
SMART WASTE MANAGEMENT FOR METROPOTIAN CITIES DOMAIN – INTERNET OF THINGS

PROJECT REPORT

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In the partial fulfillment of the requirements for the award of a degree of BACHELOR OF ENGINEERING
in COMPUTER SCIENCE OF ENGINEERING

JEPPIAAR INSTITUTE OF TECHNOLOGY

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Solid waste management is faced with a number of issues which include lack of throughput, inadequate solid waste data, efficiency problem, delays in collection and resistance to new technologies. Presently, waste management is a

Smart waste management in metropolitan cities

1.INTRODUCTION

The rate at which solid wastes are produced in most developing countries is becoming alarming. This increase may be due to recent population growth and rural-urban mi-gration . Garbage is made up of non-renewable resources used daily to meet our needs then throw away. As increase in consumption of paper, clothing, bottles, and product packaging increases, the generation of garbage also increases significantly. The form and type of solid waste depends on a number of factors which include the living standard and life style of the inhabitants of the region and the natural resources

found in the region. There are two categories of Urban waste namely, organic and inorganic. The organic waste category can be further categorized into three units: non-fermentable, fermentable and putrescible. The Putrescible wastes tend to decay faster, and if not cautiously managed, decomposition can lead to an offensive odour with an unpleasant view. Fermentable waste which also tends to decompose rapidly do so without the accompanying of offensive odour. Non-fermentable waste most times do not decompose or do so at a very slow rate. Unless organic waste is managed appropriately, the stricken negative effect it has will continue until full decomposition or stabilization occurs.

Decomposed products which are poorly managed or uncontrolled can and often times lead to contamination of air, water and soil resources .

One of the challenges a developing country faces due to rapid increase population is proper solid waste management. A typical example is the garbage bins seen around which appear overfull to the point of spilling out, leading to environmental pollution. The effect of this is increase in the number of diseases because it gives room for insects to breed. Solid waste requires systematic management the content, origin or hazard potential notwithstanding as this will ensure environmental best practices and living standard. Because solid waste management forms a very critical aspect of our environmental hygiene, it is therefore necessary to incorporate it into environmental planning.

1.1.PROJECT OVERVIEW

major problem for authorities who are responsible for such task because it's a costly service and it hugely impacts the environment as a whole. This study introduced a smart waste monitoring system that uses several sensors and communication technologies to achieve the set task. The proposed system was achieved through the development of theoretical model layout and decision-making algorithms in the course of the project.

An intelligent smart waste management system is developed using cloud computing technology. This project is developed in order to take actions before the over flowing of containers.

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.

1.2.PURPOSE

The purpose of smart waste management system is to make the citymove livable and productive for its residents and to solve issues related to public administration ,environment and healthcare.

This customized and dynamic system for waste management ca allow business, organization, and citizens to all benefit.

*Time saving

*Cost saving

*Sustainability

*Improving efficiency

*Transparency

2.LITERATUTRE SURVEY

During this literature survey, research papers related with Garbage Monitoring are studied. The papers are published during last two years - 2016 and 2017 are taken. Most of these papers focus only on functionality of Garbage Monitoring and these papers are discussed in the first section of literature survey. Only two papers include additional functionalities such as Garbage Compression and

Location Tracking along with Garbage Monitoring as a main function, and these

pers are discussed in second section of literature survey.

In the first paper, the garbage containers are interfaced with a microcontroller - Advanced RISC Machines (ARM) 7 having Infra Red (IR)sensors along with central system showing filled up-level of garbage, on mobile web browser with html page through WiFi communication . Hence, the level status is updated on to the html page, but it doesn't inform about real-time location of containers. In the second paper, The garbage containers are again interfaced with a microcontroller - ARM7 having ultrasonic sensors along with the system sending an alert text message through Short Message Service (SMS) on Global System for Mobile Communications (GSM) technology. This message is directed to the truck drivers about availability of filled containers for garbage collection garbage through Ubidots . In the next paper, related system interfacedwith Peripheral Interface Controller (PIC) microcontroller is used to send an alert text message about filled up-level of garbage through Zigbee technology.

2.1.EXISTING PROBLEM

The existing problem of smart waste management system is Lack of awareness about segregation of waste and waste management rules. Habitof open dumping in streets leads to various disadvantages . No strict rules that penalize non-segregation. Availability of collectors who don't refuse mixed waste leads people to be unaware of environment and healthcare.

2.2.REFERENCES

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Maher Arebey,
M A Hannan, Hassan Basri, R A Begum and Huda Abdullah

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Bashir, Shoaib Amin Banday Ab. Rouf Khan, Mohammad Shafi

