickly and accurately without human intervention, automate customer invoices, Enhanced cost savings Improve security.	Metal objects or liquid containers difficult to tag and track with a RFID system, The RFID tag is also affected by objects surrounding it especially metallic objects.
4	Smart Recycle Bin (2014)	Usefulness – to increase the utilization of the particular bin for waste disposal. Assist the authority to effectively and efficiently improve the collection of recyclable waste. The recycling process rewarding points to the user who contribute to waste recycling Increase the awareness among citizens	System requires 3R card for waste disposal
5	Smart bin: Smart Waste Management System (2016)	Obtain litter bin utilization - utilization information shows how a bin has been utilized litter bin daily seasonality information- shows the time when a bin is usually full.	The sensor node was deployed with battery power. Low power consumption sensor node must

			be used because of its limited power. The sensor node had limited memory size.
6	INTERNET OF BINS : Trash Management in India (20117)	Less expensive Lock based System with acknowledgment alert system. Two threshold limits are being fixed. Reduces fuel usage. Provides clean locality	ZigBee are short range, low complexity, and low data speed.

## 2.2 REFERENCES

- [1] Mohammad Aazam, Marc St-Hilaire, Chung-Horng Lung, Ioannis Lambadaris , (2016), "Cloud-based Smart Waste Management for Smart Cities", IEEE
- [2] Dr. N. Sathish Kumar, B. Vijayalakshmi, R. Jenifer Prarthana, A .Shankar, (2016 ), "IoT Based Smart Garbage alert system using Arduino UNO ", IEEE
- [3] Belal Chowdhury, Morshed U. Chowdhury, (2007) "RFID-based Real-time Smart Waste Management System", Australasian Telecommunication Networks and Applications Conference, December, Christchurch, New Zealand
- [4] Mohd Helmy Abd Wahab, Aeslina Abdul Kadir, Mohd Razali Tomari and Mohamad Hairol Jabbar (2014), "Smart Recycle Bin A Conceptual Approach of Smart Waste Management with Integrated Web based System", IEEE
- [5] Fachmin Folianto, Yong Sheng Low, Wai Leong Yeow , (2015) "Smartbin: Smart Waste Management System", Tenth International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP ) Singapore, 7-9 April, IEEE
- [6] Gopal Kirshna Shyam, Sunilkumar S. Manvi, Priyanka Bharti, (2017) " Smart Waste Management using Internet-of- Things (IoT)" Second International Conference On Computing and Communications Technologies (ICCCT'17), IEEE
- [7] Keerthana B, Sonali M Raghavendran, Kalyani S, Suja P, V.K.G.Kalaiselvi, (2017), "Internet of Bins Trash Management in India ", IEEE
- [8] Bharadwaj B, M Kumudha, Gowri Chandra N, Chaithra G, (2017) "Automation of Smart Waste Management Using IoT to Support "Swachh Bharat Abhiyan" – a practical Approach " IEEE
- [9] Shubham Thakker, R.Narayanamoorthi, (2015), "Smart and Wireless Waste

Management An innovative way to manage waste and also produce energy” 2nd International Conference on Innovations in Information Embedded and Communication Systems ICIECS’15 , IEEE

[10] Artemios G. Voyiatzis, John Gialelis, and Dimitrios Karadimas, (2014) “Dynamic Cargo Routing on-the- Go: The Case of Urban Solid Waste Collection” 2 nd IEEE WiMob 2014 international workshop on smart city and ubiquitous computing application , IEEE

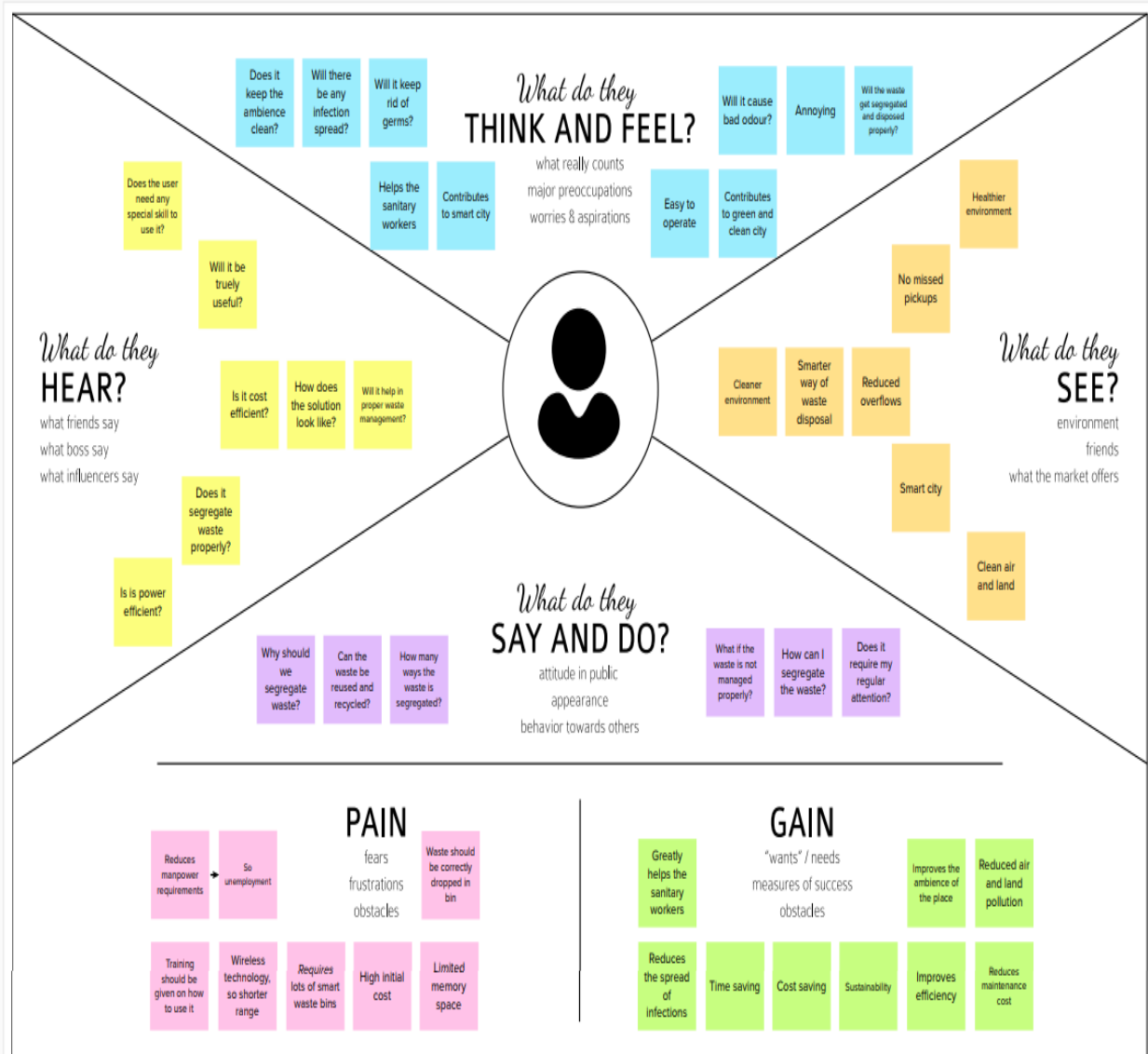
## 2.3 PROBLEM STATEMENTS



### 3. IDEATION & PROPOSED SOLUTION

#### 3.1 Empathy Map Canvas:

Build empathy and keep your focus on the user by putting yourself in their shoes.



