

PROJECT REPORT

Team ID	PNT2022TMID23556
Project name	SMART WASTE MANAGEMENT FOR METROPOLITAN CITIES

ABSTRACT :

These days, waste management is a global concern. According to World Bank research, the world creates 2.01 billion tonnes of municipal solid garbage each year, with at least 33% of it not being managed in an environmentally sound manner. It is expected to increase to 3.40 billion tonnes by 2050. Garbage collection is a time-consuming and inefficient procedure. Trucks empty bins whether they are full or nearly empty due to the consistent method of predefined routes and days. This causes wastage of fuel,time and money.

To avoid this a smart waste management system is needed where trucks only empty bins when the bins are full and corporation can keep record of how much percentage of each of the bins are filled. This can be done by following steps;

- Garbage level detection in bins.
- Getting the weight of the garbage in the bin.
- Alerting the authorized person to empty the bin whenever the bins are full.
- Garbage level of the bins can be monitored through a web App.
- We can view the location of every bin in the web application by sending GPS location from the device.

By using IoT data can be analysed in a more streamlined way i.e it can tell the rate at which each bins are filled frequency with which bins are filled up, and the location of the nearest route. Our project also helps us to schedule the location for next pickup and it will eliminate garbage overflow.

Our project is used to detect location, fill level in real time, and this data is then used to plan optimal collection routes, resulting in an efficient pickup process that saves fuel as well as manpower. Additionally, [data](#) helps with long-term planning, such as where more bins are needed or where the number can be reduced. Through our project the management can control all the bin statuses which are placed around the city through a web app or mobile application.

LITERATURE SURVEY

Smart waste management system(2021)

-Sanjiban Chakraborty, Aniket Mehta

The technology is built on the IOT, Android, Web and cloud. The components used are smart bins (bins connected with sensors), GPRS vehicle tracking and an android web application which will act as a bridge between the user and the municipal corporation. RFID TAGS which is used for reading, collecting and transferring data. Software used are REACTJS, NODEJS and AWS cloud service.

Smart Waste Management With WSN, IoT(2017)

-Sivasankari, Bhanu shri

In this project, Infrared sensors detect the level of garbage. LCD displays the level how much the bin has been filled. By embedding processing and communication with the physical world, Wireless Sensor Network (WSN) is used as a tool to bridge real and virtual environment. Data collected are transferred to Central Processing Unit (CPU) which runs the GCA.

Smart Waste management - To Citizens(2020)

-Joel Rodrigues, Ashok kumar Das

The system proposes a three layer architecture which are application, network and perception layers. Perception layer is similar to physical layer in OSI model. Network layer is used to transfer the information and this layer uses Zigbee, Zwire and GSM. The waste bin has sensors such as HC-SRO4 and Ultra sonic sensor. A GPS module is used to print Geographic coordinates. The total power of the system is made by an external rechargeable battery coupled to a solar cell.

Year	Author	Title	Technology	Primacy	Result
2021	Sanjiban Chakraborty , Aniket Mehta	Smart waste management system	IOT,Android, Web and cloud	Correct data of the level of waste in the bins are noted	Analysis has been carried out and results indicate that urban solid waste comprises mostly biodegradable and nonbiodegradable materials
2017	Sivasankari, Bhanu shri	Smart waste management with WSN	IoT,WSN	The information of overflowing	By implementing this project we

				of bins can be easily be known to the municipal corporations	will determine the stuffed up dustbins and give indication to the GCV(Garb age Collector Vehicle).
	Joel Rodrigues, Ashok kumar Das	Smart waste management -To citizens	Zigbee,Zwir e, GSM,iot	Zigbee is used to transfer the information giving accurate data	Efficient IoT-based and realtime waste manageme nt model for improving the living environme ntin cities, focused on a citizen perspective

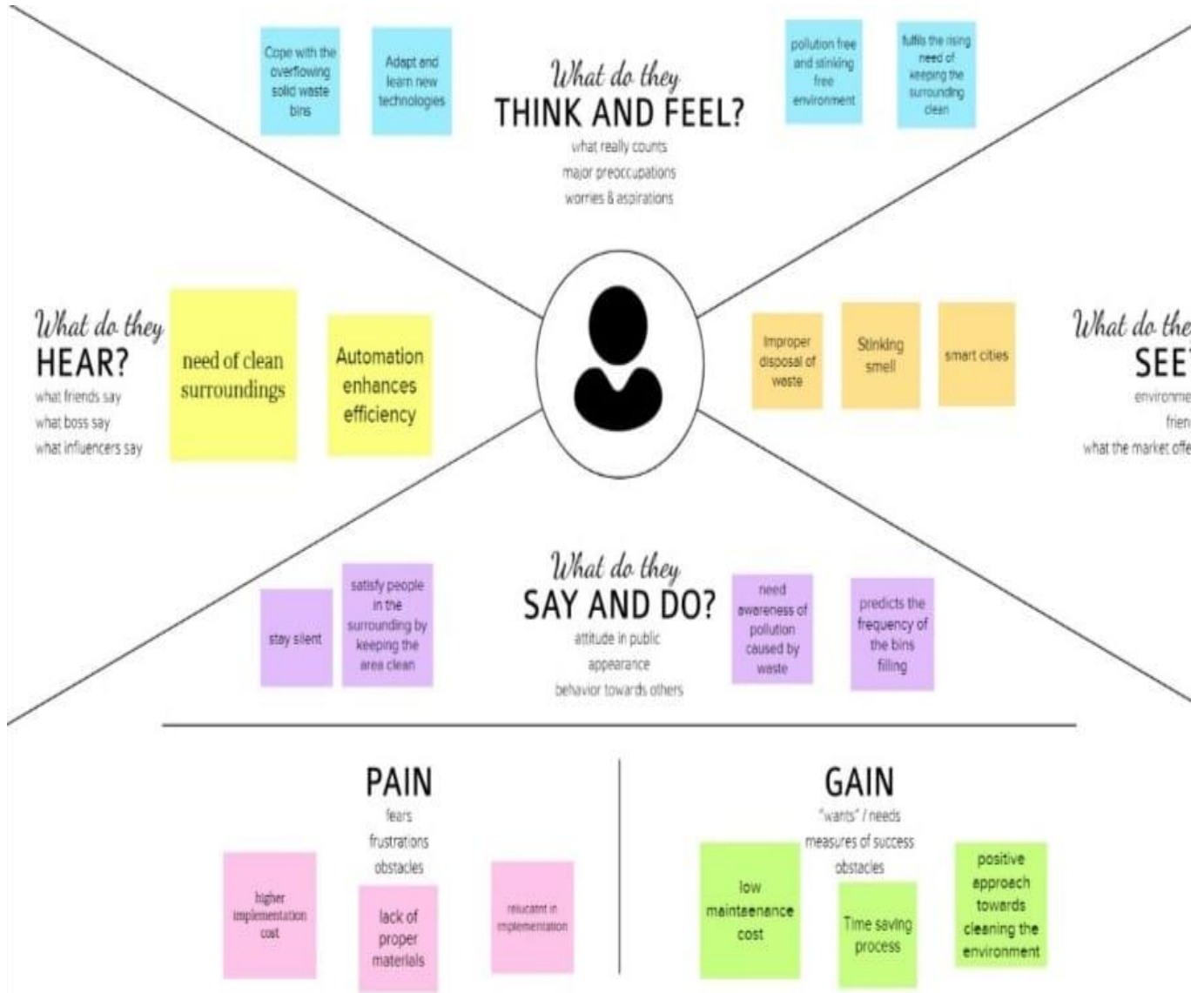
PROBLEM STATEMENT AND DEFINITION

India is getting buried under mounds of garbage as the country has been generating more than 1.50 lakh metric tonne (MT) of solid waste every day. Worse - approximately 90 per cent (1,35,000 MT per day) of the total amount is collected waste.

- Nearly 15,000 MT of garbage remain exposed every day, resulting in almost 55 lakh MT of solid waste disposed in open areas each year, which leads to "severe" pollution level.
- Day by day the population is rapidly growing and the economic broadening of the country, there is a very vast growth of the waste of management also.
- There is no actual right way of its solution or proper chain system to track and monitor the waste and disposal system. And cities are getting smart nowadays, but waste is not.
- Regardless of all the cities, the dustbins and waste are not getting tracked, sometimes the garbage in the bins gets to above the point, where it blemishes outside the garbage pail and open out in whole areas and causes so many health issues to the citizens.
- This information doesn't reach out the municipal corporation and this has been left unnoticed. This leads to cause of many deadly diseases like cholera, malaria , dengue and respiratory diseases like asthma.