11. Smart Garbage Management System Vikrant Bhor¹, Pankaj
Morajkar², Maheshwar
Gurav³, Dishant Pandya⁴

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Ogies

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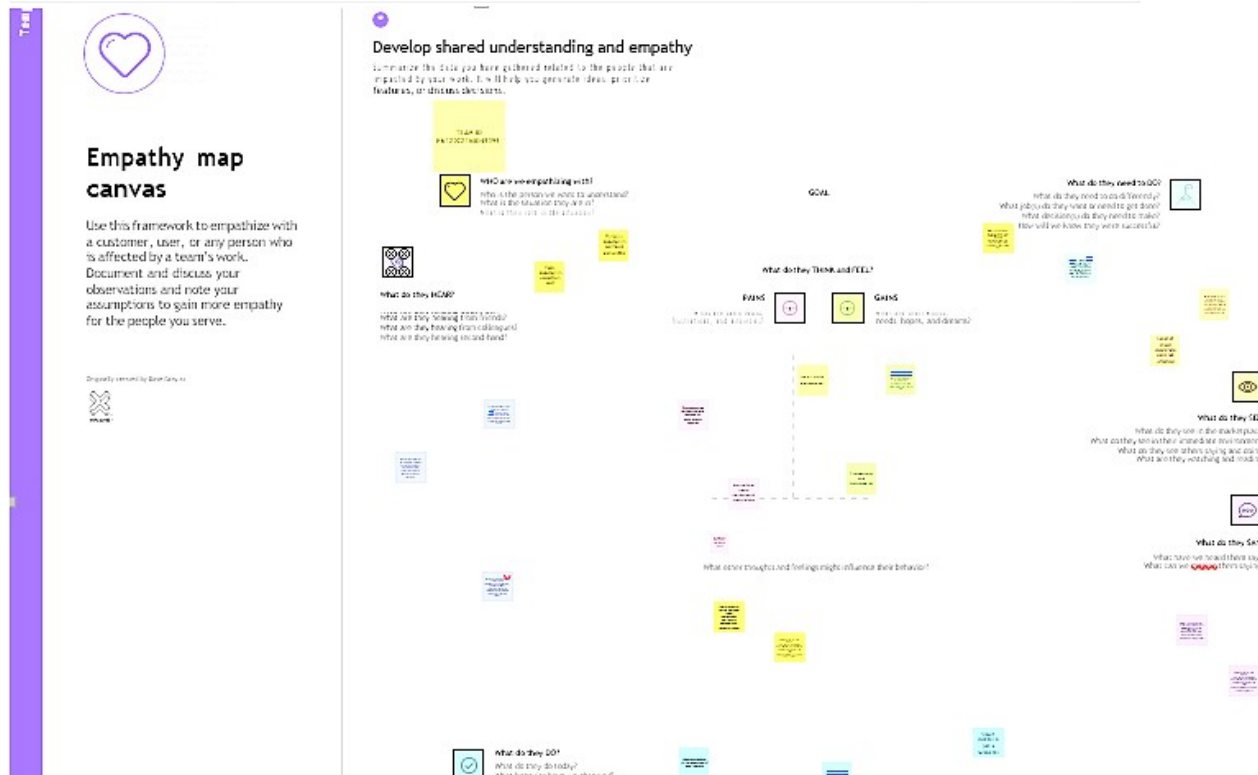
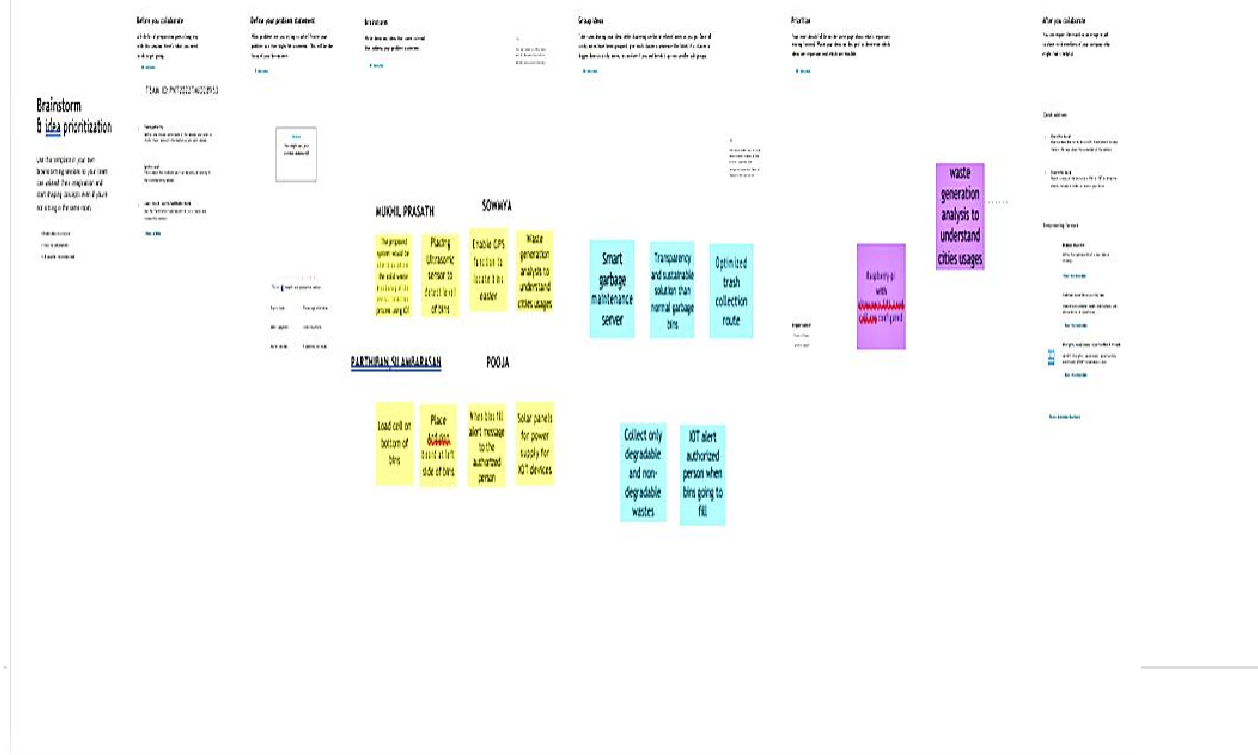
2.3.PROBLEM STATEMENT DEFINITION

the main problem facing the proper management of MSW in many developing countries are the lack of adequate administrative and financial resources. There is no clear reliable framework by which the solid waste sector is administered from the collection, transformation to disposing or treatment phases. Due to rapid increase in population and environmental development the solid waste management becomes the major issue in cities

The limited revenues earmarked for the municipalities make them ill-equipped to provide for high costs involved in the collection, storage, treatment and disposal of wastes.