## 3.2 Ideation & 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.

15 minutes to prepare  
1 hour to collaborate  
2-4 people recommended

Share template feedback

**Before you collaborate**

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

10 minutes

Team gathering  
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

Set the goal  
Think about the problem you'll be working on during the brainstorming session.

Learn how to use the facilitator's tools  
Use the Facilitator's Supporter to run a happy and productive session.

Open article

**Define your problem statement**

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

How might we (best problem statement)?

Example: Rapid increase of population leads to increases in waste which in turn results in spreading of many diseases and affects the environment. Affects the health of person sanitary workers while segregation of office wastes.

Key rules of brainstorming  
To run a smooth and productive session

- Stay in topic.
- Encourage wild ideas.
- Defer judgment.
- Listen to others.
- Collaborate.
- If possible, be visual.

**Brainstorm**

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

10 minutes

How

You've created a sticky note and in the panel below to connect your ideas together

Brainstorming A

Brainstorming B

Brainstorming C

Brainstorming D

Brainstorming E

Brainstorming F

Brainstorming G

Brainstorming H

Brainstorming I

Brainstorming J

Brainstorming K

Brainstorming L

Brainstorming M

Brainstorming N

Brainstorming O

Brainstorming P

Brainstorming Q

Brainstorming R

Brainstorming S

Brainstorming T

Brainstorming U

Brainstorming V

Brainstorming W

Brainstorming X

Brainstorming Y

Brainstorming Z

**Group Ideas**

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

10 minutes

How

After you've created sticky notes to cluster ideas together, use the sticky notes to group ideas together, and assign a sentence to each cluster. These notes will be your guide.

MONITOR

SAFETY FEATURES

SIGNIFICANCE

CHARACTERISTICS OF SOLUTION

**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

How

Participants can use their sticky notes to place ideas on the grid. The facilitator can assist the participants in the task by providing the grid and the sticky notes.

**After you collaborate**

You can export the results as an image or PDF. To share with members of your company who might find it helpful.

Quick peek

Show the results

Show how you see the map with stakeholders to help them in the loop about the outcomes of the session.

Export the map

Export a copy of the map as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

Strategic blueprint

Define the components of a new linear strategy.

Open the template

Customer experience journey map

Understand customer needs, motivations, and obstacles for an experience.

Open the template

Strength, weakness, opportunity & threat

Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.

Open the template







Share template feedback







### 3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Rapid increase of population leads to the increases in waste. Increasing volume of wastes results in spreading of many diseases and affects the environment. The traditional method of waste segregation is time consuming and also affects the health of person who is involved in segregation.
2.	Idea / Solution description	IoT based Automatic Waste Segregator for efficient recycling and waste collection bins using Wi-Fi technology are used.
3.	Novelty / Uniqueness	Our undertaking utilizes Thing Speak IoT which permits us to total, picture and dissect live information streams in the cloud. A portion of the key capacities of Thing Speak incorporate the capacity to: Easily design gadgets to send information to Thing Speak utilizing main stream IoT conventions Visualize your sensor information continuously.
4.	Social Impact / Customer Satisfaction	Waste collection and segregation becomes easier. Monitoring of bins helps in making city cleaner. It is easy to handle and cheaper.
5.	Business Model (Revenue Model)	Smart dustbin can be used at each house to get maximum benefit out of this model. The components used are easily available in the market for bulk production.
6.	Scalability of the Solution	It is scalable and efficient way of waste management wherein the increased amount of waste, if generated, can be monitored and disposed properly using this project model.

### 3.4 Problem solution fit

Define CS, fit into C	<b>1. CUSTOMER SEGMENT(S)</b>  The people who dispose various types of waste and people in metropolitan area	<b>6. CUSTOMER CONSTRAINTS</b>  Traditional ways of segregating waste consumes more time and manpower. It requires more cost	<b>5. AVAILABLE SOLUTIONS</b>  Proper segregation and disposal of waste. Reduce, reuse and recycle of waste.	Explore AS, differ
	<b>2. JOBS-TO-BE-DONE / PROBLEMS</b>  Increase in pollution Spread of diseases Environmental pollution	<b>9. PROBLEM ROOT CAUSE</b>  Rapid growth in population results in rapid increase in waste and if it is not properly disposed it may spread various diseases	<b>7. BEHAVIOUR</b>  Automatic opening and closing of bin lid in smart bin Automatic segregation of waste improves efficient disposal of waste Continuous monitoring of waste helps in preventing overflow of bins, thereby keeping the place clean	

<b>3. TRIGGERS</b>  Seeing people with many health problems and living in unhealthy and dirty environment comparing with other countries, their roads and environment which are very clean and healthy	<b>10. YOUR SOLUTION</b>  Our system is used to segregate waste property and intimate to dispose waste when the bin filled	<b>8. CHANNELS of BEHAVIOUR</b>  <b>8.1 ONLINE</b> When the waste bins filled it will send notification to the concerned person to collect and dispose it thereby the surrounding will be clean <b>8.2 OFFLINE</b> It's is easy to segregate the waste and the waste can be reused wisely The unusable waste can be disposed properly.
--	--	--

<b>4. EMOTIONS: BEFORE / AFTER</b>  Before the waste was not properly segregated and disposed. It causes bad odour, health problem and dirty environment. After waste management the environment become clean. Waste are properly segregated and disposed on time. It reduces spread of diseases		
---	--	--

## 4. REQUIREMENT ANALYSIS

## 4.1 Functional requirement

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	GPS and Cloud	GPS location of the registered bin to be received. The data collected is to be stored in cloud. So cloud registration must be done.
FR-4	Bin details and its monitoring	The data about the bin is collected- The size, the capacity, the type of waste it holds, the time it takes approximately to get filled etc. Displays real-time data on fill-levels of bins monitored by smart sensors. With real-time data and predictions, you can eliminate the overflowing bins and stop collecting half-empty ones.
FR-5	Plan waste collection routes	Based on current bin fill-levels and predictions of reaching full capacity, you are ready to respond and schedule waste collection. Inefficient picks are thus avoided
FR-6	Bin distribution	Identify areas with either dense or sparse bin distribution. Based on the data collected on capacity or location, the bin can be adjusted, if necessary.

