SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES

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1.INTRODUCTION

1.1 PROJECT OVERVIEW

With the increasing population and industrialization of nations throughout the globe, waste has become a great concern for all of us. Over years, researchers figured that only waste management is not enough for its proper treatment and disposal techniques to preserve our environment and keeping it clean in this era of globalization. With the help of technology researchers have, introduced IoT based Smart Waste Management solutions and initiatives that ensures reduced amount of time and energy required to provide waste management services and reduce the amount of waste generated. Unfortunately, developing countries are not being able to implement those existing solutions due to many factors like socio-economic environment. Therefore, in this research we have concentrated our thought on developing a smart IoT based waste management system for developing countries like INDIA that will ensure proper disposal, collection, transportation and recycling of household waste with the minimum amount of resources being available.

1.2 PURPOSE

Smart waste management focuses on solving the previously mentioned solid waste management problems using sensors, intelligent monitoring systems, and mobile applications. The first smart waste management solution to make the waste collection process more efficient is sensors. Sensors can measure the fill level of the containers and provide updated information at any time and notify waste management services to empty them when they are full or almost full. These devices help optimize the best possible route containing fully filled containers and create smart schedules for drivers. The selection of the containers also minimizes the need for trash collection staff because their duties are deduced. They can also alert the waste management companies or municipalities if an undesirable incident happens such as sudden temperature rise or displacement of the container by their GPS features.Smart waste management is about using technology and data to create a more efficient waste industry. Based on IoT (Internet of Things) technology, smart waste management aims to **optimize resource allocation, reduce running costs, and increase the sustainability of waste services**.

2. LITERATURE SURVEY

2.1. EXISTING SYSTEM

IoT Based Smart Garbage System which indicates directly that the dustbin is filled to a certain level by the garbage and cleaning or emptying them is a matter of immediate concern.This prevents lumping of garbage in the roadside dustbin which ends up giving foul smell and illness to people. The design of the smart dustbin includes a single by ultrasonic sensor which configured with Arduino Uno with this research ,it is sending SMS to the Municipal Council that particular dustbin is to overflow. Nowadays it is becoming a difficult task to distinguish wet and dry waste. The new waste management system covers several levels of enormous workforce. Every time labourers must visit the garbage bins in the city area to check whether they are filled or not. The data communicates to the cloud server for real-time monitoring of the system. With the real-time fill level information collected via the monitoring platform, the system reduces garbage overflow by informing about such instances before they arrive.

2.2 REFERENCE

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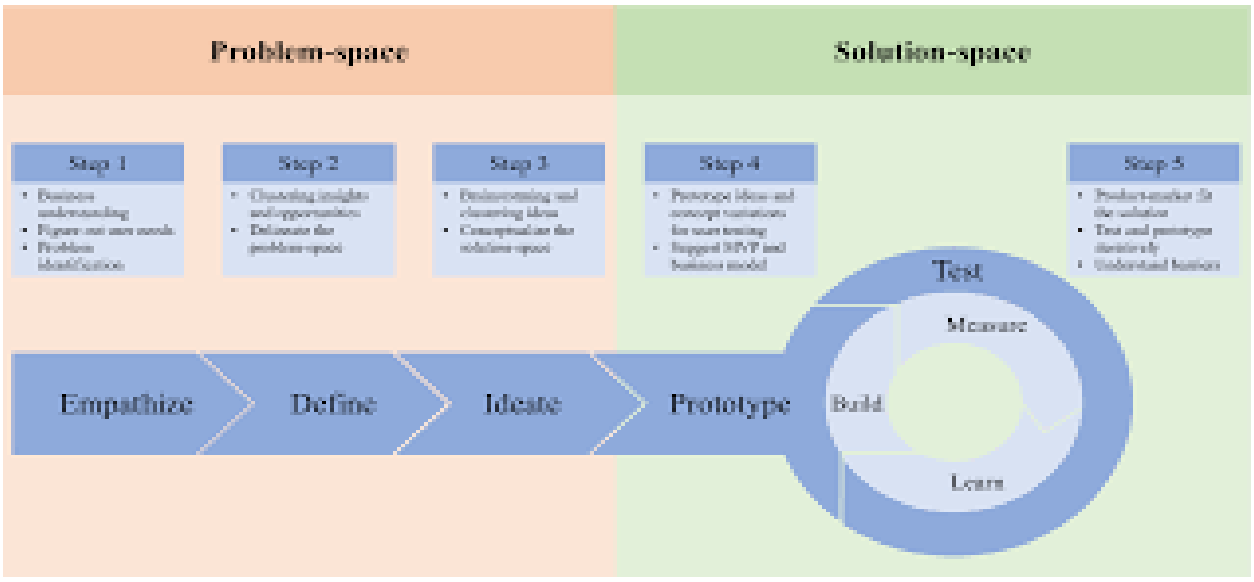
2.3 PROBLEM STATEMENT DEFINITION