IDEATION AND PROPOSED SOLUTION

EMPATHY MAP CANVAS



IDEATION AND BRAINSTORMING

TOPIC: SMART WASTE MANAGEMENT SYSTEM

Define your problem statement
What problem are you trying to solve? Frame your problem as a clear WAG (Who, What, Where, When, Why, How). This will be the focus of your brainstorm.

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

Group ideas
Use this space to group similar ideas from the brainstorm. Each group should have a title that describes what the ideas have in common. If a group is bigger than six sticky notes, try and split it up into smaller sub-groups.

Practice
Your team should all be in the same page about what's important about the problem. Place your ideas on this grid to determine which ideas are important and which are feasible.

Our team ideas

Lokhesh-Team leader		Balavigneshwaran	
Analyzes the data for alerting purpose	Automated to avoid mistakes done by workers	Sensor values are collected	Values are stored and analysed
Constantly indicate the level of waste filled in the bin	IR sensor senses the objects when dumped	Alert the workers to collect the garbage	GPS location is sent to the nearest truck driver

Aswanth		Yuvan Chandren	
Level of bin is constantly monitored	Using an application to alert the workers	Amount of garbage collected is recorded	Threshold value is already given
Amount of garbage collected is recorded	Efficiency is increased	Frequency of the bin filling is monitored	Shortest path found to reduce the fuel cost

Importance
How important is this idea to you? (1-5)

Feasibility
How feasible is this idea? (1-5)

Shortest path to the bins is found out

Data stored in cloud and analysed

Alert message is sent along with GPS location after bin is filled

Unnecessary and IR sensors are placed at full of the bin

Sensor values are collected

Data is stored in cloud and analysed

Alert message is sent as soon as the bin is full

Gps location is also sent

Optimum path to reach the bin is found out







Efficiency is increased

PROPOSED SOLUTION

	PARAMETER	DESCRIPTION
1.	Problem Statement (Problem to be solved)	Waste management is one of the serious challenges of the cities, in the present system, we continue to use an old and outmoded paradigm that no longer serves the entail of municipalities, we still find spilled waste containers giving off irritating smells causing serious health issues and atmosphere impairment.
2.	Idea / Solution description	To create management system which track the waste level in the bin and send alarm to the corporation when the bin is filled .
3.	Novelty / Uniqueness	Tracking of the frequency of filling of the bins is done using cloud and temperature and humidity tracking is also done
4.	Social Impact / Customer Satisfaction	In India, nearly 1.50 lakh metric tonne of solid waste are generated every day. Nearly 15,000 MT of garbage remain exposed every day, resulting in almost 55 lakh MT of solid waste disposed in open areas each year, which leads to "severe" pollution level. Day by day the population is rapidly growing and the

		<p>economic broadening of the country, there is a very vast growth of the waste of management also. There is no actual right way of its solution or proper chain system to track and monitor the waste and disposal system. And cities are getting smart nowadays, but waste is not. Sometimes the garbage in the bins gets to above the point, where it blemishes outside the garbage pail and open out in whole areas and causes so many health issues to the citizens. By implementing this proposed solution, overfilling of the garbage bins and lying of waste on the open can be stopped fully</p>
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PROPOSED SOLUTION FIT

<p>1. CUSTOMER SEGMENT(S) </p> <p>Government and corporates managing the public</p>	<p>6. CUSTOMER CONSTRAINTS </p> <ul style="list-style-type: none"> ✓ Indicating the waste level ✓ Alerting through buzzer system ✓ Low power requirement ✓ User portable 	<p>5. AVAILABLE SOLUTIONS: </p> <ul style="list-style-type: none"> • Recycling - it has economic and environmental advantages. • Incineration - This disposal process can be a source of air pollution. • Landfill - significant cause of health and environmental problem. Example: gas from these landfills is often incredibly dangerous • Biological Reprocessing - the ends of the stock is natural gas, which is used to produce heat and electricity. • Animal Feed - one of the ecological types of waste
<p>2. JOBS-TO-BE-DONE / PROBLEMS </p> <ul style="list-style-type: none"> ➤ Managing the wastes in metropolitan cities. ➤ Providing a smart solution in the form of smart bin. ➤ Reducing the pollution caused by the trashes. ➤ Making the public more aware. 	<p>9. PROBLEM ROOT CAUSE </p> <ol style="list-style-type: none"> 1. Lack of Public Awareness 2. Refusal to Learn About Compliance 3. Insufficient Investment in Waste Management 4. Lack of Proper Machinery <p>NEEDS:</p> <p>saving money protect the environment creating jobs builds resilience reduce emission and promote community</p>	<p>7. BEHAVIOUR: </p> <ul style="list-style-type: none"> • Proper installation of bins at regular interval. • Providing enough awareness to people. • Correct disposal of trashes in the bin. • Standard discharging of wastes once the bin is filled and • Keeping for reloading of waste.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

REQUIREMENT ANALYSIS

FUNCTIONAL REQUIREMENT

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Bin inventory	Real time data on fill levels of bins noted by different sensors are displayed. Details like capacity,waste type,Gps,pickup spot of each bin will be displayed
FR-2	Bin monitoring	By analysing the past data the frequency of filling of each bins will be predicted a feature not there in existing systems.With real time data and predictions we can prevent overflowing of bins and collecting of partially filled bins
FR-3	Facilitate bin distribution	Categorise areas based on dense or sparse bin distribution Bin location can be changed or bin capacity can be changed based on analysing the previous data
FR-4	Provide optimum waste collection route	The tool automates waste collection route planning.Based on bin levels and past datas,waste collection is scheduled.A proper full fledged schedule is figured out.
FR-5	Expensive bins	Identify the bins that drive up your collection cost .Rating for each bin is done in terms of collection cost
FR-6	Eliminate unefficient picks	Sensors recognize picks.By using real time data levels and pick recognition bin level of each bin is monitored

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	This management is usable to a great extent .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.
NFR-2	Security	This is a very secure system as we use cloud for storing and analysing the datatbase
NFR-3	Reliability	This system is not prone to much failures if in case any failure happen like not sending alarm after bin is filled or not providing proper route,it will be rectified easily
NFR-4	Performance	This is the most efficient waste management system.In the exisiting systems only alarm is sent when the bin is full but with our proposed system the frequency of filling of bin is monitored and optimum path to the nearest filled bin is also provided
NFR-5	Availability	By developing a state of the art hardware and a secure software with firewalls we can save cities,villages from pollution caused by lying of waste
NFR-6	Scalability	This system is very much scalable.We can add any number of bins in this system and we can implement this to areas ranging from a small village to a metropolitan cities.

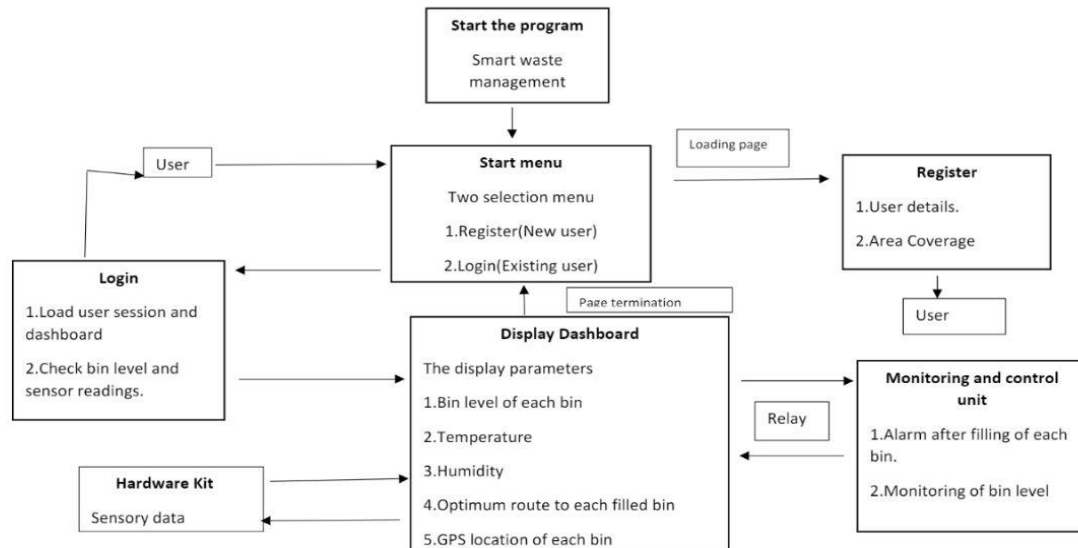
PROJECT DESIGN

Data flow diagram

Project Design Phase-II Data Flow Diagram & User Stories

Date	21 October 2022
Team ID	PNT2022TMD23556
Project Name	Smart waste management system for metropolitan cities
Maximum Marks	4 Marks