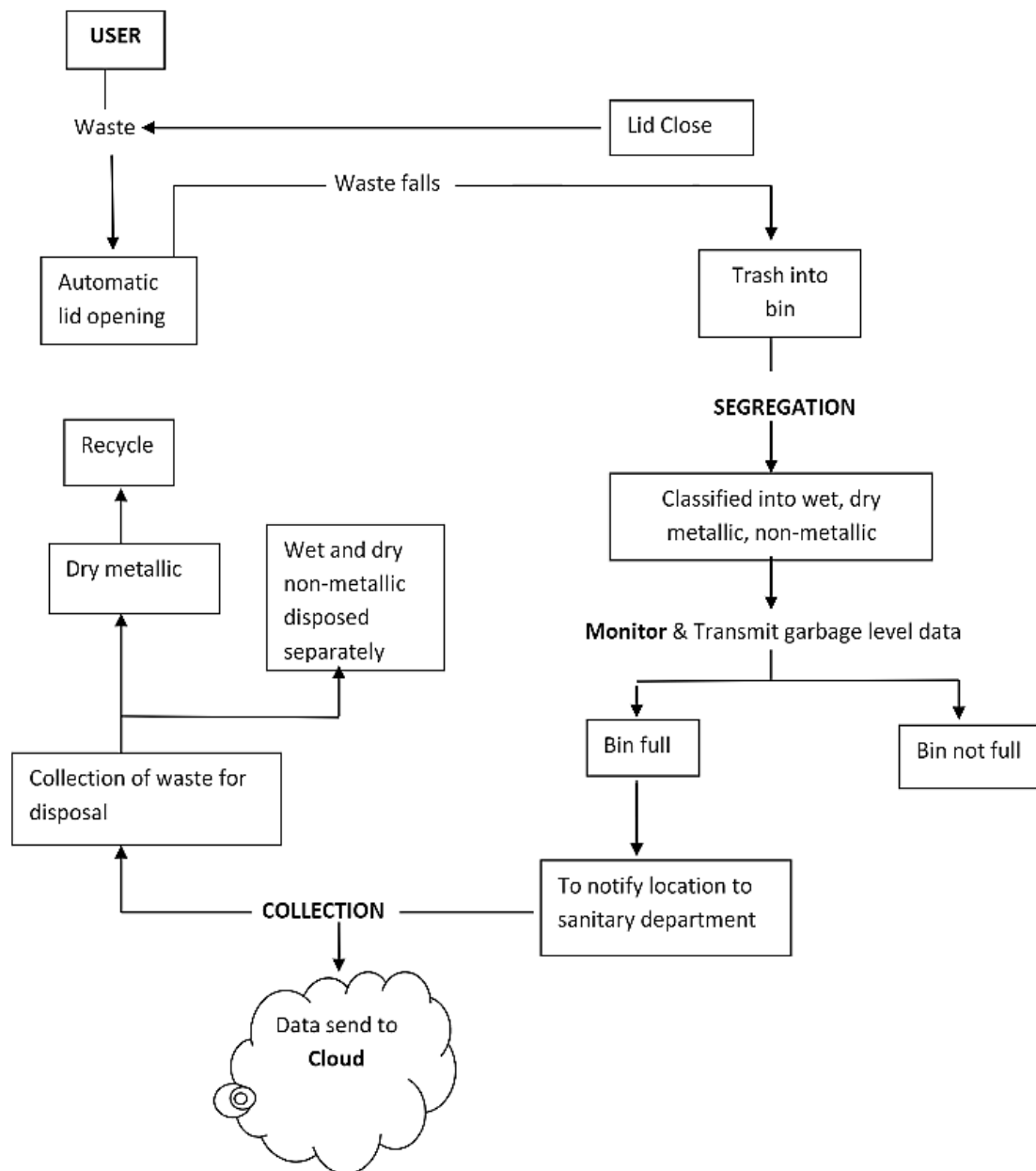
## 4.2 Non-functional Requirements

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

NFR-1	<b>Usability</b>	IoT device verifies and analyses user requirements, which can further improve the design quality. In the design process, with user experience as the core knowledge, usability can indeed help designers better understand users' potential needs in waste management, behaviour and experience.
NFR-2	<b>Security</b>	Use reusable bottles Use reusable grocery bags Purchase wisely and recycle Avoid single use food and drink containers
NFR-3	<b>Reliability</b>	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	<b>Performance</b>	The Smart Sensors use ultrasound technology (ultrasonic sensor) to measure the fill levels in bins several times a day and saved in cloud which helps in performing many data driven operations in waste management app. Customers are hence provided with data-driven decision making, and optimization of waste collection routes, frequencies, and vehicle loads resulting in route reduction by at least 30%
NFR-5	<b>Availability</b>	By developing & deploying effective hardware and apt software we can empower cities to manage waste smarter
NFR-6	<b>Scalability</b>	Using smart waste bins, reduces the number of bins inside town or cities because we able to monitor the garbage 24/7 more cost effect and scalability when we move to smarter.

## 5. PROJECT DESIGN

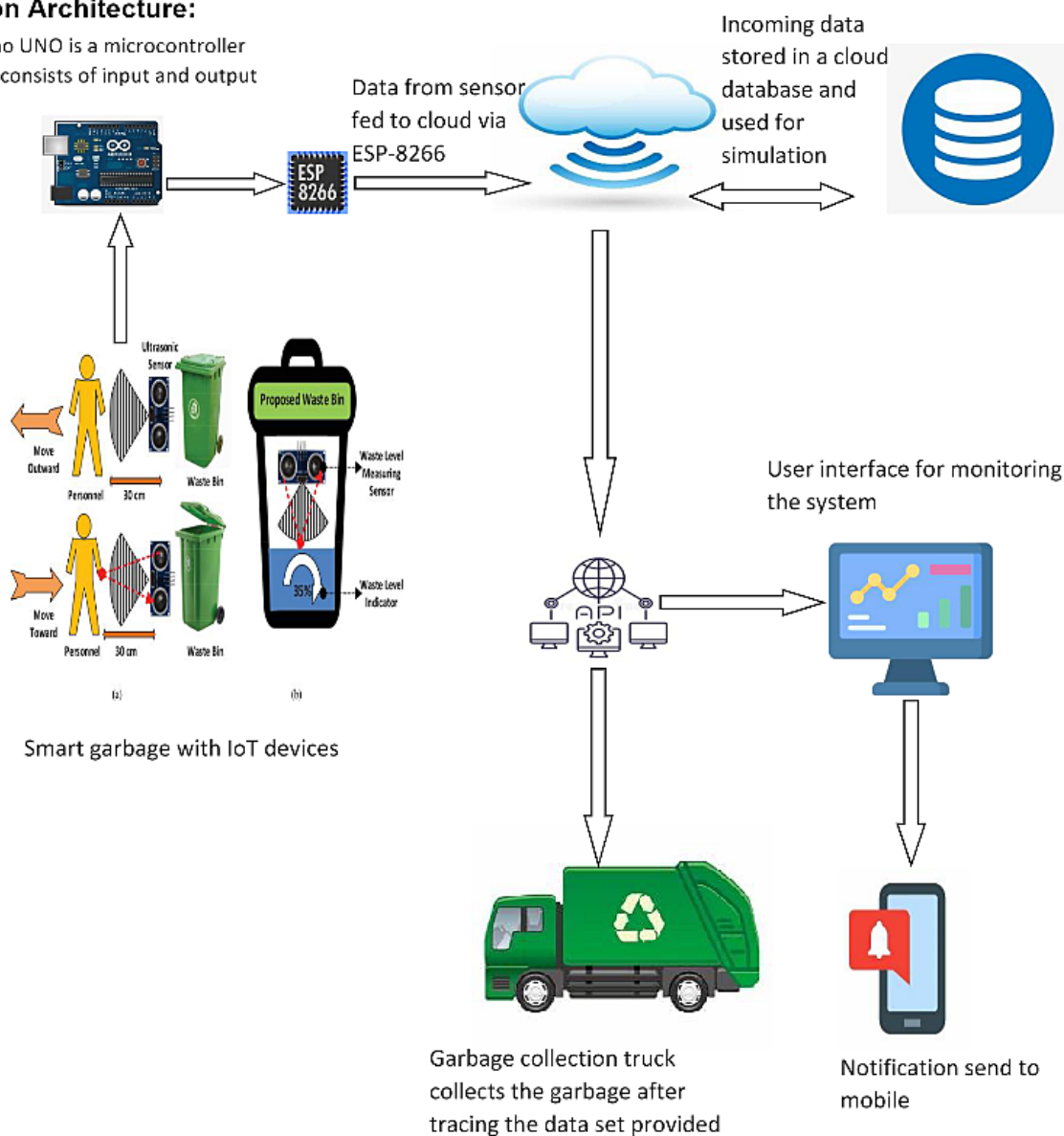
### 5.1 Data Flow Diagrams



### 5.2 Solution & Technical Architecture

### Solution Architecture:

Aurdino UNO is a microcontroller which consists of input and output pins



**Table-1 : Components & Technologies:**

S.No	Component	Description	Technology
1.	User Interface	The user interacts with application with Web UI	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	To trace the truck, to locate the bin and to show the trash level in the bin (i.e) the data from the	Java / Python