The current problem of waste management starts with the waste being created by people in the cities and disposed in trash bins near its creation point.Other problems such as some trash bins are overfilled while others are underfilled by the trash collection time,overfilled trash bins create unhygienic conditions,unoptimized truck routes result in excessive fuel usage and environmental pollution and all collected trash is combined which complicates sorting at the recycling facility.The problem statement is to answer the question “How can we make proper disposal, collection, transportation and recycling of household waste with the minimum amount of resources being available”.

3. IDEATION AND PROPOSED SOLUTION

3.1 IDEATION & BRAINSTORMING

The waste management services take care of a healthy environment allowing optimization of the utilities and prevent overloading the carrier for waste disposal. Smart waste management also contributes to the overall waste recycling efficiency and provides the route optimization opportunity for utilities to reduce traffic and fuel use.recently developed solutions based on ultrasonic distance measurement. Some companies prefer to approach the problem with an alternative solution using image processing and camera as a passive sensor. However, the majority of these solutions use ultrasonic sensor for measurement of the distance.Ultrasonic sensors use a well-known sonar technique to perform measurement of the distance between the sensor and an obstacle.



3.2 PROPOSED SOLUTION

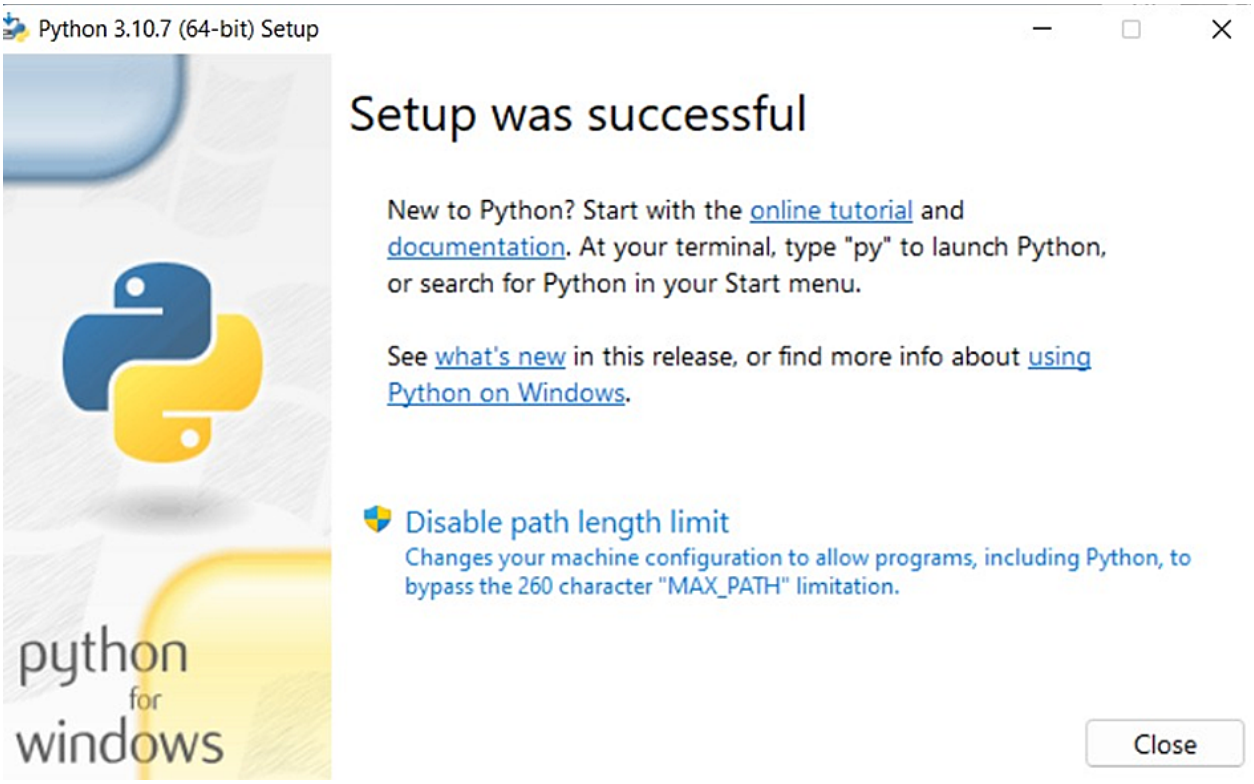
S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	This project deals with the problem of waste management in smart cities, where the garbage collection system is not optimized. This project enables the organizations to meet their needs of smart garbage management systems. This system allows the authorised person to know the fill level of each garbage bin in a locality or city at all times, to give a cost-effective and time-saving route to the truck drivers.