Data flow Diagrams:



User stories

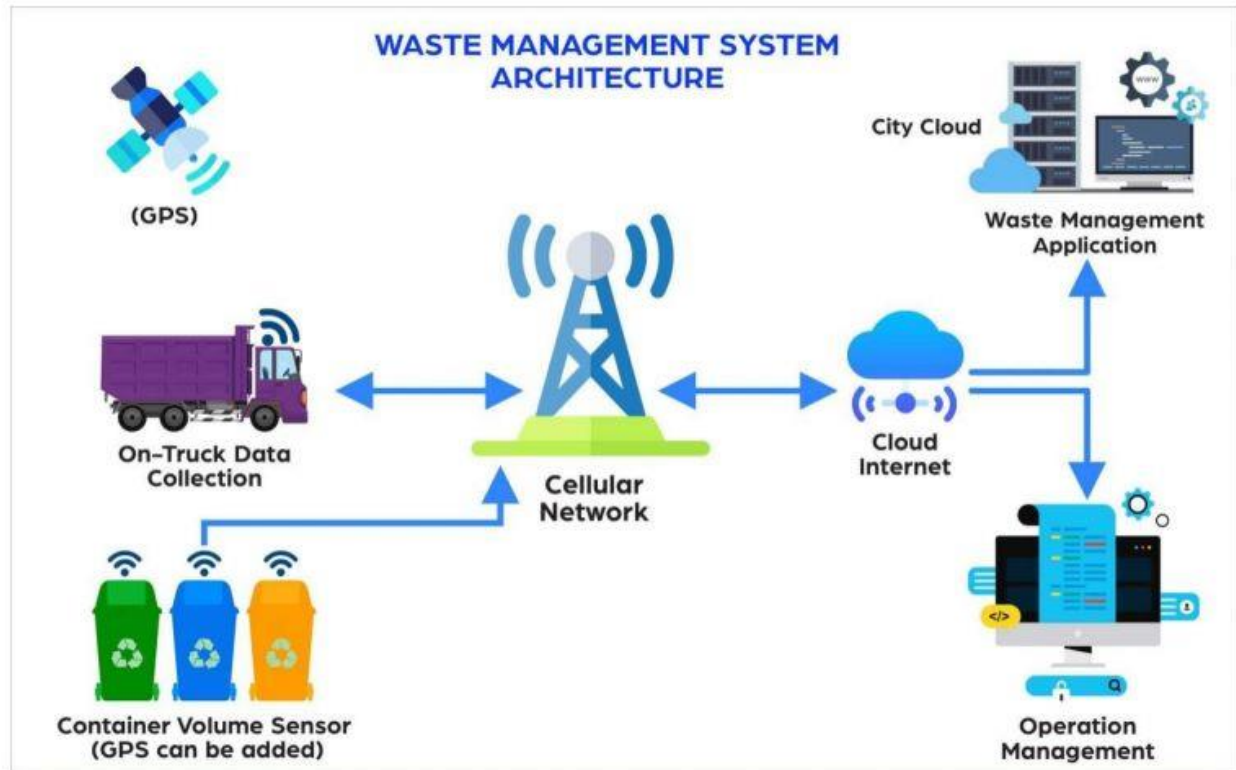
User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account	High	Sprint-1
	Login	USN-2	As an existing user, I can login easily with the help of a user ID/email or password	I can use my credentials to login	High	Sprint-1
		USN-3	As a user, I can sign in through email account	I can sign in through email	Medium	Sprint-1
	Dashboard	USN-4	As a user I can see the reading of sensors	Can view the readings	High	Sprint-II
		USN-5	As a user, it's easy to track parameters like bin level, temperature, humidity	Display readings	Medium	Sprint-II
		USN-6	As a user I am able to find optimum route to the nearest filled bin	Display route	Medium	Sprint-II
Customer (Web user)	Registration	USN-1	As a new user we can register by entering and creating the email ID and creating a password	I can access my account	High	Sprint-I
	Login	USN-2	As an existing user, I can login using email and password or by signing in through an email account	I can use my credentials to login	Medium	Sprint-I
	Dashboard	USN-3	As a user, I can see the bin fill level, temperature, humidity and its frequency of filling	Display suggestions	High	Sprint-II
Administrator	Maintenance	USN-I	Maintains data and security of the application	Security	High	Sprint-II

Solution and technical architecture

Solution Architecture Diagram:



6. PROJECT PLANNING AND SCHEDULING

Milestone and activity list

S.NO	ACTIVITY TITLE	ACTIVITY DESCRIPTION	DURATION
1	Understanding the project requirement	Assign the team members and create repository in the Github, Assign the task to each members and teach how to use and open and class the Github and IBM career education	1 WEEK
2	Starting of project	Advice students to attend classes of IBM portal create and develop an rough diagram based on project decription and gather of information on IOT and IBM project and team leader assign task to each member of the project	1 WEEK
3	Attend class	Team members and team lead must watch and learn from classes provided by IBM and NALAYATHIRAN and must gain	4 WEEK

		access of MIT license for their project	
4	Budget and scope of project	Budget and analyze the use of IOT in the project and discuss with team for budget prediction to predict the favourability for the customer to buy	1 WEEK

Sprint delivery plan

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story point	Priority	Team members
Sprint-1	Login	USN-1	As a Co-Admin, I'll control the waste level by monitoring them via real time web portal. Once the filling happens, I'll notify trash truck with location of bin with bin ID	10	high	Bala
Sprint-2	Dashboard	USN-2	As a Truck Driver, I'll follow Co-Admin's Instruction to reach the filling bin in short routes and save time	20	low	Yuvan
Sprint-3	Dashboard	USN-3	As a Local Garbage Collector, I'll gather all the waste from the garbage, load it onto a garbage truck, and deliver it to Landfills	20	medium	Aswanth

Sprint-4	Dashboard	USN-4	As a Municipality officer, I'll make sure everything is proceeding as planned and without any problems	20	high	Lokesh
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PROJECT PLANNING AND SCHEDULING

Sprint planning and estimation

Functional Requirement – Sign in / Sign up HTML CODE :

```
<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="UTF-8" />
<meta name="viewport" content="width=device-width, initial-scale=1.0" />
<title>Smart Waste Management System</title>
<!-- Bootstrap4 CSS CDN -->
<link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/bootstrap@4.5.2/css/bootstrap.min.css" /> <!-- Fontawesome CSS CDN -->
<link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/font-awesome@5.14.0/css/all.min.css" />
<link rel="stylesheet" href="css/style.css" />
</head>
<body class="bg-info">
<div class="container">
<!-- Login Form Start -->
<div class="row justify-content-center wrapper" id="login-box">
<div class="col-lg-10 my-autumShadow">
<div class="row">
<div class="col-lg-7 bg-whitep-4">
<h1 class="text-center font-weight-bold text-primary">Sign in</h1>
<hr class="my-3" />
<form action="#" method="post" class="px-3" id="login-form">
<div class="input-group input-group-lg form-group">
<div class="input-group-prepend">
<span class="input-group-text rounded-0"><i class="far fa-envelope fa-lg fa-fw"></i></span> </div>
<input type="email" id="email" name="email" class="form-control rounded-0"
placeholder="E-Mail"required /> </div>
<div class="input-group input-group-lg form-group">
<div class="input-group-prepend">
<span class="input-group-text rounded-0"><i class="fas fa-key fa-lg fa-fw"></i></span>
```

```

</div>
<input type="password" id="password" name="password" class="form-control
rounded-0" minlength="5" placeholder="Password" required
autocomplete="off" />
</div>
<div class="form-group clearfix">
<div class="custom-control custom-checkbox float-le ">
<input type="checkbox" class="custom-control-input" id="customCheck"
name="rem"/>
<label class="custom-control-label" for="customCheck">Remember me</label>
</div>
<div class="forgot float-right">
<a href="#" id="forgot-link">Forgot Password?</a>
</div>
</div>
<div class="form-group">
<input type="submit" id="login-btn" value="Sign In" class="btn btn-primary
btn-lg btn-block myBtn" />
</div>
</form>
</div>
<div class="col-lg-5 d-flexflex-column jus fy-content-center myColor p-4">
<h1 class="text-center font-weight-bold text-white">WelcomeFriend!</h1>
<hr class="my-3 bg-light myHr" />
<p class="text-center font-weight-bolder text-light lead">Start your ini a ve to
make your environment clean</p>
<bu on class="btn btn-outline-lightbtn-lg align-self-center font-weight-bolder
mt-4 myLinkBtn" id="register-link">Sign Up</bu on>
</div>
</div>
</div>
</div>
<!-- Login Form End -->
<!-- Registra on Form Start -->
<div class="row jus fy-content-center wrapper" id="register-box"style="display:
none;">
<div class="col-lg-10 my-automyShadow">