3. IDEATION AND PROPOSED SOLUTION

3.1.EMPATHY MAP CANVAS



IDEATION AND BRAINSTORMING

3. PROPOSED SOLUTION

Project Design Phase -1

Proposed Solution

Template

Date	24 September 2022
Team ID	IBM-Project-PNT2022TMID28956
Project Name	Smart Waste Management System For Metropolitan Cities
Maximum Marks	2 Marks

Proposed Solution Template :

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	This project enables the organizations to meet their needs of smart garbage management systems. This system allows the authorized 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	<p>The key research objectives are as follows:</p> <ul style="list-style-type: none"> • 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
----	-----------------------------------	--

		<p>receiver at the desired place in the area or spot.</p> <ul style="list-style-type: none"> • In the proposed system, the received signal indicates the waste bin status at monitoring control system.
3.	Novelty / Uniqueness	<p>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.</p>
4.	Social Impact / Customer Satisfaction	<p>From the public perception as worst impacts of present solid waste disposal practices are seen direct social impacts such as neighborhood of landfills to communities, breeding of pests and in property values.</p>
9	Page	

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.

5.	Business Model (Revenue Model)	Waste Management organizes 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-to energy facilities in the INDIA, and its recycling brokerage services, as well as various corporate function.
6.	Scalability of the Solution	The proposed system uses sensor and communication

4. PROBLEM SOLUTION FIT

STEP 1

Problem Solving Cards

-Basic Questions

#Problem Statement

- 1.What's most valuable to the customer?
- 2.What are we at?
- 3.Where are we looking to improve?

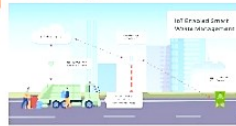


STEP 2

Framing Statements

Smart waste management system framing

How can we use our optimization skills to increase the customer's value of saving time in order to improve the waste management?



The greatest problem regarding waste management in developing countries begins at the very starting point of the process. Due to lack of proper system for disposal and collections, wastes and garbage's end up in the roads and surroundings. According to a report from Google research, the amount of waste generation in 2010 was around 20,000 ton's per day and it is estimated that by 2025 the amount will be no less than around 47000 tons per day. With the existing method of collecting and disposal it is near impossible to manage such amount of waste in the future as around 30% of waste end up on the roads and people places due to ineffective disposal and collecting methods. Not only that, there is no even systematic way for the collected garbage for treating recycling thus most of them end up in land filling and river water, making the environment unhealthier. The prime impediment of implementing smart waste management system based on IOT in a developing country is the social and economic infrastructure of the country itself. The initial stage of this system comprises of proper disposal and collection, which is the biggest challenge. In addition, to motivate and influence people to the follow proper waste disposal method is also important.

STEP 3

Ideas

Problem Solution

Example Ideas

- AI-based smart waste bin, designed for public places, enabling them to Monitor and Manage
- Reduce the number of bins required & DE-cluttering and improving the street scene

Previously there were numerous initiative on waste management and education people to dispose waste properly and as they failed to achieve significant results, we have figured out the scopes that would be develop. To solve this problem, to designed a process that ensures and proper disposal and efficient waste collection. The procedures we designed involve creative initiative that will inspire people to dump in designated area or bins and involve method by using decreasing time algorithm and or DTA for monitoring garbage generation and collection of garbage's.

4.REQUIREMENT ANALYSIS

4.1.FUNCTIONAL REQUIREMENTS

Project Design Phase-II

Solution Requirements (Functional & Non-functional)

Date	06 October 2022
Team ID	PNT2022TMID28956
Project Name	Smart Waste Management System ForMetropolitan Cities
Maximum Marks	4Marks

Functional Requirements :

Following are the functional requirements of the proposed solution.

FR 11 P NO	Functional a g e Requireme nt (Epic)	Sub Requirement (Story / Sub- Task)
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FR-1	Detailed bin inventory	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.
FR-3	Expensive bins.	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.	Based on the historical data, you can adjust bin capacity or location where necessary.

		Identify areas with either dense or sparse bin distribution.
FR-5	Eliminate inefficient picks.	Eliminate the collection of half-empty bins. The sensors recognize picks. 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.
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4.2.Non-functional Requirements:

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

FR NO.	Non-Functional Requirement	Description
<u>NF R-1</u>	<u>Usability</u>	<u>IoT device verifies that usability is a special and important perspective to analyze user requirements, which can further improve the design quality.</u> <u>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, behavior and experience.</u>