2.	Idea / Solution description	The key research objectives are as follows: • The proposed system would be able to automate the solid waste monitoring process and management of the overall collection process using IOT (Internet of Things). • The Proposed system consists of main subsystems namely Smart Trash System(STS) and Smart Monitoring and Controlling Hut(SMCH). • In the proposed system, whenever the waste bin gets filled this is acknowledged by placing the circuit at the waste bin, which transmits it to the receiver at the desired place in the area or spot. • In the proposed system, the received signal indicates the waste bin status at the monitoring and controlling system.
3.	Novelty / Uniqueness	We are going to establish SWM in our college but the real hard thing is that janitor (cleaner) don’t know to operate these thing practically so here our team planned to build a wrist band to them, that indicate via light blinking when the dustbin fill and this is Uniqueness we made here beside from project constrain.

4.	Social Impact / Customer Satisfaction	From the public perception as worst impacts of present solid waste disposal practices are seen direct social impacts such as neighbourhood of landfills to communities, breeding of pests and loss in property values
5.	Business Model (Revenue Model)	Waste Management organises its operations into two reportable business segments: Solid Waste, comprising the Company's waste collection, transfer, recycling and resource recovery, and disposal services, which are operated and managed locally by the Company's various subsidiaries, which focus on distinct geographic areas; and Corporate and Other, comprising the Company's other activities, including its development and operation of landfill gas-to energy facilities in the INDIA, and its recycling brokerage services, as well as various corporate functions.

6.	Scalability of the Solution	In this regard, smart city design has been increasingly studied and discussed around the world to solve this problem. Following this approach, this paper presented an efficient IoT based and real-time waste management model for improving the living environment in cities, focused on a citizen perspective. The proposed system uses sensor and communication technologies where waste data is collected from the smart bin, in real-time, and then transmitted to an online platform where citizens can access and check the availability of the compartments scattered around a city.

3.3 Requirement Analysis:



4.Solution Architecture

4.1 Project Planning Phase :

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Login	USN-1	As a Administrator, I need to give user id and passcode for ever workers over there in municipality	10	High	Bala Nimisha, Avanthika
Sprint-1	Login	USN-2	As a Co-Admin, I'll control the waste level by monitoring them via real time web portal. Once the filling happens, I'll notify trash truck with location of bin with bin	10	High	Bala Nimisha, Avanthika

			ID			
Sprint-2	Dashboard	USN-3	As a Truck Driver, I'll follow Co-Admin's Instruction to reach the filling bin in short roots and save time	20	Low	Bala Nimisha, Avanthika
Sprint-3	Dashboard	USN-4	As a Local Garbage Collector, I'II gather all the waste from the garbage, load it onto a garbage truck, and deliver it to Landfills	20	Medium	BalaShanmugam, Aswin

Sprint-4	Dashboard	USN-5	As a Municipality officer, I'll make sure everything is proceeding as planned and without any problems	20	High	BalaShanmugam, Aswin

4.2 Project Tracker, Velocity & Burndown Chart:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

5.Delivery of Sprint

5.1 Sprint 1:

CODE FOR REGISTRATION AND LOGIN CREDENTIALS:

```
<!DOCTYPE html>
<html>
    <head>
    <style>
 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;

    }

else {

    google.script.run.AddRecord(usernamee,passwordd,email,phone);
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:none;
}

```
/page3/

.page3_class1{

   display:none;



}

.page3_id1-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{      border-

bottom:2px solid black;

    }
```

```
</style>
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
   </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; textalign: 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;fontweight: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>

<p>Name</p>

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

   <br>

<p>Password</p>
```

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

  <br>

<p>Phone Number</p>

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

  <br>

</div>



<!--page3-->
```

