SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES

A PROJECT REPORT

Submitted by

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING
IN
ELECTRONICS AND COMMUNICATION ENGINEERING

KIT - KALAIGNARKARUNANIDHI INSTITUTE OF TECHNOLOGY, COIMBATORE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

NOVEMBER - 2022

Table of Contents

1. INTRODUCTION

a. PROJECT OVERVIEW:

The waste management is one of the challenges in the smart cities. The waste containers are typically placed in the public areas. Without well management, the waste containers may be overflowed or give off unpleasant smell, which affect the public health. An inefficient waste management may create serious environmental impacts like infectious diseases, land and water pollution, climate changes.This project proposes a smart waste management system, by using the IoT (Internet of Things) technology.

- The proposed system constructed to the top of the bins to detect bin level status and alert the admin through a cloud service-based application
- The application provides a monitoring platform for the waste management institution to handle the alert records by creating orders for the garbage collectors/drivers which can be accessed via a mobile application system

b. PURPOSE:

This initiative intends to assist municipal corporation. By cutting back on unneeded transportation costs to pointless locations, this lowers a significant amount of fuel costs for city businesses. Leads to a safe and healthy environment.

To monitor all the garbage bins status that are placed around the city through a cloud service-based mobile application. To alert the admin to collect the trashes which have been filled over a geographical area.

2. LITERATURE REVIEW

a. EXISTING SYSTEM:

›Real-time data monitoring through the website

›Location tracking system

›No other integrated system

b. REFERENCES:

TITLE	AUTHOR	YEAR	FEATURES
IOT BASED SMART WASTE BIN MANAGEMENT SYSTEM	M. C. Xenya, E. D'souza, K. D. Woelorm, R. Nii Adjei-Laryea, E. Baah-Nyarkoh	2020	• Monitor through mobile application system • Provides the location using GPS
SMART BIN FOR WASTE MANAGEMENT SYSTEM	S. Sreejith, R. Ramya, R. Roja, A.Sanjay Kumar	2019	• Monitor the level of waste • Automatic disposal of waste
REAL-TIME SOLID WASTE BIN MONITORING SYSTEM	M. A. Al Mamun, M. A. Hannan, A. Hussain	2014	• Monitor the bins • Stores and analyze the data

c. **PROBLEM STATEMENT DEFINITION:**

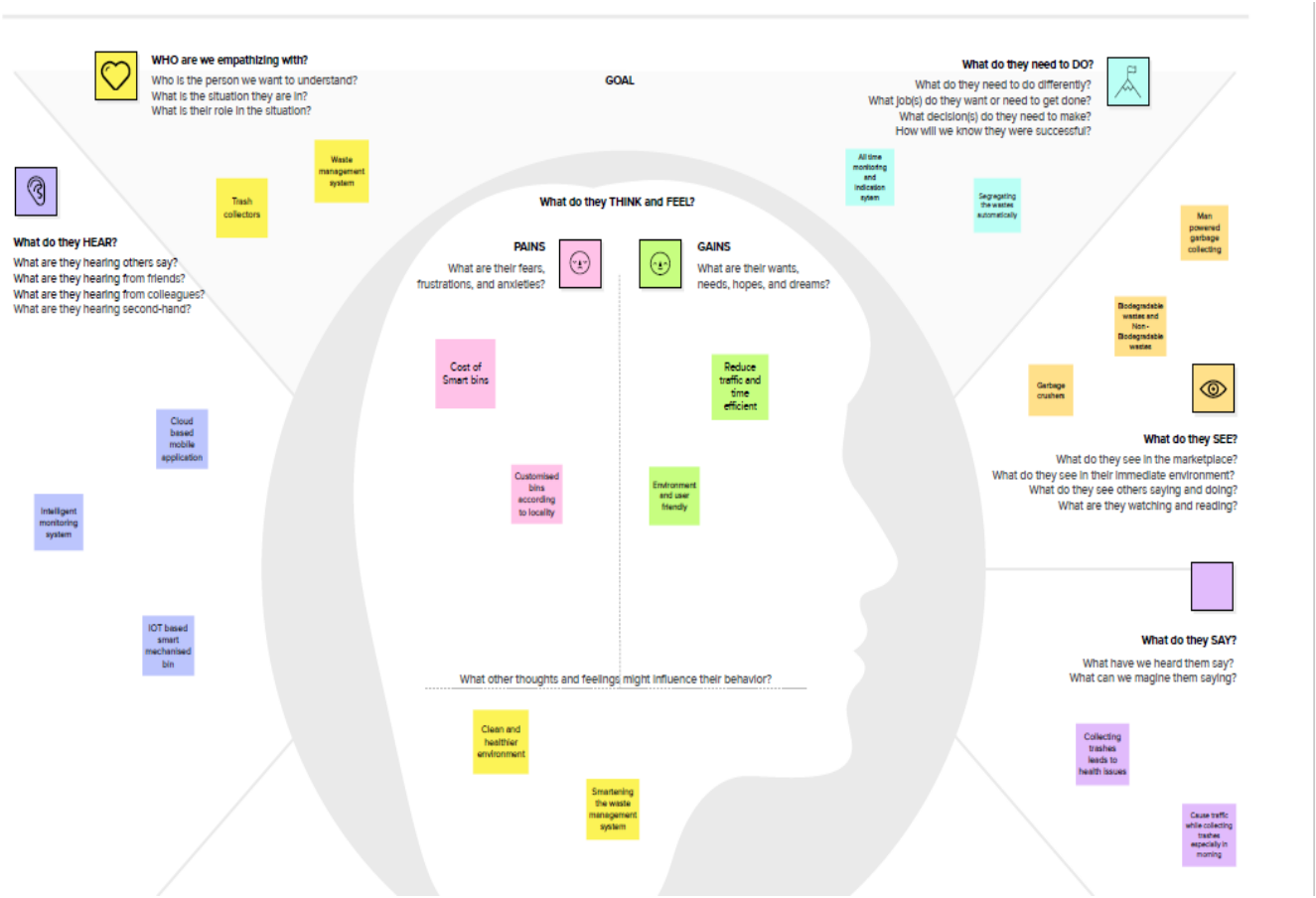
An inefficient waste management may create serious environmental impacts like infectious diseases, land and water pollution, climate changes.