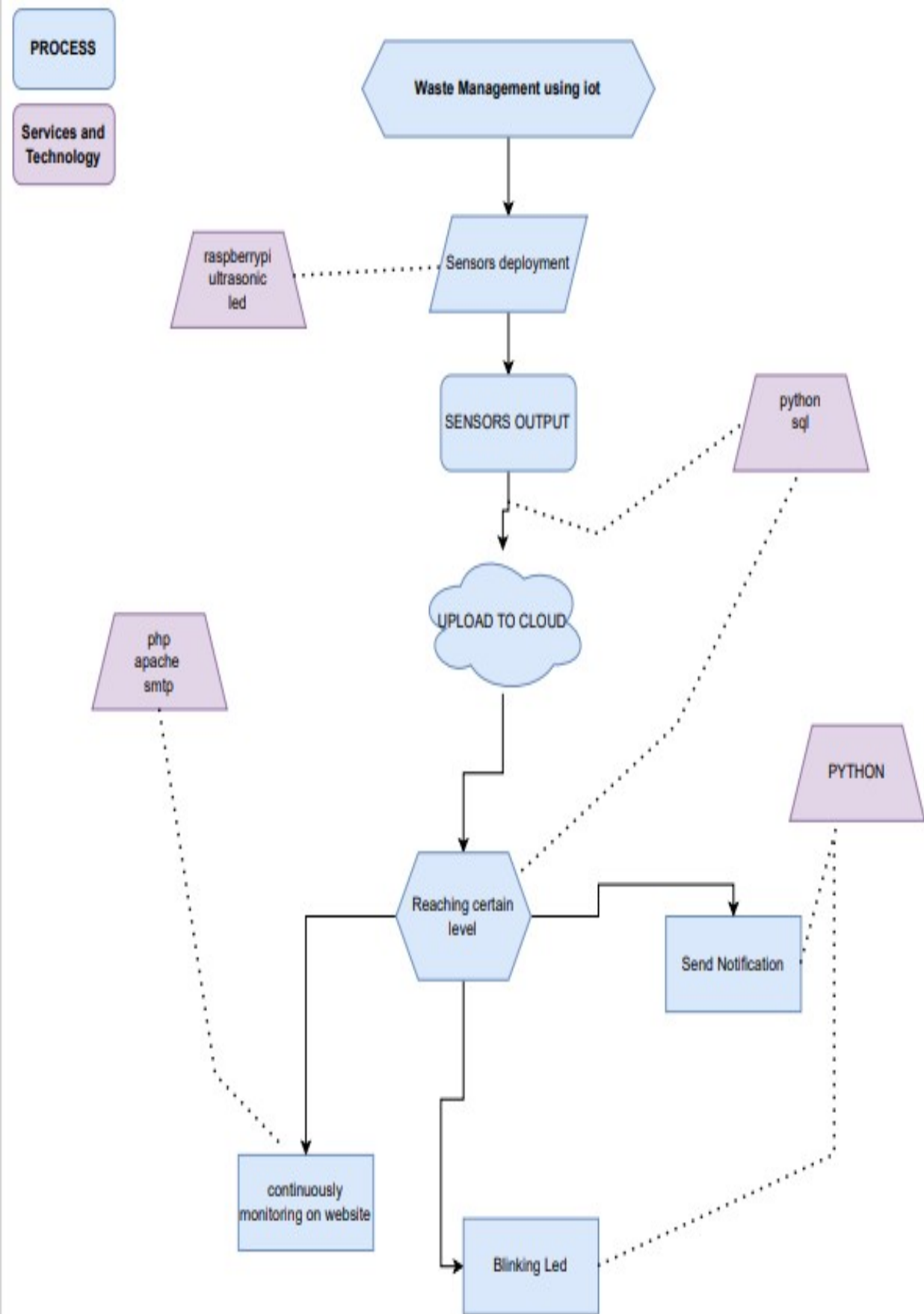
<u>NF R-2</u>	<u>Security</u>	<u>Use a reusable bottles Use reusable grocery bags</u> <u>Purchase wisely and recycle</u> <u>Avoid single use food and drink container.</u>
---------------	------------------------	--

NF R-3	Reliability	<p><u>Smart waste management is also about creating better working conditions for waste collectors and drivers.</u></p> <p><u>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.</u></p>
NF R-4	Performance	<p><u>Using a variety of IoT networks (NB-IoT, GPRS), the sensors send the data to Sensono's Smart Waste Management Software System, a powerful cloud-based platform, for data driven daily operations, available also as a waste management app.</u></p> <p><u>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%.</u></p>
NF R-5	Availability	<p><u>By developing & deploying resilient hardware and beautiful software we empower cities, businesses, and countries to manage waste smarter.</u></p>
NF R-6	Scalability	<p><u>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.</u></p>

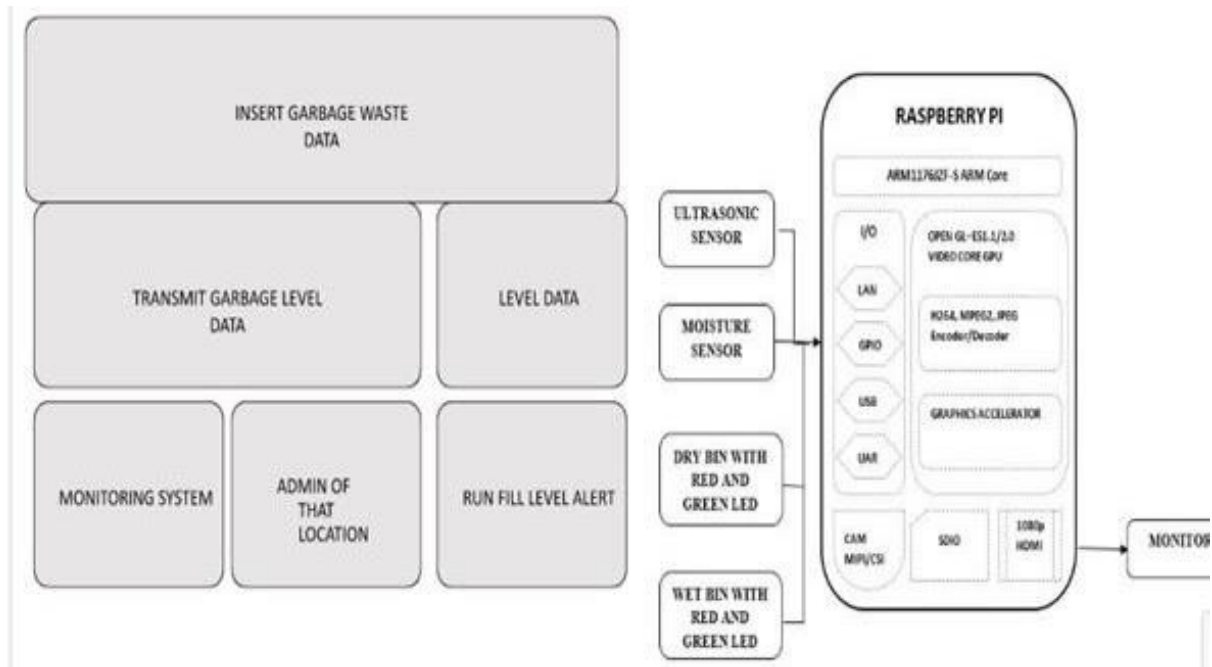
5.PROJECT DESIGN

5.1.DATA FLOW DIAGRAM

SMART WASTE MANAGEMENT SYSTEM IN METROPOLITIAN CITIES



5.2.SOLUTION & TECHNICAL ARCHITECTURE



6. PROJECT PLANNING & SCHEDULING

SPRINT1

Date	07 November 2022
Team ID	PNT2022TMID28956
Project Name	Project-Smart Waste Management System for Metropolitan Cities