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

5.2 Sprint 2:

Python Code

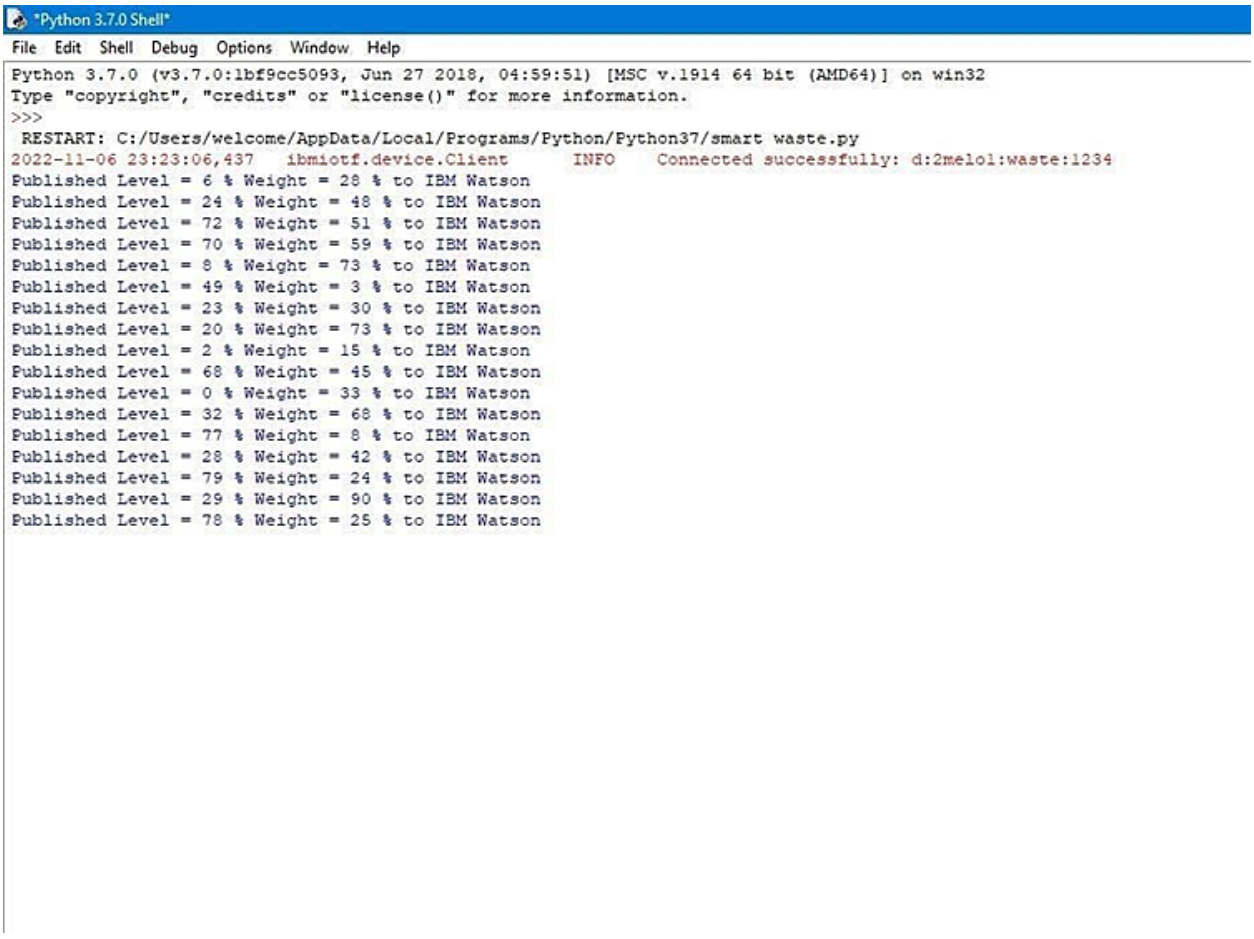
```
 import time import sys

 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)
```

```
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(0,100) 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  connected  to
IoTF")time.sleep(20)
 deviceCli.commandCallback = myCommandCallback
 # Disconnect the device and application from the cloud
deviceCli.disconnect()
```

OUTPUT:

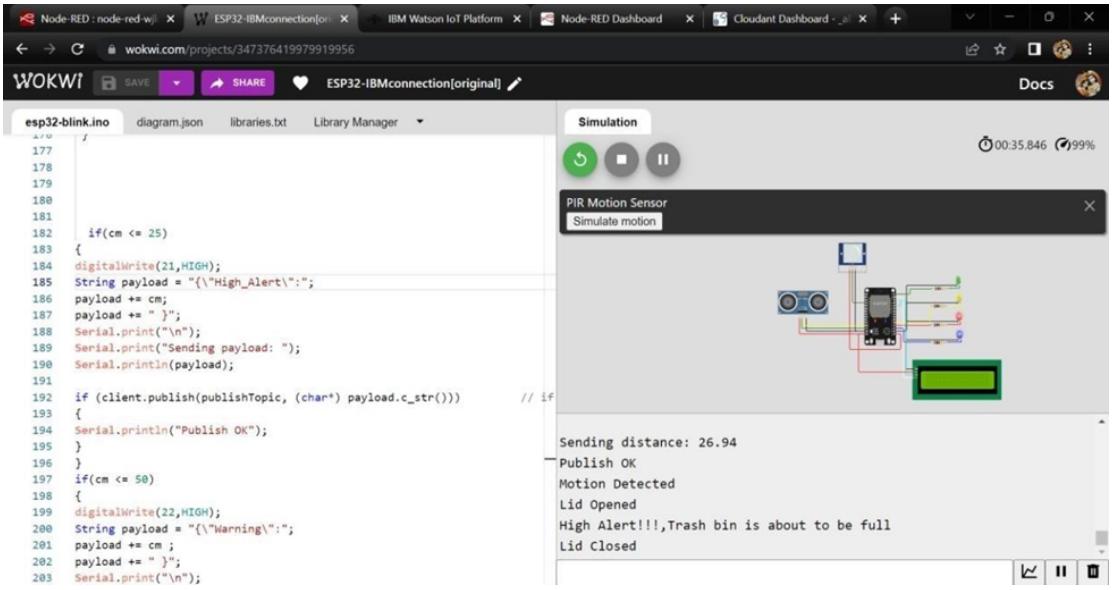
NODE RED INPUT AND OUPUT:



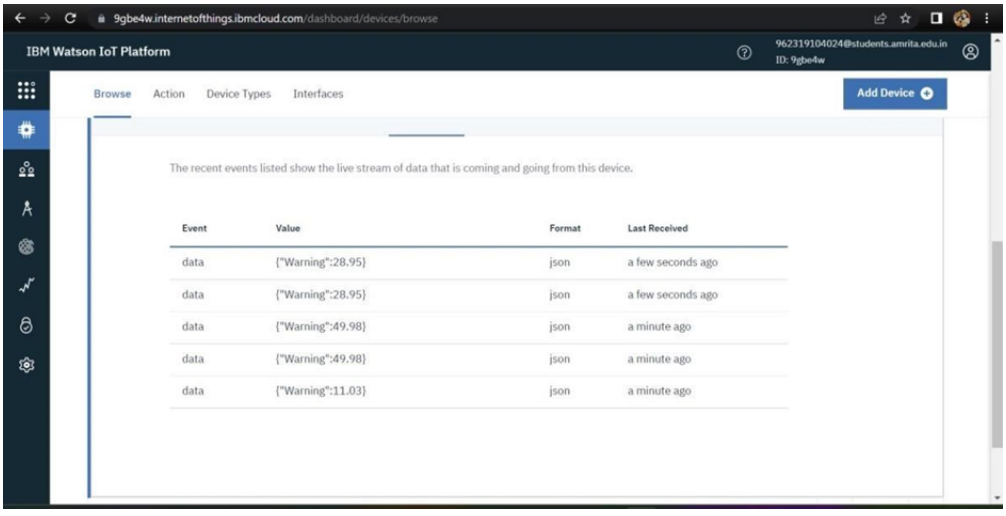
5.3.Sprint 3:

-RED Connection setup for data transmission from IBM Watson IOT platform to Node-RED dashboard.

2.Simulate Wokwi connection to transmit data from wokwi account to IBM Watson IOT platform and then to Node Red dashboard



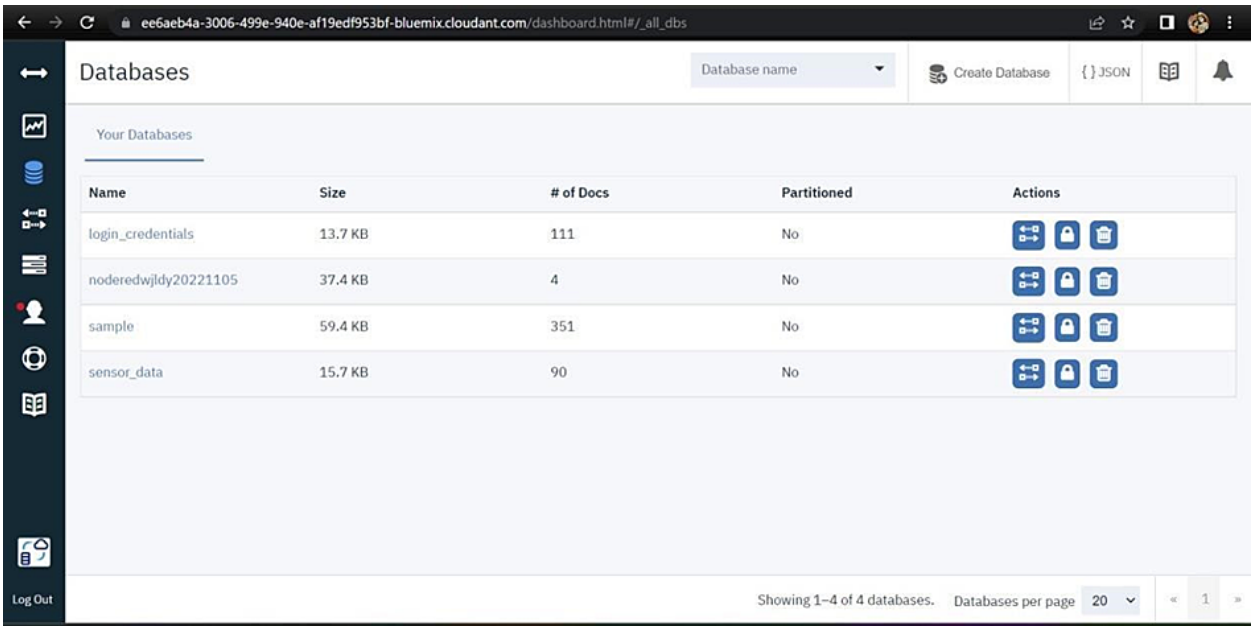
3.Data transfer to Watson IOT platform.