- Timely collection of trashes is an essential part of the problem
- Collecting wastes during morning and evening leads to more traffic in metropolitan cities

3. IDEATION AND PROPOSED SOLUTON

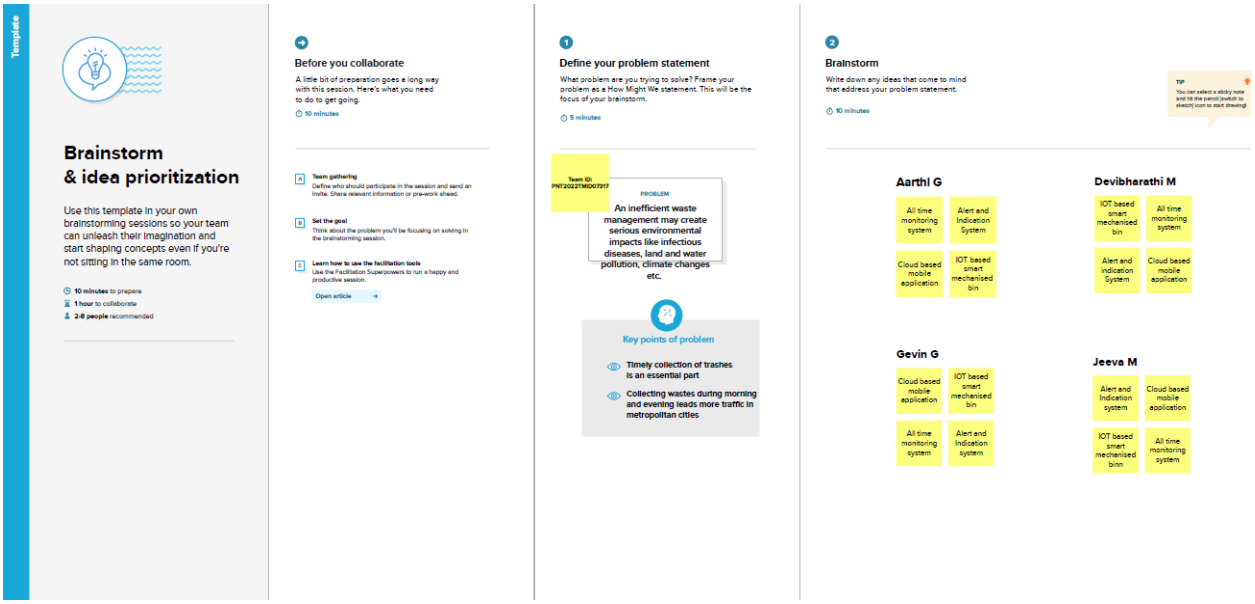
a. EMPATHY MAP CANVAS:

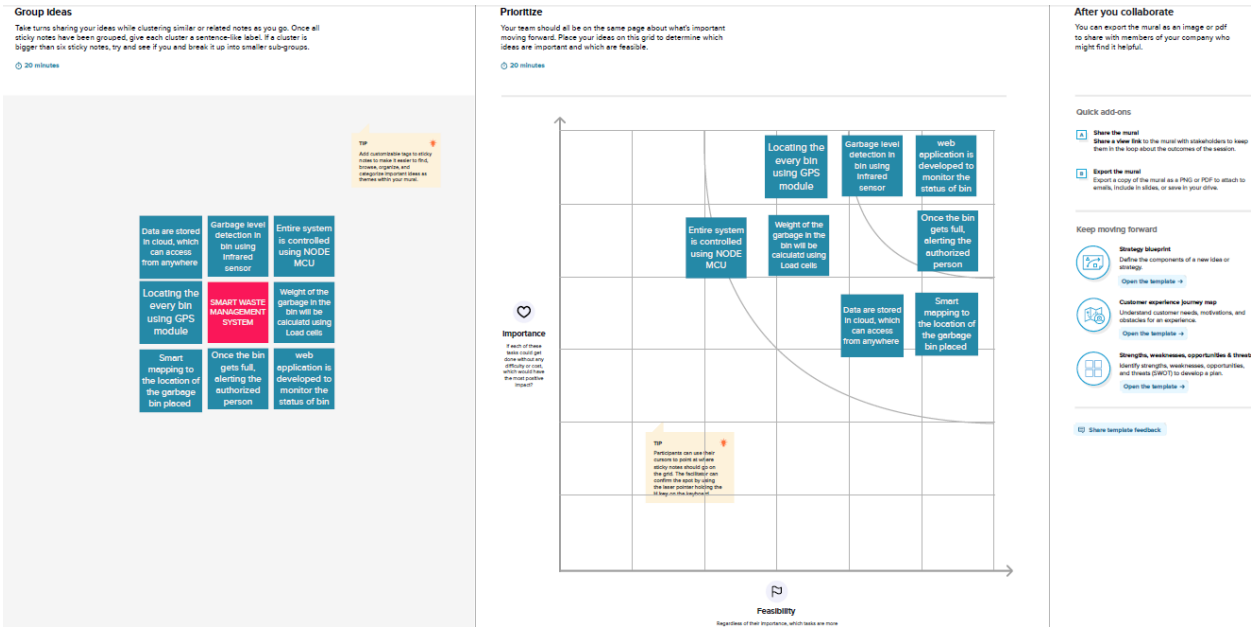
Developing a shared understanding and empathy by using a framework to empathize with a customer, user or any person who is affected by the problem statement.



b. **IDEATION AND BRAIN STORMING:**

Ideation is often closely related to the practice of brainstorming, a specific technique that is utilized to generate new ideas. A principal difference between ideation and brainstorming is that ideation is commonly more thought of as being an individual pursuit, while brainstorming is almost always a group activity.





c. **PROPOSED SOLUTION:**

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	An inefficient waste management may create serious environmental impacts like infectious diseases, land and water pollution, climate changes. ■ Timely collection of trashes is an essential part of the problem ■ Collecting wastes during morning and evening leads to more traffic in metropolitan cities
2.	Idea / Solution description	■ The proposed system constructed to the top of the bins to detect bin level status and alert the admin through a cloud service-based application ■ The application provides a monitoring platform for the waste management institution to handle the alert records by creating orders for the garbage collectors/drivers which can be accessed via a mobile application system
3.	Novelty / Uniqueness	■ All time monitoring system ■ Alerting the authorised person once the bin about to fill ■ Cloud based mobile application ■ IOT based smart mechanised bin
4.	Social Impact / Customer Satisfaction	■ Reduce traffic and time efficient ■ Environmental and user friendly ■ Reduce man power deployment in one time
5.	Business Model (Revenue Model)	■ This initiative intends to assist municipal corporation ■ By cutting back on unneeded transportation costs to pointless locations, this lowers a significant amount of fuel costs for city businesses ■ Leads to a safe and healthy environment

6.	Scalability of the Solution	■ The constant monitoring of trash cans by human labour saves a lot of time ■ It may be modernised to utilise automated rubbish pickup by trucks ■ There is no need to establish something new ■ Existing trash cans are somewhat changed

d. **PROPOSED SOLUTION FIT:**

Project Design Phase-I - Solution Fit

Project Title: SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES
Team ID: PNT2022TMID07317

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

- Garbage collector
- Municipal Corporation
- Health sector (public)

6. CUSTOMER CONSTRAINTS CC

- There is no system that can update the bin status
- Timely alerting the user

5. AVAILABLE SOLUTIONS AS

- Garbage crushers
- Biodegradable/ Non-biodegradable waste collectors
- Man powered garbage collection
- Location tracking system in garbage bins

Explore AS, differentiate

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

2. JOBS-TO-BE-DONE / PROBLEMS

- Timely collection of trashes is an essential part of the problem
- Collecting wastes during morning and evening leads to more traffic in metropolitan cities

9. PROBLEM ROOT CAUSE RC

- Increasing in population increases the wastes
- Busy working peoples

7. BEHAVIOUR BE

- Clean and healthy environment
- Smartening the waste management system
- Can monitor the bin wherever we are

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

3. TRIGGERS TR

- Automatic trash collectors
- Waste segregators
- Trash crushers

4. EMOTIONS: BEFORE / AFTER EM

- Reduce traffic and time efficient
- Environmental and user- friendly
- Reduce man power deployment in one time
- Haste work pressure will be rectified

10. YOUR SOLUTION SL

- The proposed system constructed to the top of the each bins to detect bin level status and alert the admin through a cloud service-based application
- The application provides a monitoring platform for the waste management institution to handle the alert records by creating orders for the garbage collectors/drivers which can be accessed via a mobile application system

8. CHANNELS of BEHAVIOUR CH

- Cloud based mobile application which can access through internet from anywhere
- IOT based smart mechanised bin which is a wireless communication system works

4. REQUIREMENT ANALYSIS

a. FUNCTIONAL REQUIREMENTS:

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Real time bin monitoring	■ The proposed system constructed to the top of the bins to detect bin level status and alert the admin through a cloud service-based application ■ The application provides a monitoring platform for the waste management institution to handle the alert records by creating orders for the garbage collectors/drivers which can be accessed via a mobile application system
FR-2	Eliminate inefficient picks	Get rid of the collection of half-empty trash cans. Picks are recognized by sensors. We can demonstrate to you how full the bins you collect are using real-time data on fill-levels and pick recognition
FR-3	Plan waste collection routes	Route planning for rubbish pickup is semi-automated using the tool. You are prepared to act and arrange for garbage collection based on the levels of bin fill that are now present and forecasts of approaching capacity. To find any discrepancies, compare the planned and actual paths
FR-4	Detailed bin inventory	On the map, you can see every monitored bin and stand, and you can use Google Street View at any time to visit them. On the map, bins or stands appear as green, orange, or red circles. The Dashboard displays information about each bin, including its capacity, trash kind, most recent measurement, GPS position, and pick-up schedule

b. NON-FUNCTIONAL REQUIREMENTS:

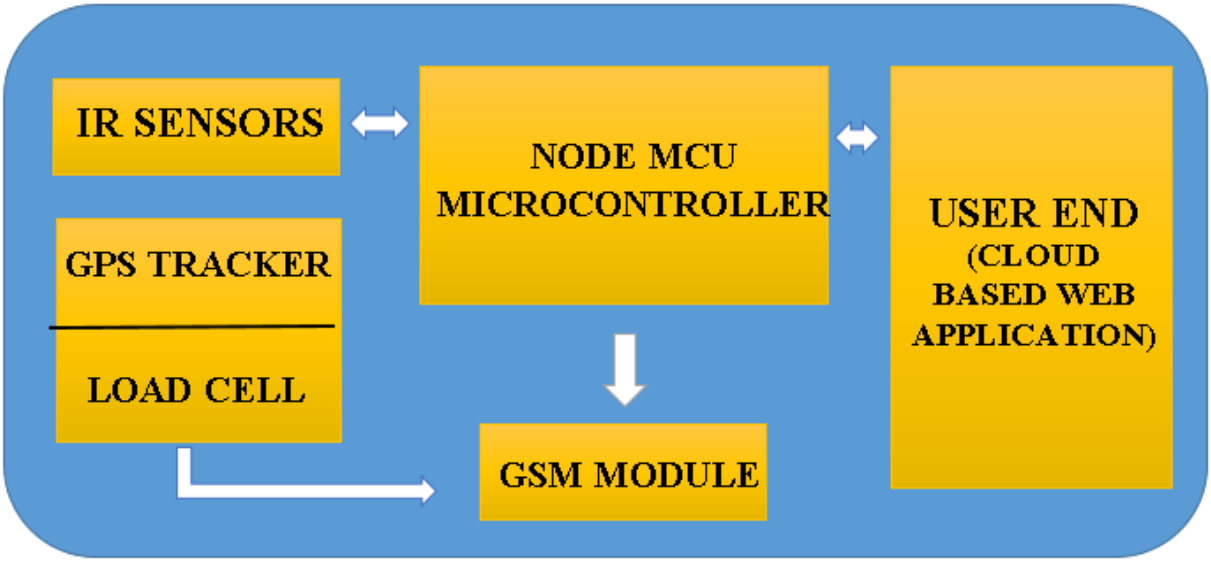
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability is a unique and significant perspective to examine user needs, which may further enhance the design quality, according to IOT devices. Analyzing how well people interact with a product may help designers better understand customers' prospective demands for waste management, behavior, and experience in the design process when user experience is at the Centre.
NFR-2	**Security**	Utilize recyclable bottles. Utilize reusable shopping bags. Spend responsibly and recycle Eat and drink in limited-use containers
NFR-3	**Reliability**	Creating improved working conditions for garbage collectors and drivers is another aspect of smart waste management. Waste collectors will use their time more effectively by attending to bins that require service rather than travelling the same collection routes and servicing empty bins.
NFR-4	**Performance**	The Smart Sensors assess the fill levels in bins (along with other data) numerous times each day using ultrasonic technology. The sensors feed data to Smart Waste Management Software System, a robust cloud-based platform with data-driven daily operations and a waste management app, using a variety of IOT networks. As a consequence, customers receive data-driven decision-making services, and garbage collection routes, frequency, and truck loads are optimized, resulting in at least a 30% decrease in route length
NFR-5	**Availability**	By creating and implementing robust hardware and gorgeous software, we enable cities, companies, and nations to manage garbage more intelligently.
NFR-6	**Scalability**	Using smart trash bins allows us to scale up and monitor the rubbish more efficiently while also reducing the number of bins needed in towns and cities

5. PROJECT DESIGN

a. DATA FLOW DIAGRAM:

Combining technology support with a vision of social, economic and environmental sustainability is the best way out of this problem. It is done in the following manner:

1. The smart bin system undergoes a thorough system check and battery level monitoring in order to function efficiently.
2. If the battery level is found to be low, it has to be recharged immediately, else it can proceed to the next step.
3. The threshold level levels of the bin are indicated my multiple sensors attached to bin. If the garbage exceeds the level, then an alert message is sent to the garbage collectors as well as to the municipality or area administration.
4. The area in which garbage is found to overflow is allocated to respective garbage collectors in the form of messages through GSM system.
5. Once the waste bin is emptied, an information update is sent to the municipality and server is updated.



b. **SOLUTION & TECHNICAL ARCHITE**CTURE:

Table-1: Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Mobile Application	HTML, CSS, JavaScript.
2.	Application Logic	Logic for a process in the application	Java
3.	Database	Data Type, Configurations etc.	MySQL
4.	Cloud Database	Database Service on Cloud	IBM Cloud
5.	File Storage	File storage requirements	Local File system and IBM cloud
6.	Infrastructure (Server / Cloud)	Application Deployment on Cloud Local Server Configuration	Local and Cloud Foundry

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Git-Hub	Internet hosting service
2.	Security Implementations	Application security Firewall: cisco	Network automation
3.	Scalable Architecture	It provides the room for expansion more database of smart bins added additionally can be updated.	Cloud storage
4.	Availability	As the system control is connected to web server it is available 24*7 and can be accessed whenever needed.	Server
5.	Performance	Performance is high it uses 5mb caches	Wireless Sensor Network

fig.technical architecture

c. **USER STORIES:**

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Admin (Corporate Authority)	Login	USN-1	As an administrator, I assigned user names and passwords to each employee and managed them.	I can control my online account and dashboard.	Medium	Sprint-1
Co-Admin	Login	USN-2	As a Co-Admin, I'll control the waste level monitor. If a garbage filling alert occurs, I will notify the trash truck of the location and rubbish ID.	I can handle the waste collection.	High	Sprint-1
Truck Driver	Login	USN-3	As a Truck Driver, I'll follow Co Admin's instruction to reach the filled garbage.	I can take the shortest path to reach the waste filled route specified.	Medium	Sprint-2
Local Garbage Collector	Login	USN-4	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	I can collect the trach, pull it to the truck, and send it out.	Medium	Sprint-3
Municipality officer	Login	USN-5	As a Municipality officer, I'll make sure everything is proceeding as planned and without any problems.	All of these processes are under my control.	High	Sprint-4

6. PROJECT PLANNING AND SCHEDULING

a. SPRINT PLANNING AND ESTIMATION:

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc.	30 SEPTEMBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements	26 SEPTEMBER 2022
Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	27 SEPTEMBER 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	25 SEPTEMBER 2022
Problem Solution Fit	Prepare problem - solution fit document.	2 OCTOBER 2022
Solution Architecture	Prepare solution architecture document.	30 SEPTEMBER 2022
Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit).	22 OCTOBER 2022

Functional Requirement	Prepare the functional requirement document.	10 OCTOBER 2022
Data Flow Diagrams	Draw the data flow diagrams and submit for review.	11 OCTOBER 2022
Technology Architecture	Prepare the technology architecture diagram.	12 OCTOBER 2022
Prepare Milestone & Activity List	Prepare the milestones & activity list of the project.	24 OCTOBER 2022
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developed code by testing it.	IN PROGRESS..

b. SPRINT DELIVERY SCHEDULE:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Login	USN-1	As an Administrator, I need to give user id and passcode for every worker over there in municipality	10	High	AARTHI G
Sprint-2	Login	USN-2	As a Co-Admin, I will control the waste level by monitoring them via real time web portal. Once the filling happens, I will notify trash truck with location of bin with bin ID	10	High	DEVIBHARATHI M
Sprint-3	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	GEVIN G
Sprint-4	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 and also I'll make sure everything is proceeding as planned and without any problems	20	Medium	JEEVA M

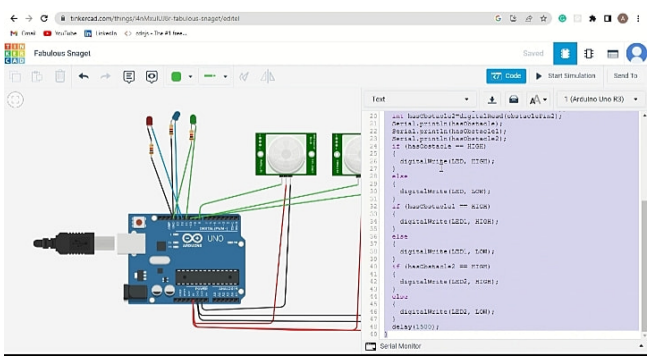
7. CODING AND SOLUTIONING

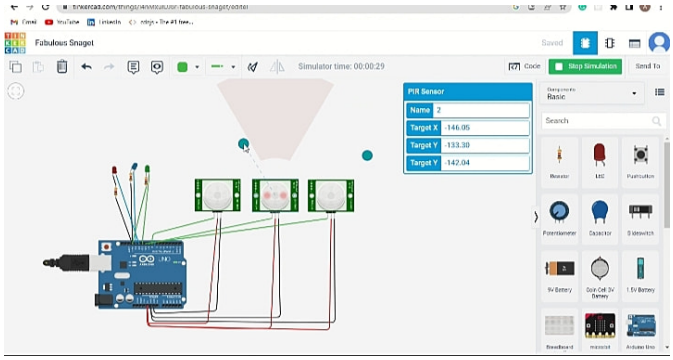
a. FEATURE 1 - IOT HARDWARE CODING:

✓ INFRARED SENSOR CODE:

```
int LED = 12;
int LED1=13;
int LED2=11;
int obstaclePin = 8;
int obstaclePin1 = 9;
int obstaclePin2 = 10;
void setup()
{
  pinMode(LED, OUTPUT);
  pinMode(obstaclePin, INPUT);
  pinMode(LED1, OUTPUT);
  pinMode(obstaclePin1, INPUT);
  pinMode(LED2, OUTPUT);
  pinMode(obstaclePin2, INPUT);
    Serial.begin(9600);
}
void loop() {
  int hasObstacle = digitalRead(obstaclePin);
  int hasObstacle1= digitalRead(obstaclePin1);
  int hasObstacle2=digitalRead(obstaclePin2);
  Serial.println(hasObstacle);
  Serial.println(hasObstacle1);
  Serial.println(hasObstacle2);
  if (hasObstacle == HIGH)
  {
    digitalWrite(LED, HIGH);
  }
  else
  {
    digitalWrite(LED, LOW);
  }
  if (hasObstacle1 == HIGH)
  {
    digitalWrite(LED1, HIGH);
```

```
  }
  else
  {
    digitalWrite(LED1, LOW);
  }
  if (hasObstacle2 == HIGH)
  {
    digitalWrite(LED2, HIGH);
  }
  else
  {
    digitalWrite(LED2, LOW);
  }
  delay(1500);
}
```

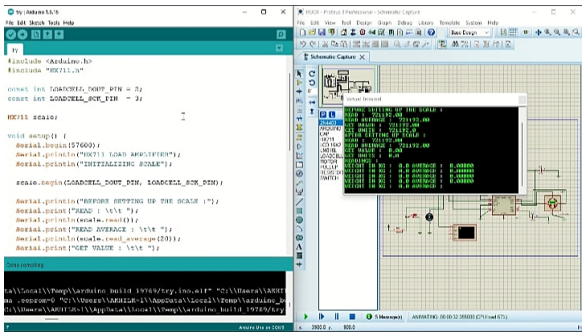


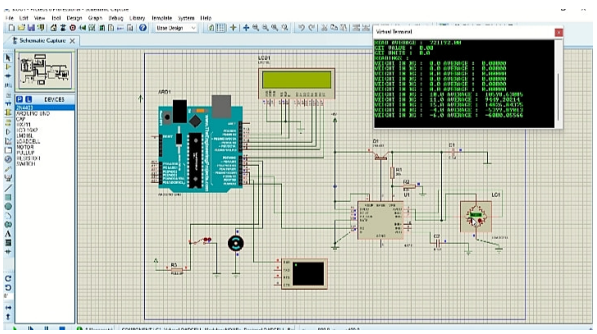


✓ <u>WEIGHT DETECTION CODING (LOAD CELL):</u>

```
#include <Arduino.h>
#include "HX711.h"
const int LOADCELL_DOUT_PIN = 2;
const int LOADCELL_SCK_PIN  = 3;

HX711 scale;

void setup() {
  Serial.begin(57600);
  Serial.println("HX711 LOAD AMPLIFIER");
  Serial.println("INITIALIZING SCALE");
```

```
  scale.begin(LOADCELL_DOUT_PIN, LOADCELL_SCK_PIN);

  Serial.println("BEFORE SETTING UP THE SCALE :");
  Serial.print("READ : \t\t ");
  Serial.println(scale.read());
  Serial.print("READ AVERAGE : \t\t ");
  Serial.println(scale.read_average(20));
  Serial.print("GET VALUE : \t\t ");
  Serial.println(scale.get_value(5));

  Serial.print("GET UNITS : \t\t ");
  Serial.println(scale.get_units(5), 1);
  scale.set_scale(36.059);
  scale.tare();
  Serial.println("AFTER SETTING UP SCALE :");

  Serial.print("READ : \t\t ");
  Serial.println(scale.read());

  Serial.print("READ AVERAGE : \t\t ");
  Serial.println(scale.read_average(20));
  Serial.print("GET VALUE : \t\t ");
  Serial.println(scale.get_value(5));
  Serial.print("GET UNITS : \t\t ");
  Serial.println(scale.get_units(5), 1);
  Serial.println("READINGS : ");
}

void loop() {
  Serial.print("WEIGHT IN KG : \t ");
  Serial.print(scale.get_units()/1000, 1);
  Serial.print("\t AVERAGE : \t ");
  Serial.println(scale.get_units(10), 5);

  delay(5000);
}
```





b. FEATURE 2 - SOFTWARE APPLICATION CODING:

HTML CODE :

```
<!DOCTYPE html>
<html lang="en">
 <head>
  <meta charset="UTF-8" />
  <meta name="viewport" content="width=device-width, initial-scale=1.0" />
  <title> Waste Management System</title>
   <!-- Bootstrap 4 CSS CDN -->

  <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/twitter-
   bootstrap/4.5.2/css/bootstrap.min.css" /> <!-- Fontawesome CSS CDN -->

  <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/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-auto myShadow">
      <div class="row">
       <div class="col-lg-7 bg-white p-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-left">
        <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-flex flex-column justify-content-center myColor
       p-4"> <h1 class="text-center font-weight-bold text-white">Welcome
       Friend!</h1>
       <hr class="my-3 bg-light myHr" />
       <p class="text-center font-weight-bolder text-light lead">Start the initiate to make your environment clean</p>
       <button class="btn btn-outline-light btn-lg align-self-center font-weight-bolder mt-4 myLinkBtn" id="register-link">Sign Up</button>
      </div>
    </div>
  </div>
 </div>
<!-- Login Form End -->

<!-- Registration Form Start -->

 <div class="row justify-content-center wrapper" id="register-box" style="display: none;">
  <div class="col-lg-10 my-auto myShadow">
   <div class="row">
    <div class="col-lg-5 d-flex flex-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 connected Please login.</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-white p-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="remail" 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="rpassword" 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>
   <!-- Registration Form End -->

   <!-- Forgot Password Form Start -->

    <div class="row justify-content-center wrapper" id="forgot-box" style="display: none;">
     <div class="col-lg-10 my-auto myShadow">
      <div class="row">
       <div class="col-lg-7 bg-white p-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-flex flex-column justify-content-center myColor p-4">
        <h1 class="text-center font-weight-bold text-white">Reset Password!</h1>
        <hr class="my-4 bg-light myHr" />
    <button class="btn btn-outline-light btn-lg font-weight-bolder myLinkBtn align-self-center"
                                                                id="back link">Back</button>
       </div>
```

```
        </div>
       </div>
      </div>
      <!-- Forgot Password Form End -->

     </div>
      <!-- jQuery CDN -->

     <script src="https://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("https://fonts.googleapis.com/css?family=Maven+Pro:400,500,600,700,800,900&display=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 rgba(0, 0,
    0, 0.5);
   }
   .myBtn { border-radius: 50px; font-weight: bold;
    font-size: 20px; background-image: linear-
    gradient(to right, #0acffe 0%, #495aff 100%);
    border: none;

   }
   .myBtn:hover { background-image: linear-gradient(to
```

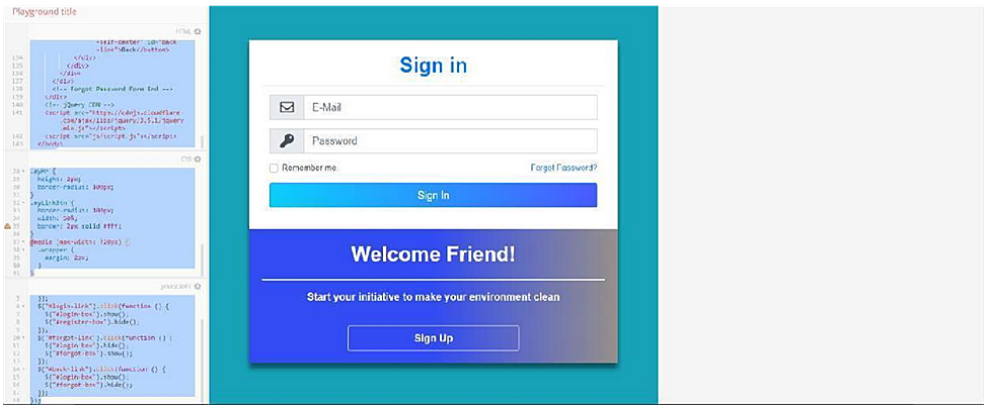
```
 right, #495aff 0%, #0acffe 100%);
}
.myHr { height: 2px; border-radius:
 100px;
}
.myLinkBtn { borderradius:
 100px;      width:
        50%;
        border:
        2px
 solid #fff;
}
@media (max-width: 720px) {
 .wrapper
  { margin:
  2px;
 } }
```