CODE FOR REGISTRATION AND LOGIN CREDENTIALS:

```
<!DOCTYPE html>
```

```
<html>
```

```
<head>
```

```
<styl
```

```
e
```

```

body
{
    background-
image:url('background.jpg');
background-repeat: no-repeat;
background-attachment:
    fixed; background-size:100%
100%;
}
</style>
<base target="_top">
<script>
    function AddRow()
    {
        var usernamee =
document.getElementById("usernamee").value; var passwordd =
document.getElementById("passwordd").value;
var email = document.getElementById("email").value;        var phone
= document.getElementById("phone").value; if
(usernamee=="" || passwordd=="" || email=="" ||
phone=="") {
    return false;
}

```

```

        google.script.run.AddRecord(usernamee,passwordd,email,ph
one); document.getElementById("page2_id1").className =
"page2_id1-off";
document.getElementById("page3_id1").className = "page3_id1";

    }
}

function LoginUser()
{
    var username =
document.getElementById("username").value; var password =
document.getElementById("password").value;
google.script.run.withSuccessHandler(function(output)
{
    if(output == 'TRUE')
    {
        var url1
='http://www.google.com'; var
winRef = window.open(url1);

        winRef ? google.script.host.close() : window.onload=function(){document.getElementById('url').href =
url1;}
    }
    else if(output == 'FALSE')
    {
        document.getElementById("errorMessage").innerHTML = "Invalid data";
    }
}
}).checkLogin(username, password);

```

```

function function1(){ document.getElementById("page1_id1").className
= "page1_class1-off";      document.getElementById("page2_id1").className
= "page2_id1"; function
function3(){
document.getElementById("page3_id1").className =
"page3_id1-off";
document.getElementById("page1_id1").className =
"page1_id1";
}

```

</script>

<style>

/page1/

```

.page1_class1-
off{display: none;
}

```

/page2/

```

.page2_class1{
display:
none;
}

```

```

.page2_id1-
off{

```

```
display:n
```

```
one;
```

```
}
```

```
/page3/
```

```
.page3_class1{
```

```
display:n
```

```
one;
```

```
}
```

```
.page3_i d1-
```

```
off{ display:
```

```
none;
```

```
input[type=text]:hover{
```

```
border-bottom:2px solid black;
```

```
}
```

```
input[type=number]:hover{
```

```
border-bottom:2px solid black;
```

```
}
```

```
input[type=password]:hover{ bor
```

```
der- bottom:2px solid
```

```
black;
```

```
}
```

```
</style>
```

```

</head>

<body>

    <br><br>

<!--page1-->

<center>

    <div class="page1_class1" id="page1_id1" style="background-color:rgb(135, 207,
235);border:2px solid gray;border-radius: 20px;width: 250px;padding-top: 10px;padding-
bottom: 20px;padding-left: 20px;padding-right: 20px;">

        <h1>Login Here</h1>

        <br>

        <p>Username</p>

        <input type="text" id="username" placeholder=" Enter Username" style="outline:
none; text-align: center;font-size:0.9em ;width: 50%;font-weight:bold;" /><br><br>

        <p>Password</p>

        <input type="password" id="password" placeholder=" Enter Password" style="border-top:
none;border-right: none;border-left: none;outline: none; text-align: center;font-
size:0.9em ;width: 50%;font-weight:bold;" />

        <br><span id="errorMessage" style="color: red" ></span><br>

        <br>

        <input type="submit" value="Login" onclick="LoginUser()" style="float: centre;padding-top:
1px;padding-bottom: 1px;padding-left: 10px;padding-right: 10px;font-size: 0.9em;font-
weight:bold;"
        /><br>

        <br><br>
        <b>If you don't have an account,</b><input type="button" onClick="function1()"
value="Create New" style="margin-top: 5px;font-weight:bold;" />

    </div>

    <!--
page2-->

    <div class="page2_class1" id="page2_id1" style="background-color:rgb(135, 207,
235);border:2px solid gray;border-radius: 20px;width: 250px;padding-top: 10px;padding- bottom:
20px;padding-left: 20px;padding-right: 20px;">

        <h1>Register Here</h1>

```

```

        <input type="text" id="username" placeholder=" Enter Name" style="border-top:
none;border-right: none;border-left: none;outline: none; text-align: center;font-size:0.9em
;width: 50%;font-weight:bold;"/><br>

        <br>
        >

        <p>Password</p>

        <input type="password" id="password" placeholder="Create password" style="border-
top: none;border-right: none;border-left: none;outline: none; text-align:center;font-size:
0.9em;width: 50%;font-weight:bold;"/><br>

        <br>

        <p>Email</p>

        <input type="text" id="email" placeholder=" Enter Email" style="border-top: none;border-
right: none;border-left: none;outline: none; text-align: center;font-size:0.9em
;width: 50%;font-weight:bold;"/><br>

        <br>
        >

        <p>Phone Number</p>

        <input type="number" id="phone" placeholder="Enter number" style="border-top:
none;border-right: none;border-left: none;outline: none; text-align: center;font-size:0.9em
;width: 50%;font-weight:bold;"/><br><br>    <br><br>

        <input type="submit" value="Create" onclick="AddRow()" style="float: centre;padding-top:
1px;padding-bottom: 1px;padding-left: 10px;padding-right: 10px;font-size: 0.9em;font-
weight:bold;"/>
    />

    <br>
    >

</S>

<!--page3-->

<div class="page3_class1" id="page3_id1" style="background:none;border:2px solid
gray;border-radius: 20px;width: 250px;padding-top: 10px;padding-bottom:
20px;padding-left: 20px;padding-right: 20px;"><center>

    <h2> REGISTRATION SUCCESSFUL! Login to your account</h2>

    <input type="submit" onClick="function3()" value="Login" style="font-weight:bold;"><br>

</div>