4.Data transfer from IBM Watson IOT platform and wokwi to Node red.

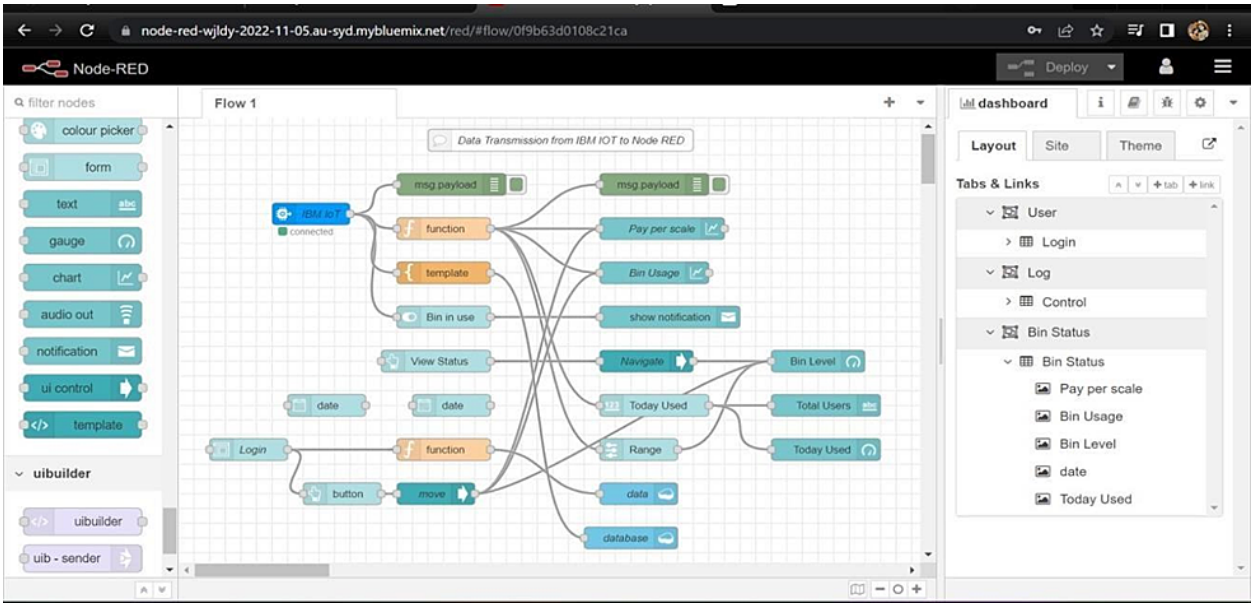
5.Storing database in IBM cloudant DB.