```

```

<div class="row">
<div class="col-lg-5 d-flexflex-column justify-content-center myColor p-4">
<h1 class="text-center font-weight-bold text-white">Welcome Back!</h1>
<hr class="my-4 bg-light myHr" />
<p class="text-center font-weight-bolder text-light lead">To stay
connectedPlease login with your personal info.</p>
<button class="btn btn-outline-light btn-lg font-weight-bolder mt-4 align-self-
center myLinkBtn" id="login-link">Sign In</button>
</div>
<div class="col-lg-7 bg-whitep-4">
<h1 class="text-center font-weight-bold text-primary">Create Account</h1> <hr
class="my-3" />
<form action="#" method="post" class="px-3" id="register-form">
<div class="input-group input-group-lg form-group">
<div class="input-group-prepend">
<span class="input-group-text rounded-0"><i class="far fa-user fa-lg fa-
fw"></i></span>
</div>
<input type="text" id="name" name="name" class="form-control rounded-0"
placeholder="Full Name" required/>
</div>
<div class="input-group input-group-lg form-group">
<div class="input-group-prepend">
<span class="input-group-text rounded-0"><i class="far fa-envelope fa-lg fa-
fw"></i></span>
</div>
<input type="email" id="email" name="email" class="form-control rounded-0"
placeholder="E-Mail"required />
</div>
<div class="input-group input-group-lg form-group">
<div class="input-group-prepend">
<span class="input-group-text rounded-0"><i class="fas fa-key fa-lg fa-
fw"></i></span>
</div>
<input type="password" id="password" name="password" class="form-control
rounded-0" minlength="5" placeholder="Password" required />
</div>

```

```

<div class="input-group input-group-lg form-group">
<div class="input-group-prepend">
<span class="input-group-text rounded-0"><i class="fas fa-key fa-lg fa-fw"></i></span>
</div>
<input type="password" id="cpassword" name="cpassword" class="form-control rounded-0" minlength="5" placeholder="Confirm Password"
required />
</div>
<div class="form-group">
<div id="passError" class="text-danger font-weight-bolder"></div>
</div>
<div class="form-group">
<input type="submit" id="register-btn" value="Sign Up" class="btn btn-primary btn-lg btn-block myBtn" />
</div>
</form>
</div>
</div>
</div>
</div>
<!-- Registra on Form End -->
<!-- Forgot PasswordForm Start -->
<div class="row jus fy-content-center wrapper" id="forgot-box" style="display: none;">
<div class="col-lg-10 my-automyShadow">

<div class="row">
<div class="col-lg-7 bg-whitep-4">
<h1 class="text-center font-weight-bold text-primary">Forgot Your Password?</h1>
<hr class="my-3" />
<p class="lead text-center text-secondary">To reset your password, enter the registered e-mail address and we will send you password reset instructions on your e-mail!</p>
<form action="#" method="post" class="px-3" id="forgot-form">
<div id="forgotAlert"></div>

```

```

<div class="input-group input-group-lg form-group">
<div class="input-group-prepend">
<span class="input-group-text rounded-0"><i class="far fa-envelope fa-
lg"></i></span>
</div>
<input type="email" id="femail" name="email" class="form-control rounded-0"
placeholder="E-Mail"required />
</div>
<div class="form-group">
<input type="submit" id="forgot-btn" value="Reset Password" class="btn btn-
primary btn-lg btn-block myBtn" />
</div>
</form>
</div>
<div class="col-lg-5 d-flexflex-column jus fy-content-center myColor p-4">
<h1 class="text-center font-weight-bold text-white">Reset Password!</h1>
<hr class="my-4 bg-light myHr" />
<bu on class="btn btn-outline-lightbtn-lg font-weight-bolder myLinkBtn align-
self-center" id="back link">Back</bu on>
</div>
</div>
</div>
</div>
<!-- Forgot PasswordForm End -->
</div>
<!-- jQuery CDN -->
<script src="h
ps://cdnjs.cloudflare.com/ajax/libs/jquery/3.5.1/jquery.min.js"></script> <script
src="js/script.js"></script>
</body> </html>

```

CSS CODE :

```

@import url("h
ps://fonts.googleapis.com/css?family=Maven+Pro:400,500,600,700,800,900&di
splay=swap");

```

```

* { margin: 0; padding: 0; box-sizing: border-box; font-family: "Maven Pro",
sans-serif;
}
.wrapper
{ height: 100vh;}
.myColor
{
background-image: linear-gradient(to right, #324bf3 50%, #f9d423 150%);
}
.myShadow { box-shadow: 0 10px 10px rgba(0, 0, 0, 0.5);
}
.myBtn { border-radius: 50px; fontweight: bold; font-size: 20px;
background-image: linear-gradient(to right, #0acffe 0%, #495aff 100%); border:
none;
}
.myBtn:hover { background-image: linear-gradient(to right, #495aff 0%, #0acffe
100%);
}
.myHr { height: 2px; border-radius: 100px;
}
.myLinkBtn { border-radius: 100px; width:
50%;
border: 2px solid #fff;
}
@media (max-width: 720px) {
.wrapper {
margin: 2px;
}
}

```

JS CODE:

```

$(func on () {

$("#register-link").click(func on () {

$("#login-box").hide();

```

```
$("#register-box").show();

});

$("#login-link").click(function () {

$("#login-box").show();

$("#register-box").hide();

});

$("#forgot-link").click(function () {

$("#login-box").hide();

$("#forgot-box").show();

});

$("#back-link").click(function () {

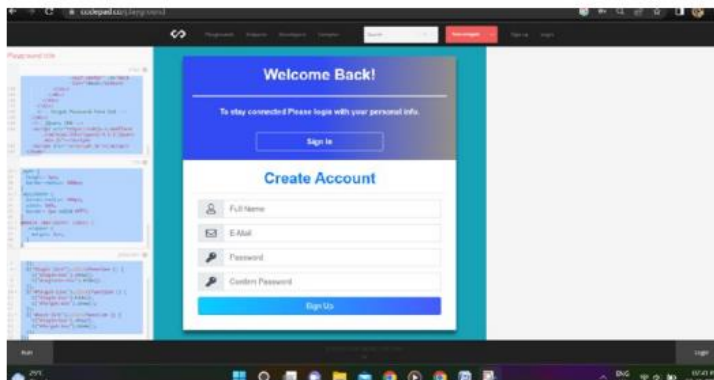
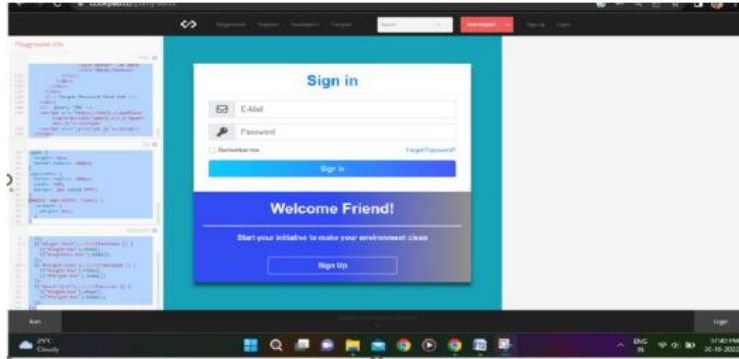
$("#login-box").show();

$("#forgot-box").hide();

});

});
```

OUTPUT:-



SPIRNT 2

Code for Data Transfer from Sensors

Code for Data Transfer from Sensors

```
#include <WiFi.h> // libraryfor wifi
```

```
#include <PubSubClient.h> // libraryfor MQTT#include
```

```
<LiquidCrystal_I2C.h>
```

```
LiquidCrystal_I2C lcd(0x27,20, 4);
```