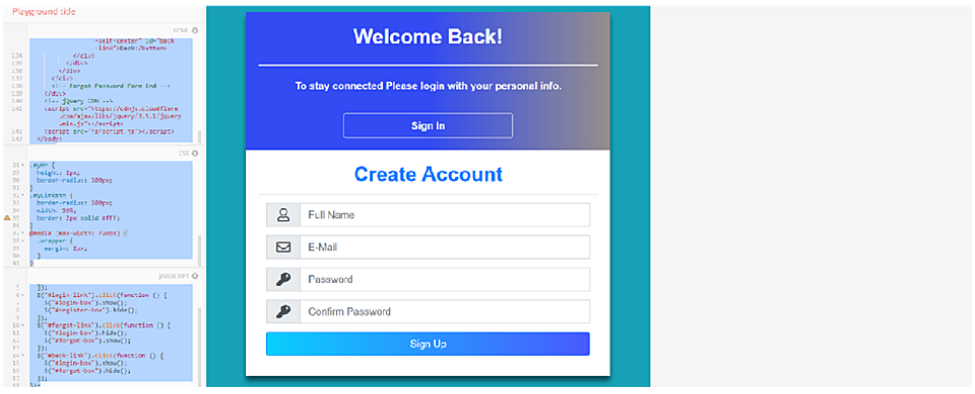
JS CODE:

```
 $(function () {
 $("#register-link").click(function () {
   $("#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 :





8. TESTING

a. TEST CASES:

Date					18-Nov-22						
Team ID					PNT2022TMID07317						
Project Name					SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES						
Maximum Marks					4 marks						
Test case ID	**Feature Type- Bin Level**	**Component**	**Test Case Scenario**	**Pre-Requisite**	**Availability**	**Test Condition**	**Expected Result**	**Actual Result**	**Status**	**Comments**	**Accessed By**
Test case 1	Empty	Infrared Sensor	When Bin is empty	Infrared Sensor, Load cells, Garbage Bins	Bin is accessible to users	Bin Level == 0	Displays Bin level and space left	Working as expected	Pass		User
Test case 1	Accessible	Infrared Sensor	When bin level is below 50 %	Infrared Sensor, Load cells, Garbage Bins	Bin is accessible to users	Bin Level < 50	Displays Bin level and space left	Working as expected	Pass		User
Test case 3	Accessible	Infrared Sensor	When bin level is above 50	Infrared Sensor, Load cells, Garbage Bins	Bin is accessible to users and the admin gets warning about the bin level	Bin Level > 50	Displays Bin level and space left	Working as expected	Pass		User
Test case 4	Accessible	Infrared Sensor	When bin level is below 75 %	Infrared Sensor, Load cells, Garbage Bins	Bin is accessible to users and the admin gets warning about the bin level	Bin Level < 75	Displays Bin level and space left	Working as expected	Pass		User
Test case 5	Limit exceeded	Infrared Sensor	When bin level is above 75 %	Infrared Sensor, Load cells, Garbage Bins	Bin is not accessible to the users, the admin recieves High alert and seals the the bin to avoid overflow.	Bin Level > 75	Displays Bin is FULL and Seals the bin.	Working as expected	Pass	The system starts to sense the level once the Bin is emptied partially or fully	User/Admin

b. USER ACCEPTANCE TESTING:

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	51	0	0	51
Security	2	0	0	2
Outsource shipping	3	0	0	3
Exception reporting	9	0	0	9
Final report output	4	0	0	4
Version control	2	0	0	2

9. RESULTS

a. PERFORMANCE METRICES:

One of the main concerns with our environment has been solid waste management which impacts the health and environment of our society. The detection, monitoring and management of wastes is one of the primary problems of the present era. The traditional way of manually monitoring the wastes in waste bins is a cumbersome process and utilizes more human effort, time and cost which can easily be avoided with our present technologies. This is our solution, a method in which waste management is automated. This is our IoT Garbage Monitoring system, an innovative way that will help to keep the cities clean and healthy.

10. ADVANTAGES AND DISADVANTAGES

Key Uniqueness:

 All time monitoring system

 Alerting the authorised person once the bin about to fill

 Cloud based mobile application

 IOT based smart mechanised bin

Challenges :

• Ensuring the Infrared sensor are correctly placed. If the pile of dump increased in the middle the sensor could be giving misleading data.

• There could be liquid/water thrown in to the bin. The design needs to have water proof electronics and embedded software.

• The BIGGEST issue availability of 3G/4G Cellular networks. The fact that we made a model at home bypassed this issue as we used WiFi. This in fact is this only main issue, although personally I feel in a couple of years every corner of the world will have Internet Connection

11. CONCLUSION

The report proposes IoT-enabled waste management system (SWM) for smart city applications. Therefore, an application is developed initially in the smart cities, namely, the smart waste management (SWM) system. The SWM system provides on-time garbage collection which eventually minimizes the total cost of the garbage collection process. The proposed work demonstrates that the waste management system in IOT empowers the cleaning operators to detect cleaning issues in real time. Therefore, this system helps in increasing overall productivity and cleanness.

12. FUTURE SCOPE

After having made one ourselves we realized how widely this system could be used to turn this rather horrible cumbersome chore into a really efficient one.

The way it can impact the city or even a country on a big scale is understandable, and hopefully in the future it is implemented. But other than that each individual can benefit with this concept. A community, an apartment complex or even a house can all use this powerful tool fueled by the internet of things to make their life a whole lot simpler.

13. APPENDIX

SOURCE CODE: https://docs.google.com/document/d/1cG02II68UQ6uHO_3FsvcK98c-LoaoNGM/edit?usp=drivesdk&ouid=100550727520349222160&rtpof=true&sd=true

PROJECT DEMO LINK:
https://drive.google.com/file/d/1cCXAMXrKr2C79GAnHiDAfXmrHau341gF/view?usp=drivesdk