6.Data is stored in JSON format

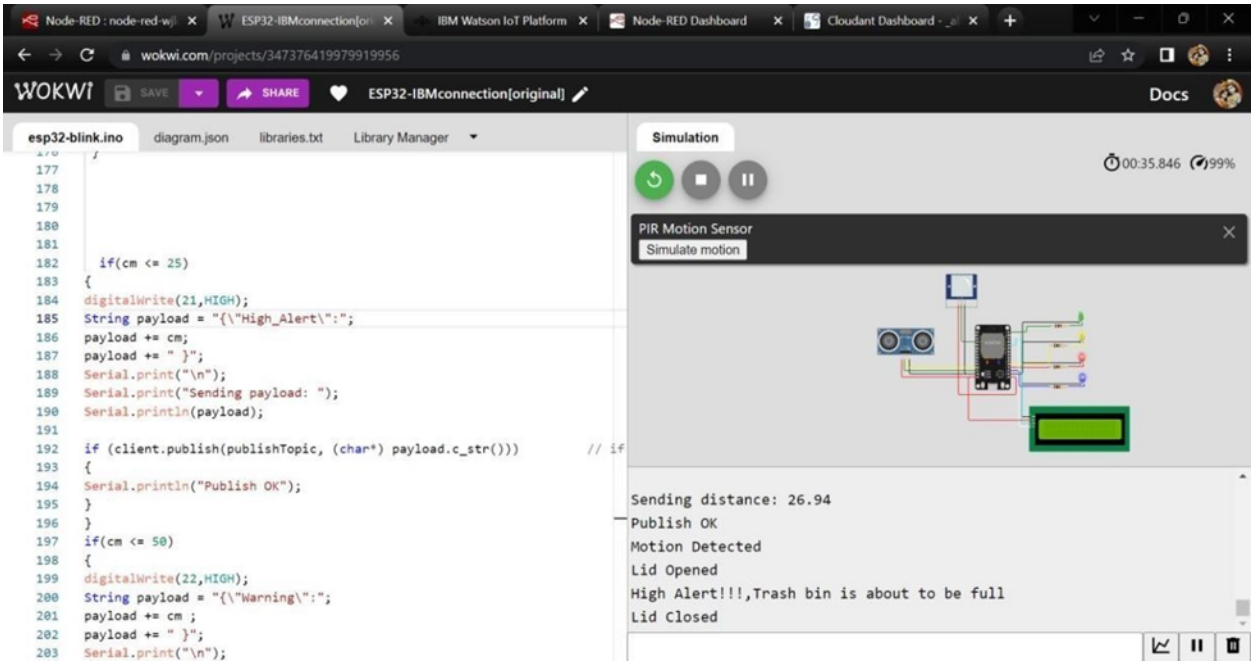


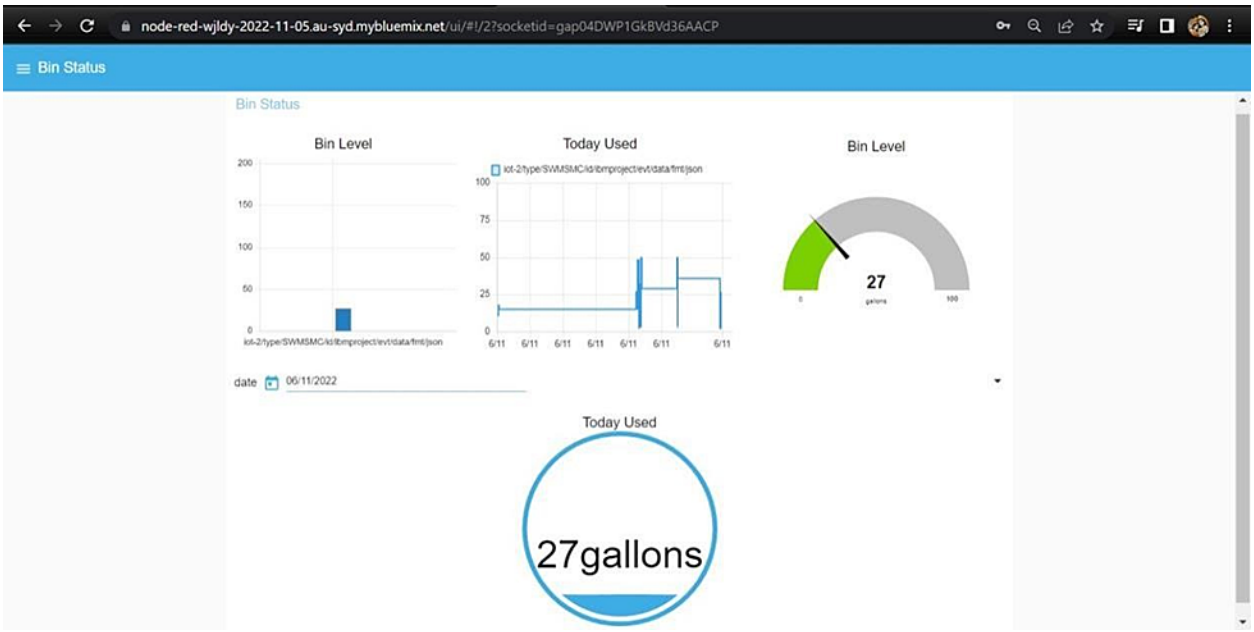
5.4 -RED Connection setup for data transmission from IBM Watson IOT platform to Node-RED dashboard. Simulate Wokwi connection to transmit data from wokwi account to IBM Watson IOT platform and then to Node Red dashboard. Data transfer to Watson IOT platform. Data transfer from IBM Watson IOT platform and wokwi to Node red. Storing database in IBM cloudant DB.