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

```
#define ORG "9gbe4w" // IBM organisation id
```

```
#define DEVICE_TYPE "SWMSMC" // Device type mentioned in ibm watson  
iot platform
```

```
#defineDEVICE_ID "ibmproject" // DeviceID mentioned in ibm watson iot  
platform
```

```
#define TOKEN "sUNA41tG6-Pq)0rk5X" // Token
```



```

// customise above values -
charserver[] =ORG ".messaging.internetofthings.ibmcloud.com"; // server
namechar
publishTopic[] = "iot-2/evt/data/fmt/json";
char topic[] = "iot-2/cmd/led/fmt/String"; // cmd Represent type and command is
test format of strings
char authMethod[] = "use-token-auth"; // authentication methodchar
token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID; //Client id
//
WiFiClient wifiClient; // creatinginstance for wificlient
PubSubClient client(server, 1883, wifiClient);
#define ECHO_PIN 12
#define TRIG_PIN13float dist;
void setup()
{
Serial.begin(115200); pinMode(LED_BUILTIN,
OUTPUT); pinMode(TRIG_PIN, OUTPUT);
pinMode(ECHO_PIN, INPUT);
//pir pin pinMode(4, 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(); // functioncall to connectto IBM
  }
}
/* -retrieving to cloud */
void wifiConnect()
{
  Serial.print("Connecting to ");
  Serial.print("Wifi"); WiFi.begin("WokwiGUEST", "", 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 Detected");
Serial.println("Lid Opened"); digitalWrite(15,
HIGH);
}
else
{
digitalWrite(15, LOW);
}
if(digitalRead(34)==true)
{
if(cm <= 100) //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 > 150 && cm < 250)
{
digitalWrite(4, HIGH);
Serial.println("Warning!!,Trash is about to cross 50% of bin
level");digitalWrite(2,
LOW);
digitalWrite(23, LOW);
}
else if(cm > 250 && cm <=400)
{
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");
}
if(cm <= 100)
{
digitalWrite(21,HIGH);
String payload= "{\"High Alert!!\":\":";
payload+= cm;
payload += "left\" }"; Serial.print("\n");
Serial.print("Sending payload: ");
Serial.println(payload);
if (client.publish(publishTopic, (char*) payload.c_str())) // ifdata is uploaded to
cloud successfully,prints publish ok or printspublish failed
{
Serial.println("Publish OK");
}
}

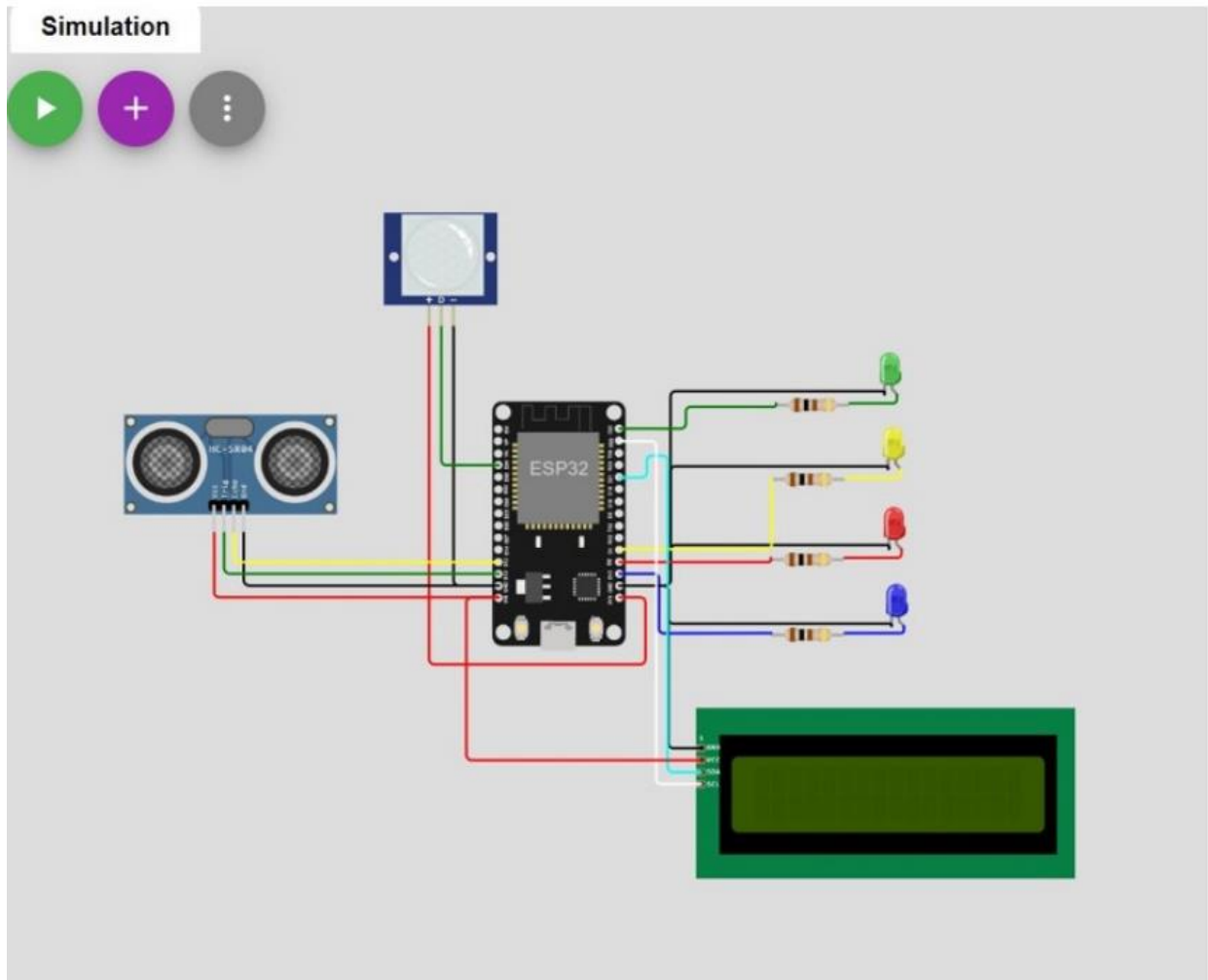
```

```

}
}
if(cm <= 250)
{
digitalWrite(22,HIGH);
String payload= "{\"Warning!!\":\":";
payload+= dist;
payload += "left\" }"; Serial.print("\n");
Serial.print("Sending distance: ");
Serial.println(cm);
if(client.publish(publishTopic, (char*) payload.c_str()))
{
Serial.println("Publish OK");
}
else
{
Serial.println("Publish FAILED");
}
}
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();
}

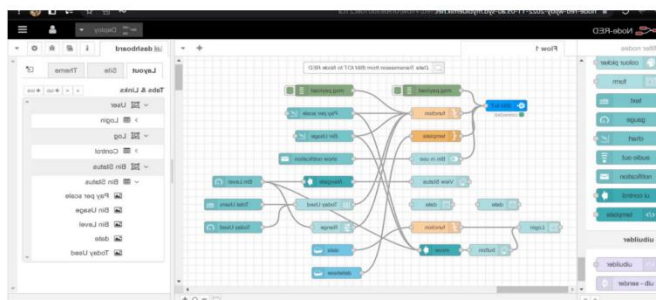
```