		ultrasonic sensor and alert through the mobile application	
3.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
4.	Cloud Database	Database Service on Cloud	IBM Cloudant etc.
5.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
6.	Ultrasonic sensor	Monitors the trash level in bin	Distance recognition model
7.	External API-1	API is used to fetch the data of the trash bin	API
8.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Local host Cloud Server Configuration : IBM cloud	Local, Cloud Foundry, Kubernetes, etc.

**Table-2: Application Characteristics:**

S. No	Characteristics	Description	Technology
1.	Open-Source Frameworks	NodeRed, Python, IBM simulator	Python
2.	Security Implementations	Request authentication using Encryptions and Firewall for network security to secure the data of the user.	Encryptions and decryptions
3.	Scalable Architecture	Scalability consists of 3 tier architecture	Database server: IBM cloud. IBM Kubernetes provide

			better accuracy. Web Server: HTML, CSS, Javascript Application server: Python
4	Availability	Available for all cloud users and Municipality department of the city. They can access through mobile application	IBM cloud hosting, Android or iOS
5	Performance	Performance can be increased by Analysing data and through machine learning	Machine learning

### 5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Admin (who manages web server)	Login	USN-1	As an admin, I gave user ID and password for every worker and manage them.	I can manage my account / dashboard	High	Sprint-1
Co admin	Login	USN-2	As a co admin, I will manage garbage level monitor. If garbage get filled I will send alert and will post location and garbage ID to trash truck.	I can manage monitoring	High	Sprint-1
Truck driver	Login	USN-3	As a Truck driver, I will follow the route sent by co admin to reach the filled garbage.	I can drive to reach the garbage filled route in shortest route given	Medium	Sprint-2
Local garbage collector	Login	USN-4	As a Waste collector, I will collect all the trash from garbage and load into	I can collect trash and load it to truck and	Medium	Sprint-2



			garbage truck and send them to landfill.	send off		
Municipality	Login	USN-5	As a Municipality, I will check the process if they are happening in disciplined manner without any issues.	I can manage all these process if going good	High	Sprint-1

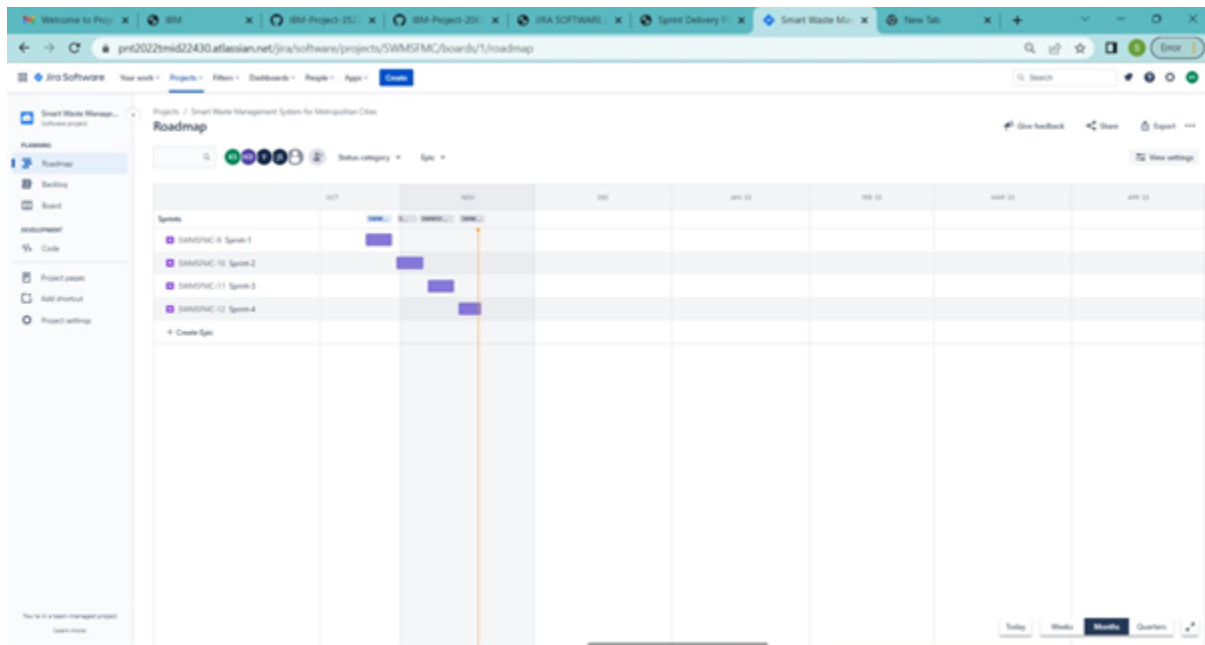
## 6. PROJECT PLANNING & SCHEDULING

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration (User)	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	5	High	Jayasri S
Sprint-1	Registration (User)	USN-2	As a user, I will receive confirmation email once I have registered for the application	5	Low	Yogarani S
Sprint-1	Admin Registration	USN-3	As a admin (Municipality worker- truck driver), I can register by entering name and email	5	High	Kotteshwari and Sai Sharanya
Sprint-1	Login	USN-4	As a user, I can log into the application by entering email & password	5	High	Kalyana sundari
Sprint-2	Dashboard	USN-5	As a user, I can explore the features in the dashboard.	20	High	Jayasri, Yogarani and Kalyana sundari
Sprint-3	Cloud registration	USN-6	As a admin I will create a cloud account to store the details of the bin	10	High	Kotteshwari
Sprint-3	Monitoring	USN-7	Collect the details of bin and save in cloud	10	Medium	Sai Sharanya
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members

		er				
Sprint-4	Testing	USN-8	Perform User acceptance testing and collect feedback and improvements needed in the project	20	High	Jayasri, Yogarani, Kalyana sundari, Kotteshwari and Sai Sharanya

The screenshot displays the Jira Software interface for a project named 'Smart Waste Management System for Metropolitan Cities'. The 'Backlog' view is active, showing a list of issues organized into sprints. The left sidebar contains navigation options like 'Smart Waste Manage...', 'PLANNING', 'Roadmap', 'Backlog', 'Board', 'Development', 'Code', 'Project pages', 'Add shortcut', and 'Project settings'. The main area shows four sprints:

- SWMSFMC Sprint 1** (24 Oct - 29 Oct, 4 issues): Marked as 'Complete sprint'. Issues include:
  - SWMSFMC-43: As a user, I can register for the application by entering my email, password, and confirming my password.
  - SWMSFMC-44: As a user, I will receive confirmation email once I have registered for the application.
  - SWMSFMC-45: As a admin (Municipality worker- truck driver), I can register by entering name and email.
  - SWMSFMC-46: As a user, I can log into the application by entering email & password.
- SWMSFMC Sprint 2** (31 Oct - 5 Nov, 1 issue): Issues include:
  - SWMSFMC-47: As a user, I can explore the features in the dashboard.
- SWMSFMC Sprint 3** (7 Nov - 12 Nov, 2 issues): Issues include:
  - SWMSFMC-48: As a admin I will create a cloud account to store the details of the bin.
  - SWMSFMC-49: Collect the details of bin and save in cloud.
- SWMSFMC Sprint 4** (14 Nov - 19 Nov, 1 issue): Issues include:
  - SWMSFMC-50: Perform User acceptance testing and collect feedback and improvements needed in the project.



## 7. CODING & SOLUTIONING

```
import time
```

```
import sys
```

```
import ibmiotf.application
```

```
import ibmiotf.device
```

```
import random
```

```
#Provide your IBM Watson Device Credentials
```

```
organization = "32ws5h"
```

```
deviceType = "Ultrasonic_sensor"
```

```
deviceId = "554517"
```

```
authMethod = "token"
```

```
authToken = "12345678"
```

```
# Initialize GPIO
```

```
def myCommandCallback(cmd):
```

```
    print("Message received from IBM IOT Platform : %s" % cmd.data['ALERT'])
```

```
    status=cmd.data['ALERT']
```

```
    if status=="BIN FULL":
```

```
        print ("ALERT!! BIN IS FULL")
```

```

else status=="NORMAL LEVEL":
    print ("BIN IS IN NORMAL LEVEL")

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()

deviceCli.connect()

#SENSOR DATA

binlevel=0
binweight=0
while True:

    #Get Sensor Data from Ultrasonic sensor

    binlevel=binlevel+random.randint(90,110)
    binweight=binweight+random.randint(60,100)
    data = { 'binlevel' : binlevel, 'binweight': binweight }

    def myOnPublishCallback():
        print ("Published binlevel = %s %" % Garbage_level, "binweight = %s %" % binweight,
"to IBM Watson")

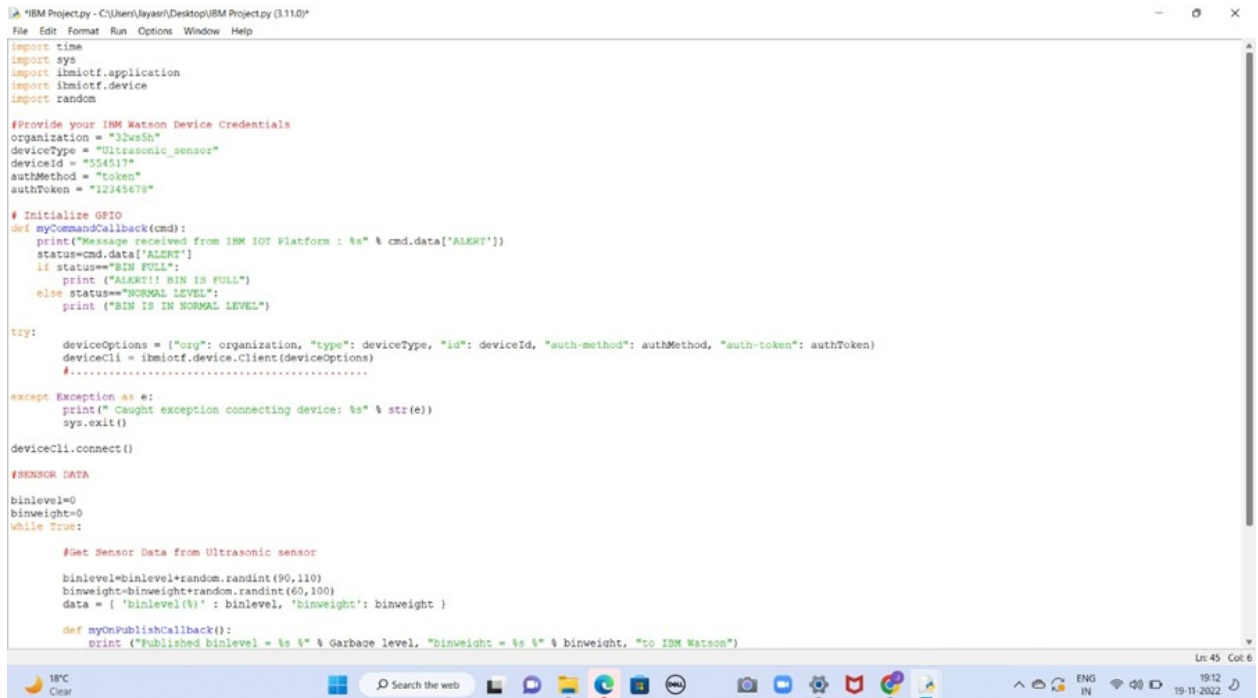
    success = deviceCli.publishEvent("Ultrasonic_sensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
    if not success:
        print("Not connected to IoT")
        time.sleep(10)

```

```
deviceCli.commandCallback = myCommandCallback
```

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

```
deviceCli.disconnect()
```



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

#Provide your IBM Watson Device Credentials
organization = "32w5h"
deviceType = "Ultrasonic_sensor"
deviceId = "554517"
authMethod = "token"
authToken = "12345678"

# Initialize GPIO
def myCommandCallback(cmd):
    print("Message received from IBM IOT Platform : %s" % cmd.data['ALERT'])
    status=cmd.data['ALERT']
    if status=="BIN FULL":
        print ("ALERT!! BIN IS FULL")
    else status=="NORMAL LEVEL":
        print ("BIN IS IN NORMAL LEVEL")

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()

deviceCli.connect()

#SENSOR DATA
binlevel=0
binweight=0
while True:

    #Get Sensor Data from Ultrasonic sensor
    binlevel=binlevel+random.randint(90,110)
    binweight=binweight+random.randint(60,100)
    data = { 'binlevel': binlevel, 'binweight': binweight }

    def myOnPublishCallback():
        print ("Published binlevel = %s %s" % Garbage level, "binweight = %s %s" % binweight, "to IBM Watson")
```

```

IBM Project.py - C:\Users\Jayasri\Desktop\IBM Project.py (3.11.0)
File Edit Format Run Options Window Help

authToken = "12345678"

# Initialize GPIO
def myCommandCallback(cmd):
    print("Message received from IBM IOT Platform : %s" % cmd.data['ALERT'])
    status=cmd.data['ALERT']
    if status=="BIN FULL":
        print ("ALERT!! BIN IS FULL")
    else status=="NORMAL LEVEL":
        print ("BIN IS IN NORMAL LEVEL")

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()

deviceCli.connect()

#SENSOR DATA
binlevel=0
binweight=0
while True:

    #Get Sensor Data from Ultrasonic sensor
    binlevel=binlevel+random.randint(90,110)
    binweight=binweight+random.randint(60,100)
    data = { 'binlevel':binlevel, 'binweight': binweight }

    def myOnPublishCallback():
        print ("Published binlevel = %s %s" % Garbage_level, "binweight")
    success = deviceCli.publishEvent("Ultrasonic_sensor", "json", data, qos=0, on_publish=myOnPublishCallback)
    if not success:
        print("Not connected to IoT")
        time.sleep(10)

    deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud
deviceCli.disconnect()

```

```

IDLE Shell 3.11.0
File Edit Shell Debug Options Window Help
Python 3.11.0 (main, Oct 24 2022, 18:26:48) [MSC v.1933 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: C:\Users\Jayasri\Desktop\IBM Project 1.py =====
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
ALERT!! BIN IS FULL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL
BIN IS IN NORMAL LEVEL

```

## 8.TESTING

TEST CASE ID	FEATU RE TYPE	COMPON ENT	TEST SCENARIO	PRERE QUISITE	STEPS TO EXECUTE	TEST DATA	EXPECTED RESULT	ACTUAL RESULT	STAT US	COMMENTS
LOG IN PAGE _TC_ 001	FUNCTI ONAL	HOME PAGE	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SIGN UP WEN USER CLICK ON MY ACCOUNT BUTTON		1. ENTER URL AND CLICK GO 2. VERIFY LOGIN/SIGN UP	https://169.51.204.219.30106	L0gin page is visible	Working as expected	PASS	Successful
LOG IN PAGE _TC_ 002	UI	HOME PAGE	VERIFY THE USER IS ABLE TO SEE THE LOGIN/SIGN UP WEN USER CLICK ON MY		1. ENTER URL AND CLICK GO 2. VERIFY LOGIN/SIGN UP	https://169.51.204.219.30106	Application should show below UI element	Working as expected	PASS	Successful

			ACCOUNT BUTTON		Elements a.ID text box B. password text box c..login button D.new user E.already have an account					
LOG IN PAGE _TC_ 003	FUNCTI ONAL	LOGIN PAGE	VERIFY THE USER IS ABLE TO SEE  THE LOGIN/SIGN UP WEN USER  CLICK ON MY ACCOUNT BUTTON		1.enter url and  click go  2.click on my  account  3.Enter valid ID 4.Enter valid password 5.click on login button	Id:1111  password:56 78	User should  navigate your  home page.	Working as  expected	PASS	Successful
LOG IN PAGE _TC_ 004	FUNCTI ONAL	LOGIN PAGE	VERIFY THE USER IS ABLE TO SEE  THE LOGIN/SIGN UP WEN USER  CLICK ON MY ACCOUNT BUTTON		1.enter url and  click go  2.click on my  account  3.Enter valid ID 4.Enter valid password 5.click on login butvton	Id:1111  password:56 78	Confirmation  message sent	Working as  expected	PASS	Successful
LOG IN PAGE _TC_ 005	UI	LOGIN PAGE	VERIFY THE USER IS ABLE TO SEE  THE LOGIN/SIGN UP WEN USER  CLICK ON MY ACCOUNT BUTTON		1.enter url and click go 2.click on my account 3.Enter valid ID 4.Enter valid password 5.click on login button	Id:1111 password:56 78	Confirmation message sent	Working as expected	PASS	Successful