6.Data is stored in JSON format



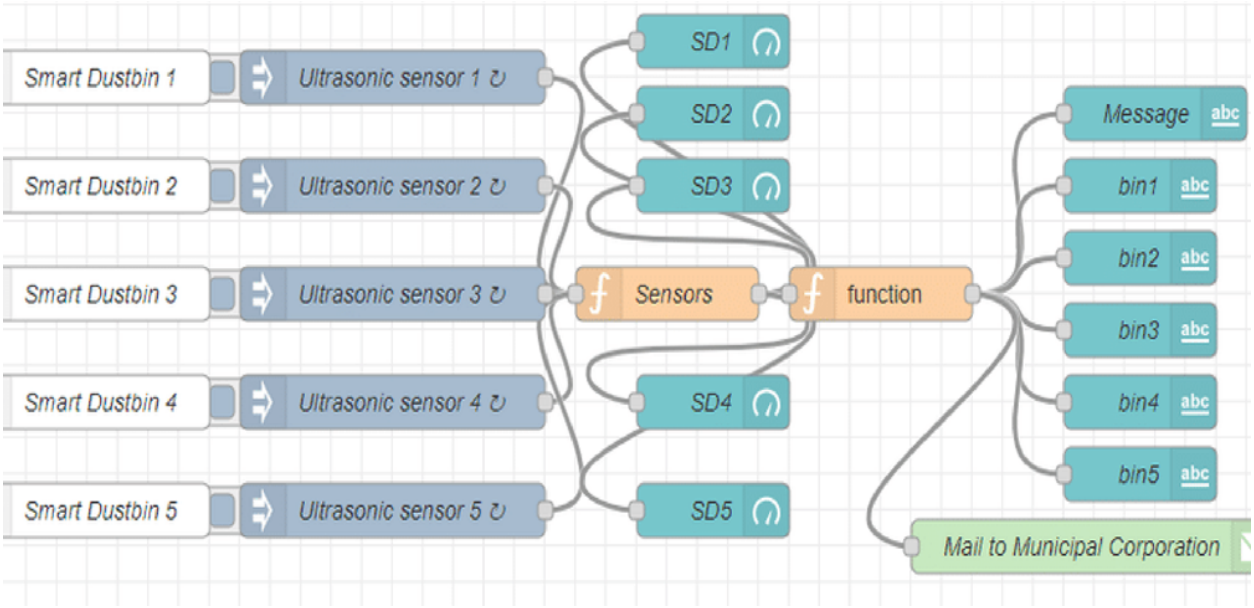
7. Web UI


Node-RED : node-red-wj
ESP32-IBMconnection[or
IBM Watson IoT Platform
Node-RED Dashboard
Cloudant Dashboard -
wokwi.com/projects/347376419979919956
WOKWI
SAVE
SHARE
ESP32-IBMconnection[original]
Docs
esp32-blink.ino
diagram.json
libraries.txt
Library Manager
if(cm <= 25)
{
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()))
{
Serial.println("Publish OK");
}
}
if(cm <= 50)
{
digitalWrite(22,HIGH);
String payload = "{\"Warning\":";
payload += cm ;
payload += " }";
Serial.print("\n");
Simulation
00:35.846
99%
PIR Motion Sensor
Simulate motion
Sending distance: 26.94
Publish OK
Motion Detected
Lid Opened
High Alert!!!,Trash bin is about to be full
Lid Closed


node-red-wjldy-2022-11-05.au-syd.mybluemix.net/ui/#!/2?socketid=gap04DWP1GkBVd36AACP
Bin Status
Bin Status
Bin Level
Today Used
Bin Level
27
date
06/11/2022
Today Used
27gallons

6.RESULTS

WEB APPLICATION



7.ADVANTAGES AND DISADVANTAGES

7.1 Advantages:

A reduction in the number of waste collections needed by up to 80%, resulting in less manpower, emissions, fuel use and traffic congestion. A reduction in the number of waste bins needed. Analytics data to manage collection routes and the placement of bins more effectively.

7.2 Disadvantages:

There may be several disadvantages such as **increasing cost of the dustbin**.
Significant Installation Costs,helplessness If Technology Fails,
Reliable Internet Connection is Crucial.

Demo Link:

https://drive.google.com/file/d/1MEHggA5V4BT56439MTKk2sqKmHrRoOnA/view?usp=sharing