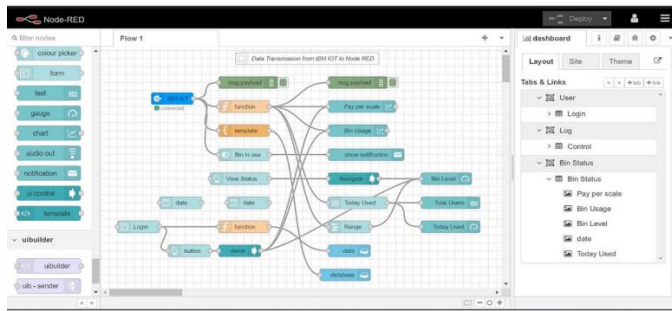
Connection Diagram



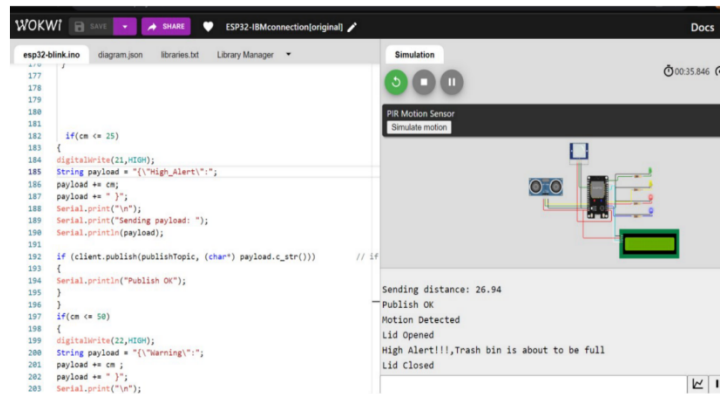
SPiRNT 3

1. Node-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.

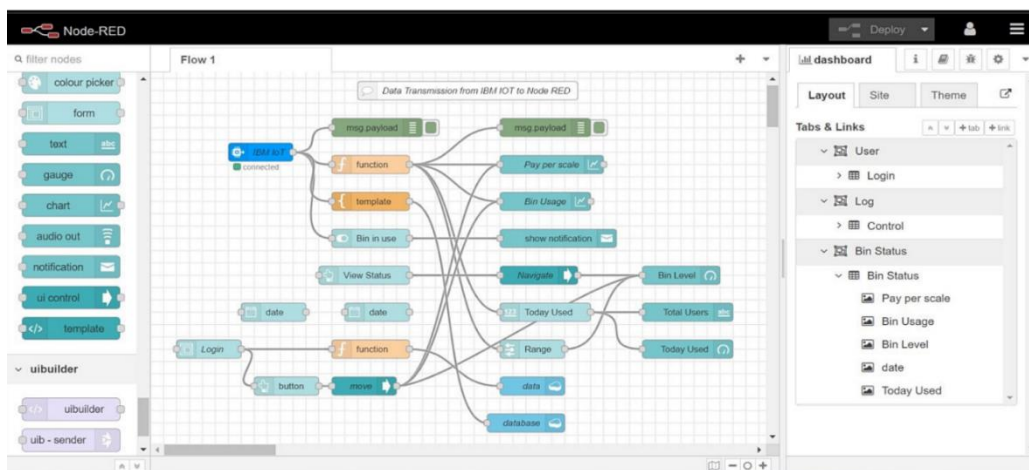
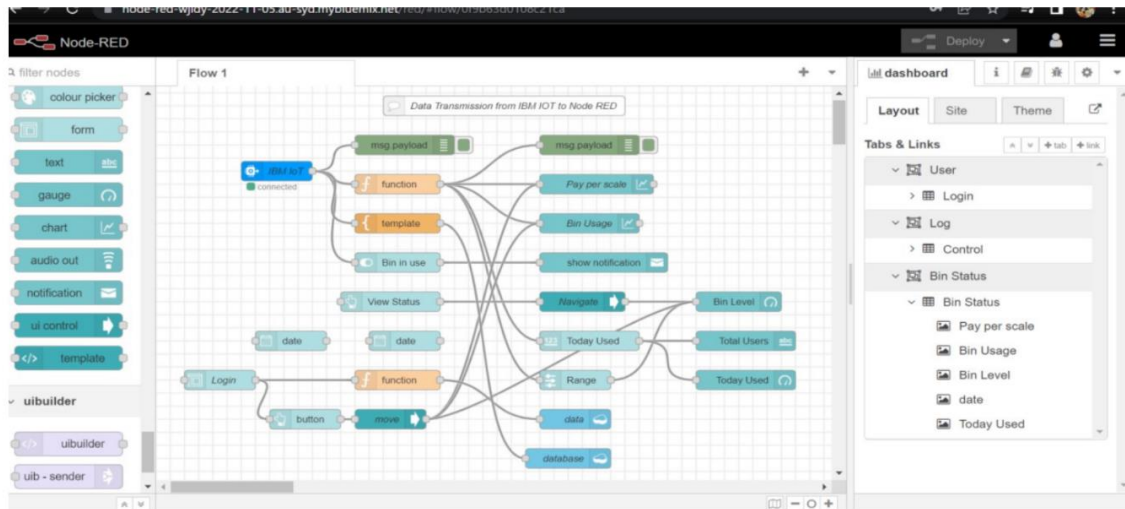


3. Data transfer to Watson IOT platform.

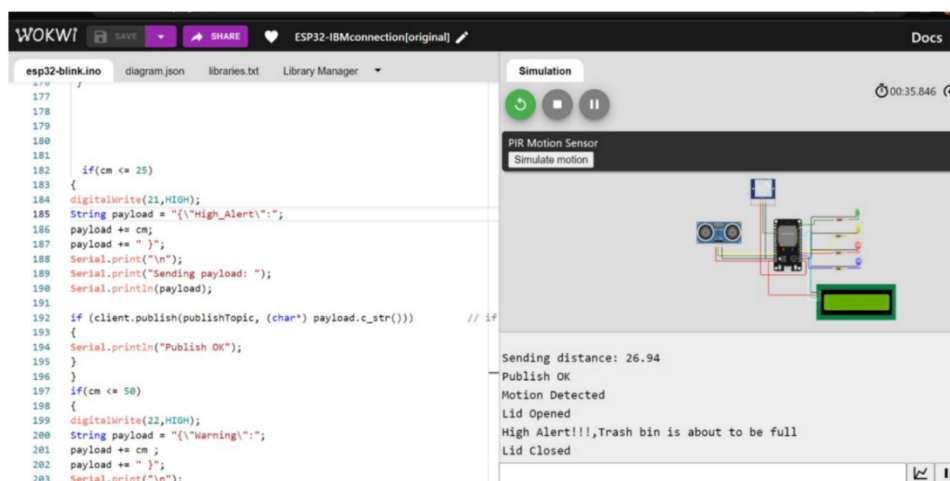
Event	Value	Format	Last Received
data	['Warning':28.95]	json	a few seconds ago
data	['Warning':28.95]	json	a few seconds ago
data	['Warning':49.98]	json	a minute ago
data	['Warning':49.98]	json	a minute ago
data	['Warning':11.03]	json	a minute ago

SPIRNT 4

1. Node-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.

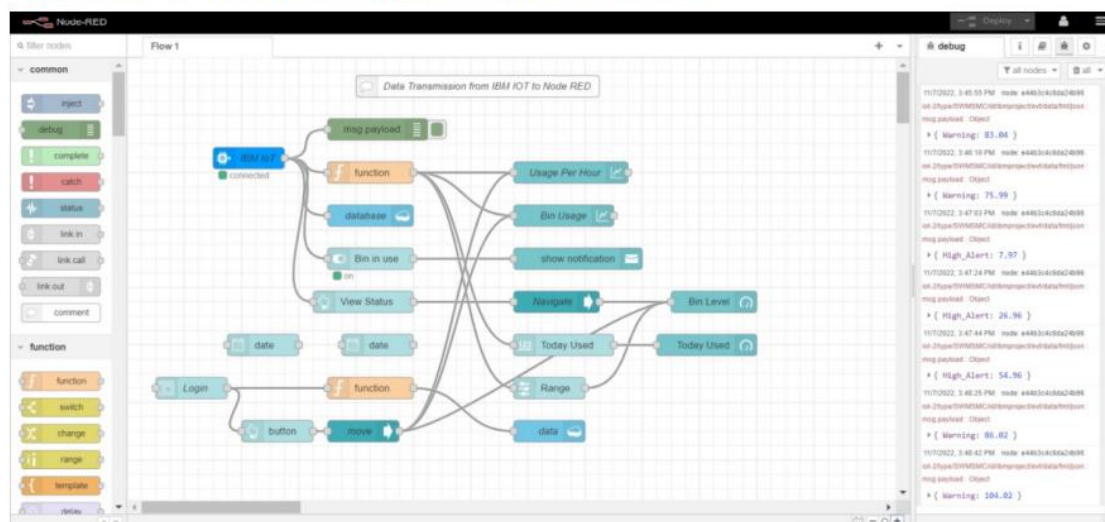


3.Data transfer to Watson IOT platform.

The screenshot shows the 'Recent Events' page in the EdgeX Foundry UI. The top navigation bar includes 'Browse', 'Action', 'Device Types', and 'Interfaces'. On the right, there is an 'Add Device' button with a plus icon. A left sidebar contains various icons for system management. The main content area has a heading 'Recent Events' followed by a paragraph: 'The recent events listed show the live stream of data that is coming and going from this device.' Below this is a table with four columns: Event, Value, Format, and Last Received. The table lists five events, all with a value starting with '[\"Warning\":' and ending with a timestamp. The format for all events is 'json', and the last received times are 'a few seconds ago', 'a minute ago', and 'a minute ago'.