## 8.1 User Acceptance Testing

### UAT Execution & Report Submission

#### Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

#### Defect Analysis

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	Subtotal
By Design	12	6	4	3	25
Duplicate	1	0	2	0	3
External	3	2	0	1	6
Fixed	13	4	3	18	38
Not Reproduced	0	0	1	0	1
Skipped	0	1	0	1	2
Won't Fix	0	4	2	1	7
Totals	29	17	12	24	82

## 8.2 Test Case Analysis

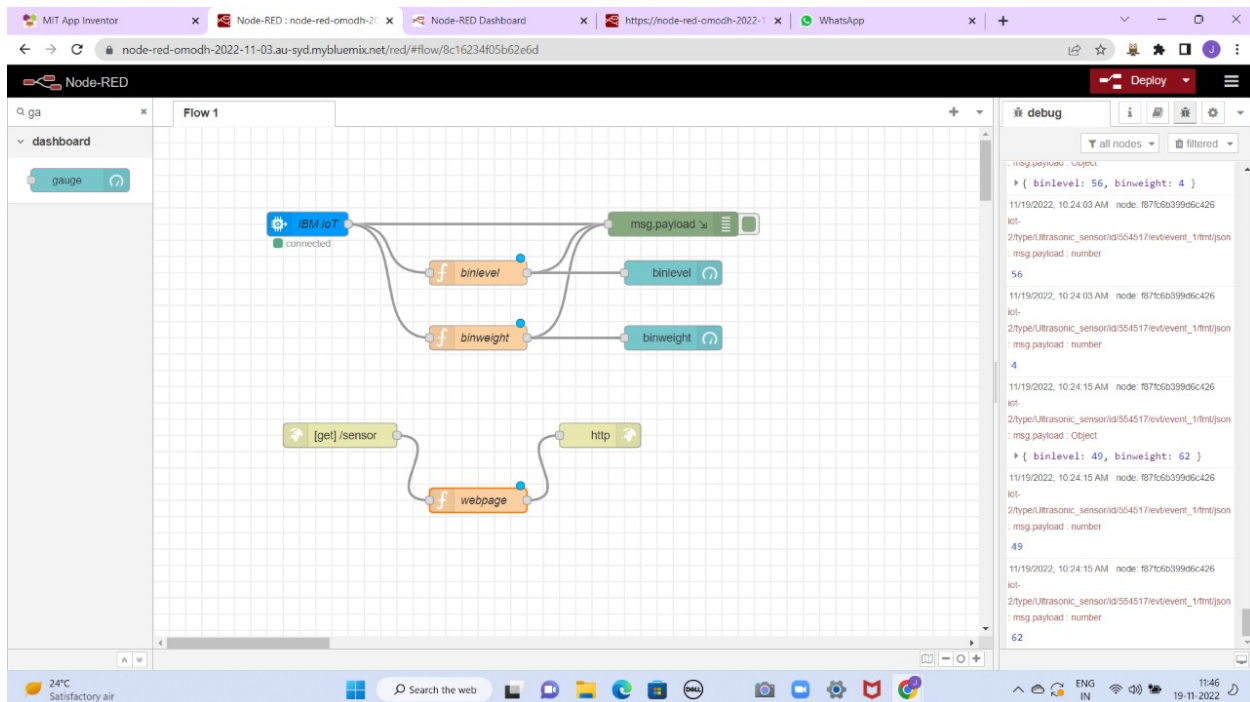
This report shows the number of test cases that have passed, failed, and untested

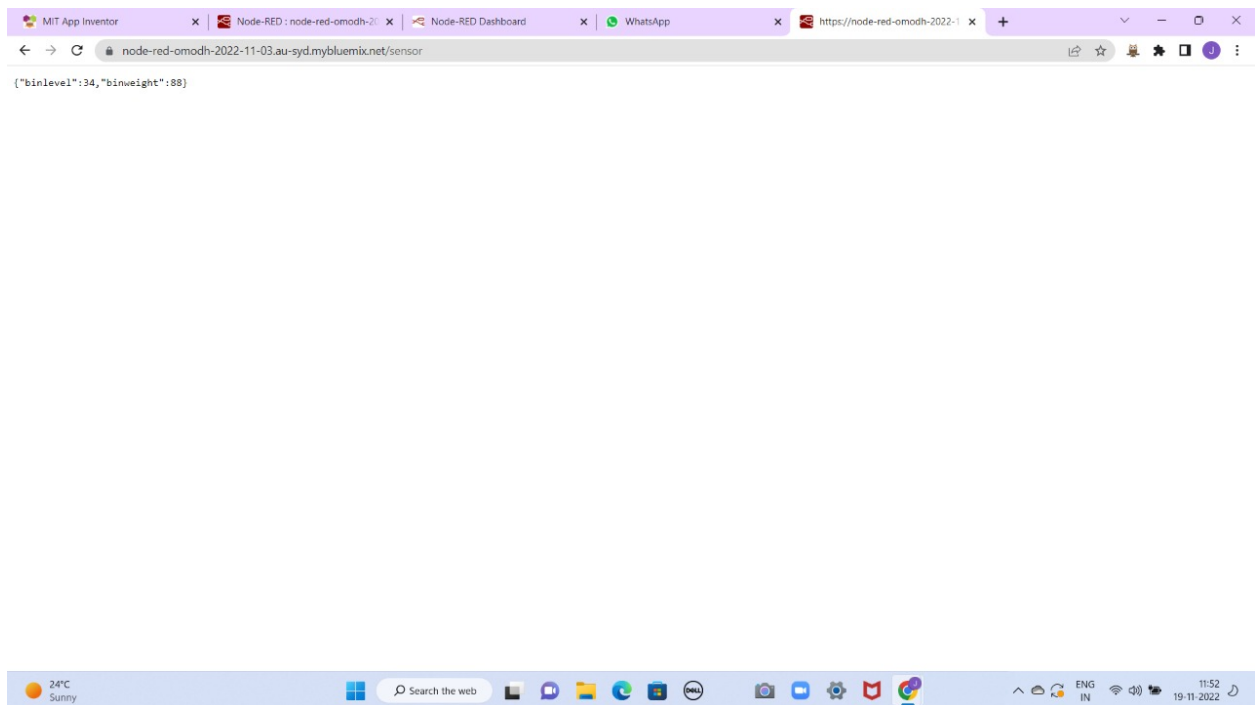
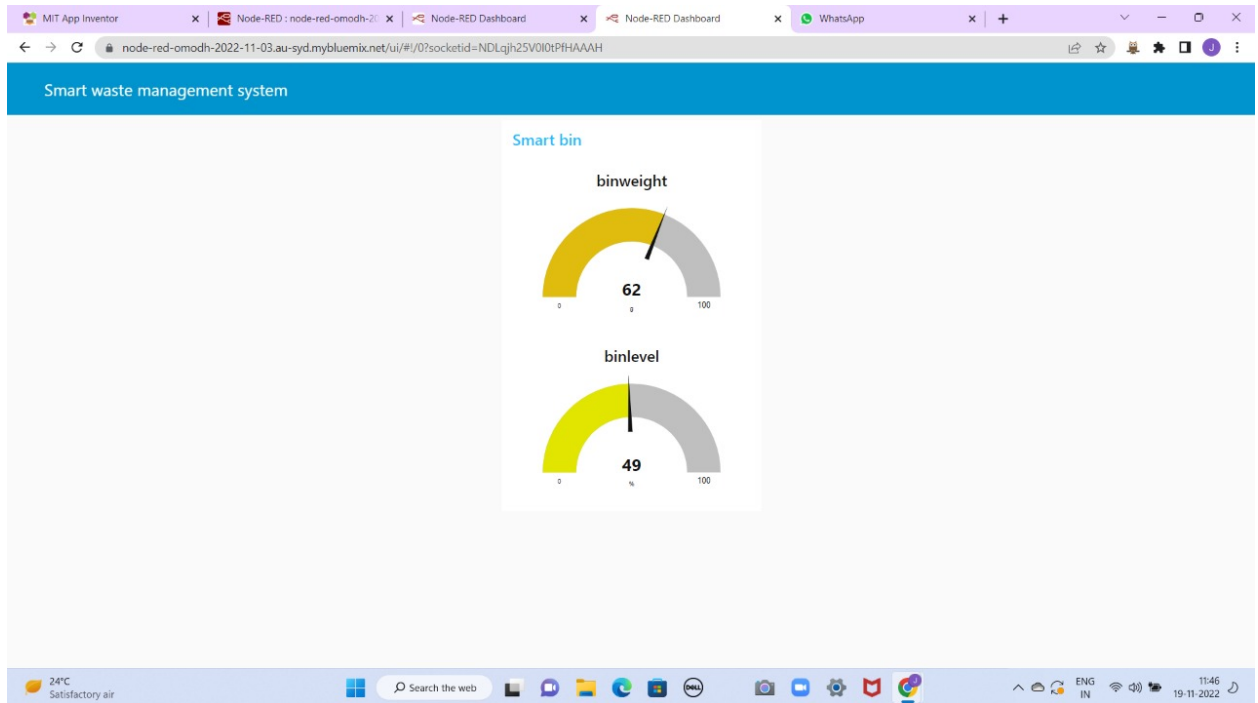
Section	Total Cases	Not Tested	Fail	Pass
Print Engine	6	0	0	6
Client Application	48	0	0	48
Security	2	0	0	2



Outsource Shipping	2	0	0	2
Exception Reporting	7	0	0	7
Final Report Output	3	0	0	3
Version Control	1	0	0	1

## 9. RESULTS





## 10. ADVANTAGES & DISADVANTAGES

### ADVANTAGES

- Practice is highly lucrative.
- Keeps the environment clean and fresh.
- Saves the earth and conserves energy.
- Reduces environmental pollution.
- Waste management will help to earn money.
- Create more employments.

### DISADVANTAGES

- The process is not always cost-effective.
- The resultant product has a short life.
- The sites are often dangerous.
- The practices are not done uniformly.
- Waste management can cause more problems.

## 11. Conclusion

In this project, we have implemented the Smart bin. The bin level is monitored using Ultrasonic sensor and if the bin level exceeds a particular level we get alert. The application for smart waste management system, created using MIT app inventor displays the output from the IBM IOT platform using node-red

## 12. Future Scope

Smart waste management is important as the waste generation increases day by day. This project can be enhanced by segregation the waste as wet, dry, metallic and green waste so that disposal of these waste becomes easier. There can be automatic lid opening mechanism in this project to enhance the ambience of the environment.

## 13. APPENDIX

### Esp8266 - Microcontroller :

ESP8266 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth

**Memory:** 320 KB SRAM

**CPU:** Tensilica Xtensa LX6 microprocessor @ 160 or 240 MHz

**Power:** 3.3 V DC

**Manufacturer:** Espressif Systems

**Predecessor:** ESP8266

**Sensors :** Ultrasonic sensor

Ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception

### 13.1: SOURCE CODE - Wokwi Code

```
#include <WiFi.h> //library for wifi
#include <PubSubClient.h> //library for MQTT
#define SOUND_SPEED 0.034 //define sound speed in cm/uS
#define LED 13
const int trigPin = 12;
const int echoPin = 14;

void callback(char* subscribetopic, byte* payload, unsigned int
payloadLength);