```

</center>

</body>

</html>

SPRINT 2

Python Code

```
import time
import sys
```

```
import
```

```
ibmiotf.application
```

```
import ibmiotf.device
```

```
import random
```

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

```
Credentials.organization = "2melo1"
```

```
deviceType = "waste"
deviceId = "1234"
```

```
authMethod = "token"
authToken =
```

```
"12345678"
```

```
# Initialize GPIO
```

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

```
    print("Command received: %s" %
```

```
cmd.data['command'])
```

```
status=cmd.data['command'] if status=="waste
```

```
level":
```

```

        print ("waste level
monitored") else :
        print ("weight level monitored")

#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:

    #Get Sensor Data from DHT11

    level=random.randint(0,1
00)

    weight=random.randint(0,100)

```

```

data = { 'level' : level, 'weight':
weight } #print data

def myOnPublishCallback():

    print ("Published Level = %s %" % level, "Weight = %s %" % weight, "to IBM Watson")

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

if not success:

    print("Not    connectedto
        IoT")

time.sleep(20)

deviceCli.commandCallback = myCommandCallback

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

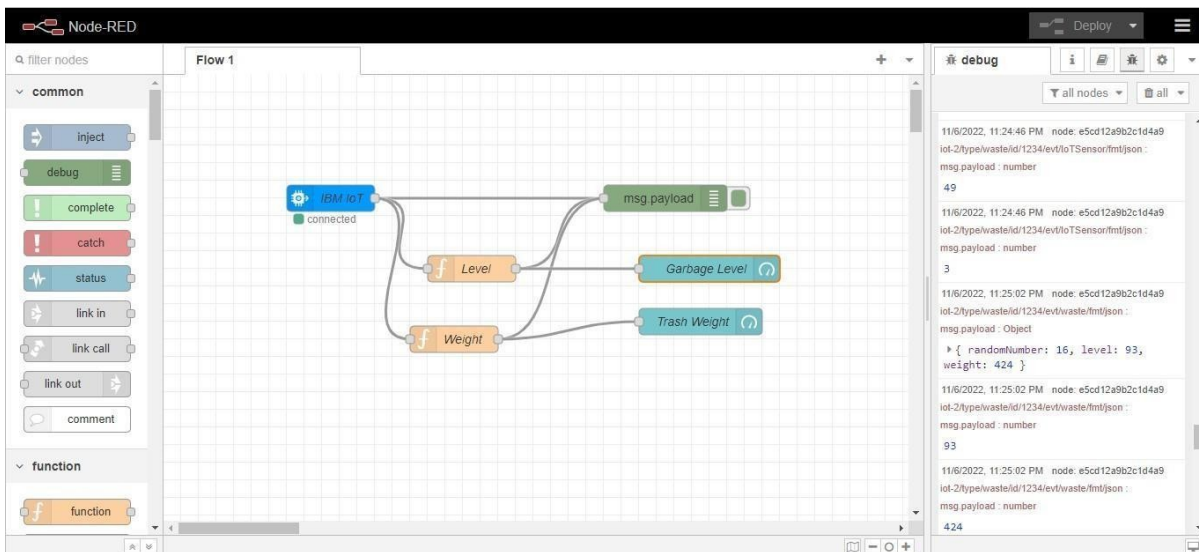
```

OUTPUT:

```
Python 3.7.0 Shell
File Edit Shell Debug Options Window Help

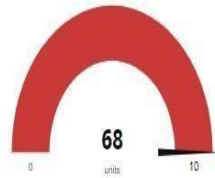
Python 3.7.0 (v3.7.0:1bdf9cc5093, Jun 27 2018, 04:59:51) [MSC v.1914 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
RESTART: C:/Users/welcome/AppData/Local/Programs/Python/Python37/smart waste.py
2022-11-06 23:23:06,437 ibmiotf.device.Client INFO Connected successfully: d:2melol:waste:1234
Published Level = 6 % Weight = 28 % to IBM Watson
Published Level = 24 % Weight = 48 % to IBM Watson
Published Level = 72 % Weight = 51 % to IBM Watson
Published Level = 70 % Weight = 59 % to IBM Watson
Published Level = 8 % Weight = 73 % to IBM Watson
Published Level = 49 % Weight = 3 % to IBM Watson
Published Level = 23 % Weight = 30 % to IBM Watson
Published Level = 20 % Weight = 73 % to IBM Watson
Published Level = 2 % Weight = 15 % to IBM Watson
Published Level = 68 % Weight = 45 % to IBM Watson
Published Level = 0 % Weight = 33 % to IBM Watson
Published Level = 32 % Weight = 68 % to IBM Watson
Published Level = 77 % Weight = 8 % to IBM Watson
Published Level = 28 % Weight = 42 % to IBM Watson
Published Level = 79 % Weight = 24 % to IBM Watson
Published Level = 29 % Weight = 90 % to IBM Watson
Published Level = 78 % Weight = 25 % to IBM Watson
```

NODE RED INPUT AND OUPUT:

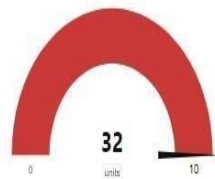


Garbage Monitoring

Trash Weight



Garbage Level



7.CODING & SOLUTIONING

FEATURE1

- IOT device
- IBM watson platform
- Node red
- Cloudant DB

8.TESTING

| Test case ID | Feature Type | Component | Test Scenario |
|------------------|--------------|------------|--|
| LoginPage_TC_O01 | Functional | Home Page | Verify user is able to see the Login/Signup popup when user clicked on My account button |
| LoginPage_TC_O02 | UI | Home Page | Verify the UI elements in Login/Signup popup |
| LoginPage_TC_O03 | Functional | Home page | Verify user is able to log into application with Valid credentials |
| LoginPage_TC_O04 | Functional | Login page | Verify user is able to log into application with Invalid credentials |
| LoginPage_TC_O04 | Functional | Login page | Verify user is able to log into application with Invalid credentials |
| LoginPage_TC_O05 | Functional | Login page | Verify user is able to log into application with Invalid credentials |

| | | | | |
|---------------------------|---|---|---|---|
| 29 Page
Print Engine | 5 | 0 | 1 | 4 |
|---------------------------|---|---|---|---|

| | | | | |
|---------------------|----|---|---|----|
| Client Application | 47 | 0 | 2 | 45 |
| Security | 3 | 0 | 0 | 3 |
| Outsource Shipping | 2 | 0 | 0 | 2 |
| Exception Reporting | 11 | 0 | 2 | 9 |
| Final Report Output | 5 | 0 | 0 | 5 |
| Version Control | 3 | 0 | 1 | 2 |

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

| Resolution | Severity1 | Severity2 | Severity3 | Severity4 | Subtotal |
|-----------------|-----------|-----------|-----------|-----------|----------|
| By Design | 11 | 4 | 2 | 2 | 19 |
| Duplicate | 1 | 1 | 2 | 0 | 4 |
| External | 2 | 3 | 0 | 1 | 6 |
| Fixed | 10 | 2 | 3 | 20 | 35 |
| Not Reproduc ed | 0 | 0 | 2 | 0 | 2 |
| Skipped | 0 | 0 | 2 | 1 | 3 |
| Won't Fix | 0 | 5 | 2 | 1 | 8 |
| Totals | 24 | 15 | 13 | 25 | |

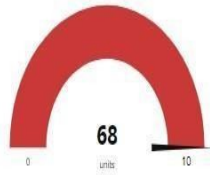
3. Test Case Analysis

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

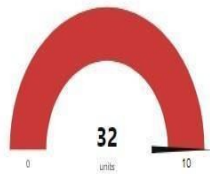
9. RESULTS

Garbage Monitoring

Trash Weight



Garbage Level



Control

Bin in use



Range



Today Used

▼ 0 ▲

Enter Location
change

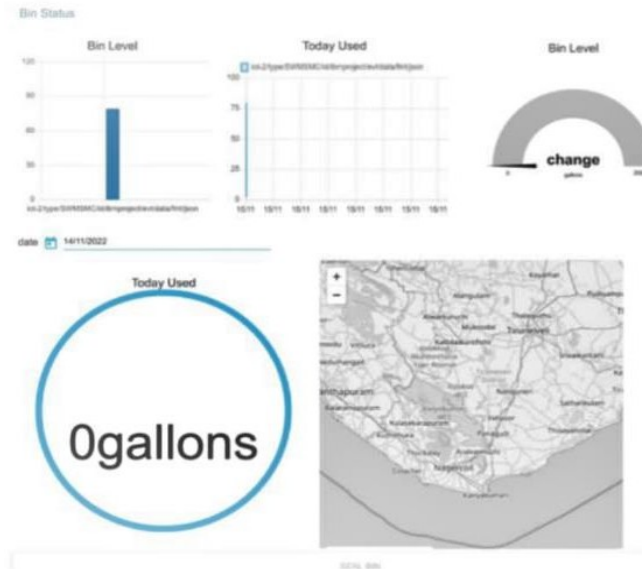
date



15/11/2022



VIEW STATUS



10. ADVANTAGES&DISADVANTAGES

ADVANTAGES

1. This practice is highly lucrative:
2. Keeps the environment clean and fresh:
3. Saves the Earth and conserves energy:
4. Reduces **environmental** pollution

DISADVANTAGES

1. the imbalance between the production and the capability to manage it
2. the waste volume continues to increase in line with the population growth
3. changes in the quality of life and the dynamics of community activities.

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.

*Carry your own cloth or jute bag when you go shopping.

*Say no to all plastic bags as far as possible.

*Reduce the use of paper bags.

*Segregate the waste in the house – keep two garbage bins and see to it that the biodegradable and the non biodegradable is put into separate bins and disposed off separately.

12.FUTURE SCOPE

This paper describes the development of garbage monitoring system, which is based on Arduino UNO. It is very useful in improving the efficiency of waste disposal management especially in the residential areas, by alerting the municipality for immediate collection. The proposed system can be adapted in all areas because of its reliability, reasonable cost and efficient environmental protection. In this method it is able to achieve above 90% of efficiency. In future, this system can also be installed in the home and if the dustbin gives bad odour, we can identify that it is time to dispose the dustbin, it can be done by placing gas sensor. An app based interface and webpage based interface will be handy for the civic bodies to monitor and manage multiple bins simultaneously.