Event	Value	Format	Last Received
data	[\"Warning\":28.95]	json	a few seconds ago
data	[\"Warning\":28.95]	json	a few seconds ago
data	[\"Warning\":49.98]	json	a minute ago
data	[\"Warning\":49.98]	json	a minute ago
data	[\"Warning\":11.03]	json	a minute ago

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



5. Storing database in IBM cloudant DB.

Database name

Create Database

{ } JSON

Databases

Your Databases

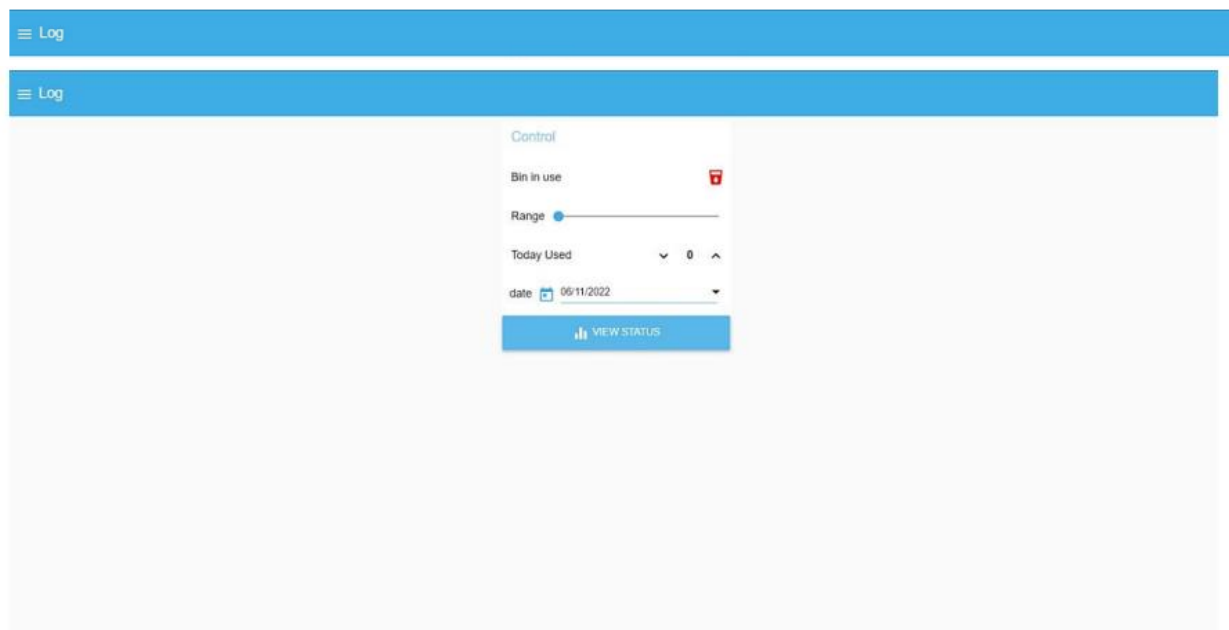
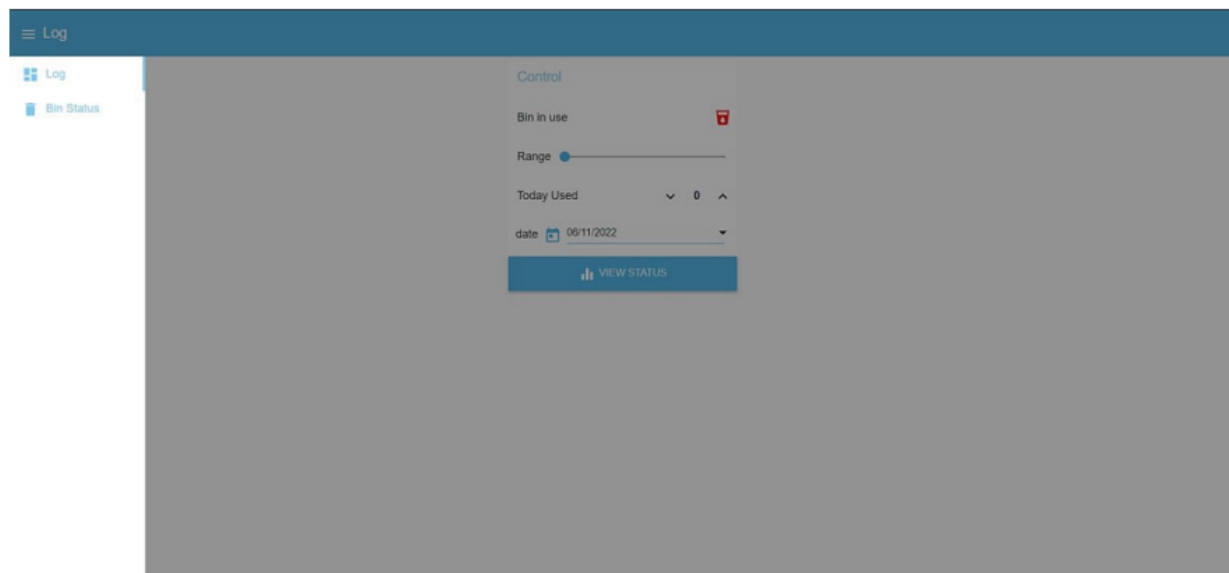
Name	Size	# of Docs	Partitioned	Actions
login_credentials	13.7 KB	111	No	<div></div> <div></div> <div></div>
noderedwjldy20221105	37.4 KB	4	No	<div></div> <div></div> <div></div>
sample	59.4 KB	351	No	<div></div> <div></div> <div></div>
sensor_data	15.7 KB	90	No	<div></div> <div></div> <div></div>

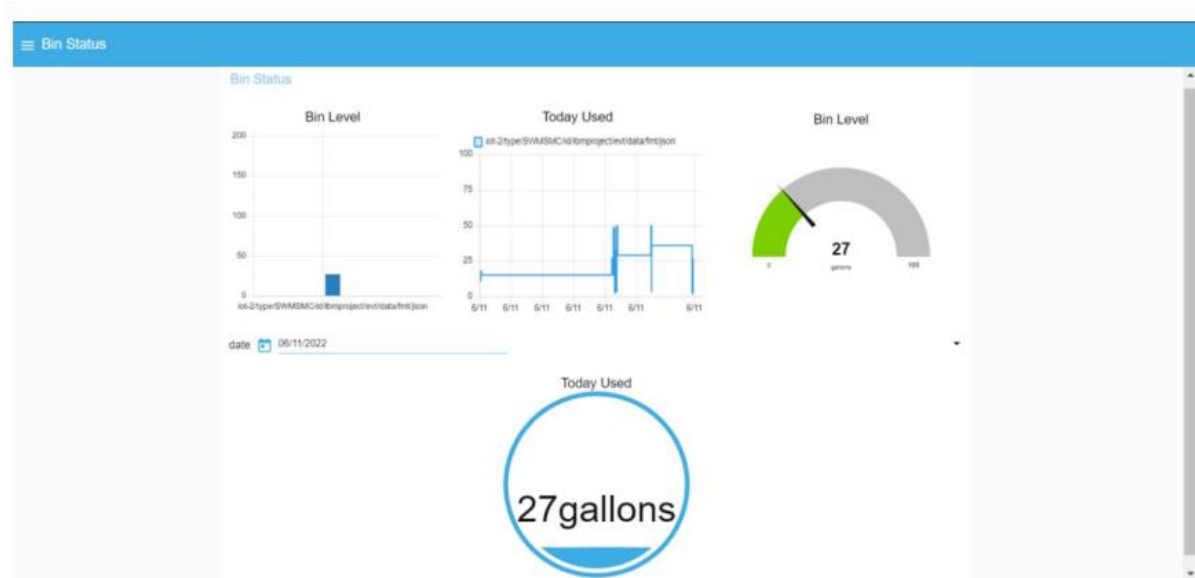
Showing 1–4 of 4 databases.