//-----credentials of IBM Accounts-----

#define ORG "32ws5h"
#define DEVICE_TYPE "Ultrasonic_sensor"
#define DEVICE_ID "554517"
#define TOKEN "12345678"
String data3;
float d;
long duration;

//----- Customise the above values -----
char server[] = ORG ".messaging.internetofthings.ibmcloud.com"; // Server
Name
```

```

char publishTopic[] = "iot-2/evt/Data/fmt/json";// topic name and type of
event perform and format in which data to be send
char subscribetopic[] = "iot-2/cmd/command/fmt/String";// cmd REPRESENT
command type AND COMMAND IS TEST OF FORMAT STRING
char authMethod[] = "use-token-auth";// authentication method
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;//client id

//-----
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the
predefined client id by passing parameter like server id,portand
wificredential

void setup()// configureing the ESP32
{
    Serial.begin(115200); // Starts the serial communication
    pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
    pinMode(echoPin, INPUT); // Sets the echoPin as an Input
    pinMode(LED,OUTPUT);
    delay(10);
    Serial.println();
    wificonnect();
    mqttconnect();
}

void loop()// Recursive Function
{

    digitalWrite(trigPin, LOW);
    delayMicroseconds(2);
    // Sets the trigPin on HIGH state for 10 micro seconds
    digitalWrite(trigPin, HIGH);

```

```

delayMicroseconds(10);
digitalWrite(trigPin, LOW);

// Reads the echoPin, returns the sound wave travel time in microseconds
duration = pulseIn(echoPin, HIGH);

// Calculate the distance
d = duration * SOUND_SPEED/2;
if (d<100)
{
    Serial.print("Alert distance:");
    Serial.println(d);
}

if(d<100)
{
    PublishData(d);
}

delay(1000);
if (!client.loop()) {
    mqttconnect();
}
}

/*.....retrieving to
Cloud.....*/
void PublishData(float d) {
    mqttconnect();//function call for connecting to ibm
    /*
        creating the String in in form JSON to update the data to ibm cloud
    */
    String payload = "{\"Alert\":\"";
    payload += d;
    payload += "\"}";
}

```

```

    Serial.print("Sending payload: ");
    Serial.println(payload);

    if (client.publish(publishTopic, (char*) payload.c_str())) {
        Serial.println("Publish ok");// if it sucessfully upload data on the
cloud then it will print publish ok in Serial monitor or else it will
print publish failed
    } else {
        Serial.println("Publish failed");
    }
}

void mqttconnect() {
    if (!client.connected()) {
        Serial.print("Reconnecting client to ");
        Serial.println(server);
        while (!!!client.connect(clientId, authMethod, token)) {
            Serial.print(".");
            delay(500);
        }

        initManagedDevice();
        Serial.println();
    }
}

void wificonnect() //function defination for wificonnect
{
    Serial.println();
    Serial.print("Connecting to ");

    WiFi.begin("Wokwi-GUEST", "", 6);//passing the wifi credentials to
establish the connection
    while (WiFi.status() != WL_CONNECTED) {
        delay(500);
    }
}

```

```

        Serial.print(".");
    }

    Serial.println("");
    Serial.println("WiFi connected");
    Serial.println("IP address: ");
    Serial.println(WiFi.localIP());
}

void initManagedDevice() {
    if (client.subscribe(subscribetopic)) {
        Serial.println((subscribetopic));
        Serial.println("subscribe to cmd OK");
    } else {
        Serial.println("subscribe to cmd FAILED");
    }
}

void callback(char* subscribetopic, byte* payload, unsigned int
payloadLength)
{
    Serial.print("callback invoked for topic: ");
    Serial.println(subscribetopic);
    for (int i = 0; i < payloadLength; i++) {
        //Serial.print((char)payload[i]);
        data3 += (char)payload[i];
    }

    Serial.println("data: "+ data3);
    if(data3=="lighton")
    {
        Serial.println(data3);
        digitalWrite(LED, HIGH);
    }
    else
    {

```



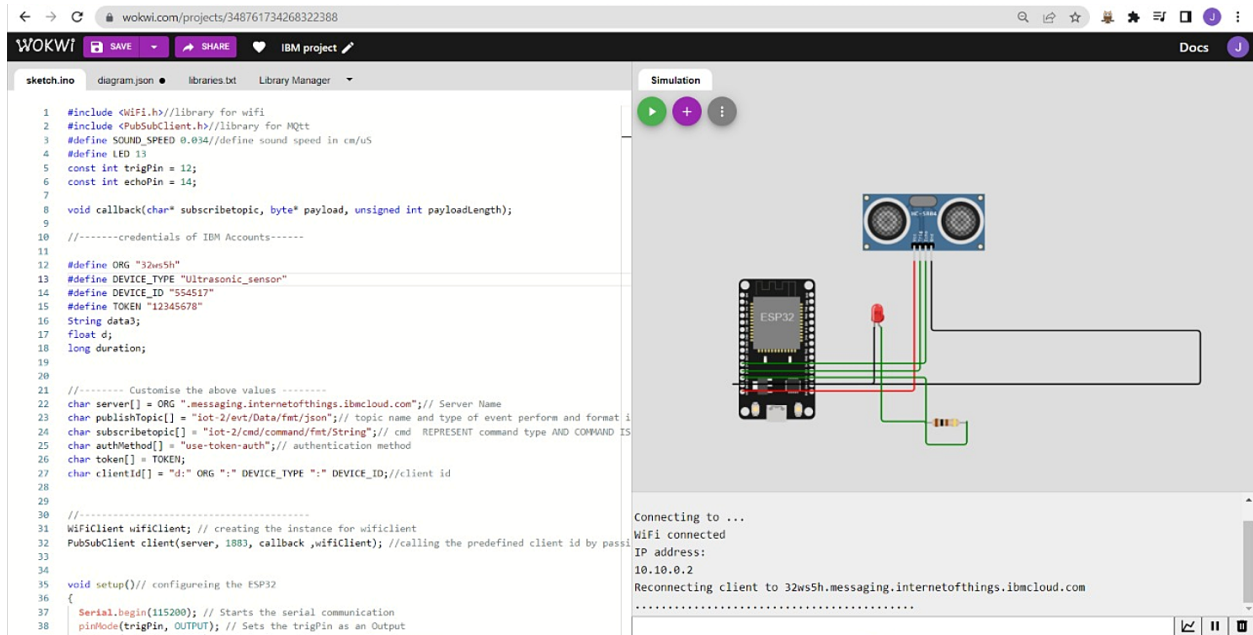
```

Serial.println(data3);
digitalWrite(LED, LOW);

}

data3=" ";
}

```



## 13.2: GITHUB & DEMO VIDEO LINK

### GITHUB LINK:

<https://github.com/IBM-EPBL/IBM-Project-20671-1659760138>

### DEMO VIDEO LINK:

<https://youtu.be/fahMhgVetm8>

VEL TECH MULTI TECH DR.RANGARAJAN  
DR.SAKUNTHALA ENGINEERING COLLEGE

SMART WASTE MANAGEMENT SYSTEM FOR  
METROPOLITAN CITIES

TEAM ID PNT2022TMID22430

PRESENTED BY:

JAYASRI .S

TEAM MEMBERS:

KALYANA SUNDARI .V

KOTTESHWARI .D

KETHIRENII SAI SHARANYA

YUGAKRISHNA .S

KAPWING