APPENDIX

Source code

```

//pir pin
LiquidCrystal_I2C lcd(0x27, 20, 4);

//                                credentials of IBM Accounts

#define ORG "9gbe4w"                // IBM organisation id
#define DEVICE_TYPE "SWSMC"         // Device type mentioned in
ibmwatson iot platform
#define DEVICE_ID "ibmproject"      // Device ID mentioned in
ibmwatson iot platform
#define TOKEN "sUNA41tG6-Pq)0rk5X" // Token

//                                customise above values

char server[] = ORG
".messaging.internetofthings.ibmcloud.com"; // server name
char publishTopic[] = "iot-
2/evt/data/fmt/json"; // topic name and type
ofevent perform and format in which data to be send
char topic[] = "iot-
2/cmd/led/fmt/String"; // cmd Represent
type and command is test format of strings
char authMethod[] = "use-token-
auth"; // authentication method
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE
":"DEVICE_ID; //Client id

//

WiFiClient wifiClient; //
creating instance for wificlient
PubSubClient client(server, 1883, wifiClient);

#define ECHO_PIN 12
#define TRIG_PIN 13
float dist;

void setup()
{
32Serial.begin(115200);
11CONCLUSION
pinMode(LED_BUILTIN,
OUTPUT); pinMode(TRIG_PIN,

```

```
OUTPUT); pinMode(ECHO_PIN,  
INPUT);
```

```

//ledpins
pinMode(23, OUTPUT);
pinMode(2, OUTPUT);
pinMode(4, OUTPUT);
pinMode(15, OUTPUT);

lcd.init();
lcd.backlight();
lcd.setCursor(1, 0);
lcd.print("");
wifiConnect();
mqttConnect();
}

float readcmCM()
{
    digitalWrite(TRIG_PIN, LOW);
    delayMicroseconds(2);
    digitalWrite(TRIG_PIN,
HIGH);delayMicroseconds(10);
    digitalWrite(TRIG_PIN, LOW);
    int duration = pulseIn(ECHO_PIN,
HIGH);return duration * 0.034 / 2;
}

void loop()
{

    lcd.clear();

    publishData();
    delay(500);
    if (!client.loop())
    {
        mqttConnect(); // function call to
connect to IBM
    }
}

/*                      retrieving to cloud
*/

```



```
Serial.print("Connecting to ");  
Serial.print("Wifi");
```

```

WiFi.begin("Wokwi-GUEST", "", 6);
while (WiFi.status() !=
WL_CONNECTED)
{
    delay(500);
    Serial.print(".");
}
Serial.print("WiFi connected, IP address: ");
Serial.println(WiFi.localIP());
}
void mqttConnect()
{
    if (!client.connected())
    {
        Serial.print("Reconnecting MQTT client to ");
        Serial.println(server);
        while (!client.connect(clientId, authMethod, token))
        {
            Serial.print(".");
            delay(500);
        }
        initManagedDevice();
        Serial.println();
    }
}
void initManagedDevice()
{
    if (client.subscribe(topic))
    {
        Serial.println("IBM subscribe to cmd OK");
    }
    else
    {
        Serial.println("subscribe to cmd FAILED");
    }
}

void publishData()
{
    float cm = readcmCM();

    if(digitalRead(34)) //pir motion detection
    {
        Serial.println("Motion
if(digitalRead(34)==
Detected");Serial.println("Lid

```

```
Opened"); digitalWrite(15, HIGH);
```

```
if(digitalRead(34)==
```

```

{
  if(cm <= 60)                                     //Bin level
detection
  {
    digitalWrite(2, HIGH);
    Serial.println("High Alert!!!,Trash bin is about to be full");
    Serial.println("Lid
Closed");    lcd.print("Full!
Don't use");delay(2000);
    lcd.clear();
    digitalWrite(4, LOW);
    digitalWrite(23, LOW);
  }
else if(cm > 60 && cm < 120)
{
  digitalWrite(4, HIGH);
  Serial.println("Warning!!,Trash is about to cross 50% of bin
level");digitalWrite(2, LOW);
  digitalWrite(23, LOW);

}
else if(cm > 120)
{
  digitalWrite(23, HIGH);
  Serial.println("Bin is
available");digitalWrite(2,LOW);
  digitalWrite(4, LOW);

}
  delay(10000);
  Serial.println("Lid Closed");
}
else
{
  Serial.println("No motion
detected");digitalWrite(2, LOW);
  digitalWrite(15, LOW);
  digitalWrite(4, LOW);
  digitalWrite(23, LOW);
}

}
else
{
  } digitalWrite(15, LOW);
}

```

```
    if(cm <= 60)
    {
digitalWrite(21,HIGH);
String payload =
"{\"High_Alert\":\"";payload += cm;
payload += " }";
Serial.print("\n");
Serial.print("Sending payload:
");Serial.println(payload);

if (client.publish(publishTopic, (char*) payload.c_str()))    // if data
is uploaded to cloud successfully,prints publish ok else prints publish
failed
{
Serial.println("Publish OK");
}
}
else if(cm <= 120)
{
digitalWrite(22,HIGH);
String payload =
"{\"Warning\":\"";payload += cm ;
payload += " }";
Serial.print("\n");
Serial.print("Sending payload:
");Serial.println(payload);
if(client.publish(publishTopic, (char*) payload.c_str()))
{
Serial.println("Publish OK");
}
else
{
Serial.println("Publish FAILED");
}
}
else
{
Serial.println();
}

float inches = (cm / 2.54);                                //print on
lcd
lcd.setCursor(0,0);
lcd.print("Inches");
lcd.setCursor(4,0);
```

```
lcd.setCursor(12,0);  
lcd.print("cm");  
lcd.setCursor(1,1);
```

```
}
```

```
lcd.print(inches, 1);  
lcd.setCursor(11,1);  
lcd.print(cm, 1);  
lcd.setCursor(14,1);  
delay(1000);  
lcd.clear();  
}
```

GITHUB LINK

IBM-

Project-11585-1659335303

SIMULATION LINK

<https://wokwi.com/projects/348024368289284690>

PROJECT DEMO LINK

**[https://node-red-wjldy-2022-11-05.au-syd.mybluemix.net/ui/#!/0?
socketid=PyqH93j_A9ODVDSLAAAB](https://node-red-wjldy-2022-11-05.au-syd.mybluemix.net/ui/#!/0?socketid=PyqH93j_A9ODVDSLAAAB)**