Databases per page 20

1

7. Web UI





CODING & SOLUTIONING (Explain the features added in the project along with code)

7.1 Feature 1

```
int t=2;
int e=3;

void setup()
{
  Serial.begin(9600);
  pinMode(t,OUTPUT);
  pinMode(e,INPUT);
  pinMode(12,OUTPUT);
}

void loop()
{
```

```
//ultrasonic sensor
digitalWrite(t,LOW);
digitalWrite(t,HIGH);
delayMicroseconds(10);
digitalWrite(t,LOW);
float dur=pulseIn(e,HIGH);
float dis=(dur*0.0343)/2;
Serial.print("Distance is: ");
Serial.println(dis);
```

```
//LED ON
if(dis>=100)
{
    digitalWrite(8,HIGH);
    digitalWrite(7,HIGH);
}
```

```
//Buzzer For ultrasonic Sensor
if(dis>=100)
{
    for(int i=0; i<=30000; i=i+10)
    {
        tone(12,i);
        delay(1000);
        noTone(12);
        delay(1000);
    }
}
```

```
//Temperate Sensor
double a= analogRead(A0);
double t=((a/1024)*5)-0.5)*100;
Serial.print("Temp Value: ");
Serial.println(t);
```

```
delay(1000);
```

```
//LED ON
```

```
if(t>=100)
```

```
{
```

```
    digitalWrite(8,HIGH);
```

```
    digitalWrite(7,HIGH);
```

```
}
```

```
//Buzzer for Temperature Sensor
```

```
if(t>=100)
```

```
{
```

```
for(int i=0; i<=30000; i=i+10)
```

```
{
```

```
tone(12,i);
```

```
delay(1000);
```

```
noTone(12);
```

```
delay(1000);
```

```
}
```

```
}
```

```
//LED OFF
```

```
if(t<100)
```

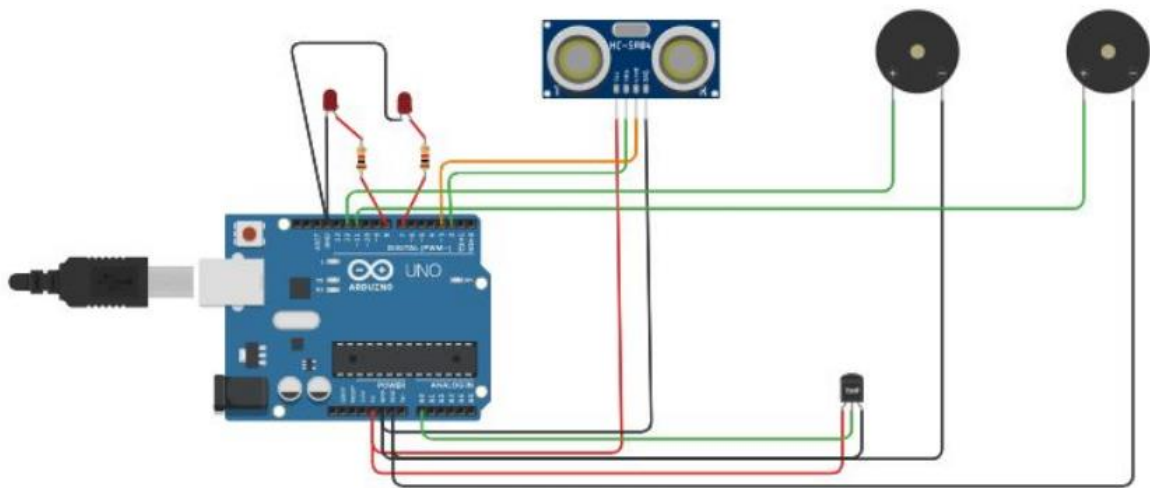
```
{
```

```
    digitalWrite(8,LOW);
```

```
    digitalWrite(7,LOW);
```

```
}
```

```
}
```



Feature 2

```
import random
```

```
while(True):
```

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

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

```
    if(a>35 and b>60):
```

```
        print("High Temperature and humidity of:",a,b,"% ","Alarm is ON")
```

```
    elif(a<35 and b<60):
```

```
        print("High Temperature and humidity of:", a, b, "% ", "Alarm is OFF")
```

```
    break
```

```
Run: main x
C:\Users\varun\PycharmProjects\pythonProject\venv\Scripts\python.exe C:\Users\varun\PycharmProjects\pythonProject\pythonProject\main.py
High Temperature and humidity of: 83 77 % Alarm is ON
High Temperature and humidity of: 18 23 % Alarm is OFF

Process finished with exit code 0
```

TESTING

TYPES OF TESTING

Manual Testing Manual testing includes testing a software manually, i.e., without using any automated tool or any script. In this type, the tester takes over the role of an end-user and tests the software to identify any unexpected behaviour or bug. There are different stages for manual testing such as unit testing, integration testing, system testing, and user acceptance testing. Testers use test plans, test cases, or test scenarios to test a software to ensure the completeness of testing. Manual testing also includes exploratory testing, as testers explore the software to identify errors in it. Following are the testing techniques that are performed manually during the test life cycle

- ❖ Acceptance Testing
- ❖ White Box Testing
- ❖ Black Box Testing
- ❖ Unit Testing
- ❖ System Testing
- ❖ Integration Testing

LEVELS OF TESTING

There are four levels of testing:

1. Unit
2. Integration
3. System
4. Acceptance

1) Unit Testing:

In this software testing process where individual units/components of a software/system are tested. The purpose is to validate that each unit of the software performs as designed. And with the help of this testing we also tested the individual hardware of the system.

2) Integration Testing:

A level of the software testing process where individual units and the hardware components are combined and tested as a group. The purpose of this level of testing is to expose faults in the interaction between software and the hardware.

3) System Testing:

A level of the software testing process where a complete, integrated system/software is tested. The

purpose of this test is to evaluate the system's compliance with the specified requirements and produce the required output.

4) Acceptance Testing:

A level of the software testing

process where a system is tested for acceptability. The purpose of this test is to evaluate the system's compliance with the business requirements and assess whether it is acceptable for delivery.

RESULT

In this dashboard which contain the different area of the city and each area contain the number of dustbin and in dashboard there will also be an admin option. To go to the admin option there will be a login page. The login page will only contain the admin ID to login to the page.

Figure 6.1 Dashboard

After that the admin can add the area and also can remove or delete the area from the dashboard. The admin can also add and delete the dustbin from the table. If the dustbin is not

showing the percent or it is not working then the admin can easily delete the dustbin from the table.

Each dustbin has its own dustbin ID and location where the bin is located. This dustbin ID and location are in a table and it shows the percentage of each dustbin in the table.

ADVANTAGES & DISADVANTAGES

ADVANTAGES

➡ It saves time and money by using smart waste collection bins and systems equipped with fill level sensors. As smart transport vehicles go only to the filled containers or bins. It reduces infrastructure, operating and maintenance costs by up to 30%.

➡ It decreases traffic flow and consecutively noise due to less air pollution as a result of less waste collection vehicles on the roads. This has become

possible due to two way communication between smart dustbins and service operators.

- ➡It keeps our surroundings clean and green and free from bad odour of wastes, emphasizes on healthy environment and keep cities more beautiful.
- ➡It further reduces manpower requirements to handle the garbage collection process.
- ➡Applying smart waste management process to the city optimizes management, resources and costs which makes it a "smart city".
- ➡It helps administration to generate extra revenue by advertisements on smart devices.

DISADVANTAGES

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

CONCLUSION

We Design and completed the investigation of complex problem for our problem statement “IOT Based Smart Garbage and Waste Collection Bin”. We have applied Engineering Knowledge for investigation and analyze societal problem so that it will be beneficial for engineer and society. We have studied previous work which is related to our project, we have analyze these work and try to overcome the problems and drawbacks of their work. We make use of modern tools and technologies for faster and advance development of the system. During the development of our project we learned so many things that give us lifelong learning. We came to importance of each individual and the whole team also. Team management and coordination is the key point for the successful development of the project

FUTURE SCOPE

We have successfully completed the project “Smart Garbage Management”, but, there still room for change.

- ❖ Automatic Garbage Fill system helps us to reduce the pollution. Many times garbage dustbin is overflow and many animals like dog or cow enters inside or near the dustbin. Also some birds are also trying to take out garbage from dustbin. This project can avoid such situations.
- ❖ And the message can be sent directly to the cleaning vehicle instead of the contractor’s office. Apart from this, differentiation can be made between dry trash bin and wet trash bin collecting plastic dry waste and biodegradable waste respectively.
- ❖ To implement this methane and smell sensors can be used. This helps in distinguishing the waste at the source and hence reducing the requirement of manpower. To enhance it further, an automated system can be developed which is able to pick up waste in and around the bin, segregate them and put them in respective bins.

