Project Report Format

Project Overview

In this system, a 24×7 monitoring system is designed for monitoring dumpsters ,A smart and organized system is designed for selective clearing The ultrasonic sensor is used for measuring the level of waste in the dustbin , DC motor powered platform is used for segregating wet and dry waste ,IR sensor and moisture sensor is used for separating wet and dry waste .If either of the containers is full then an alert message is sent from the dustbin to employees and the cloud. In turn, employees can clear the corresponding dumpster

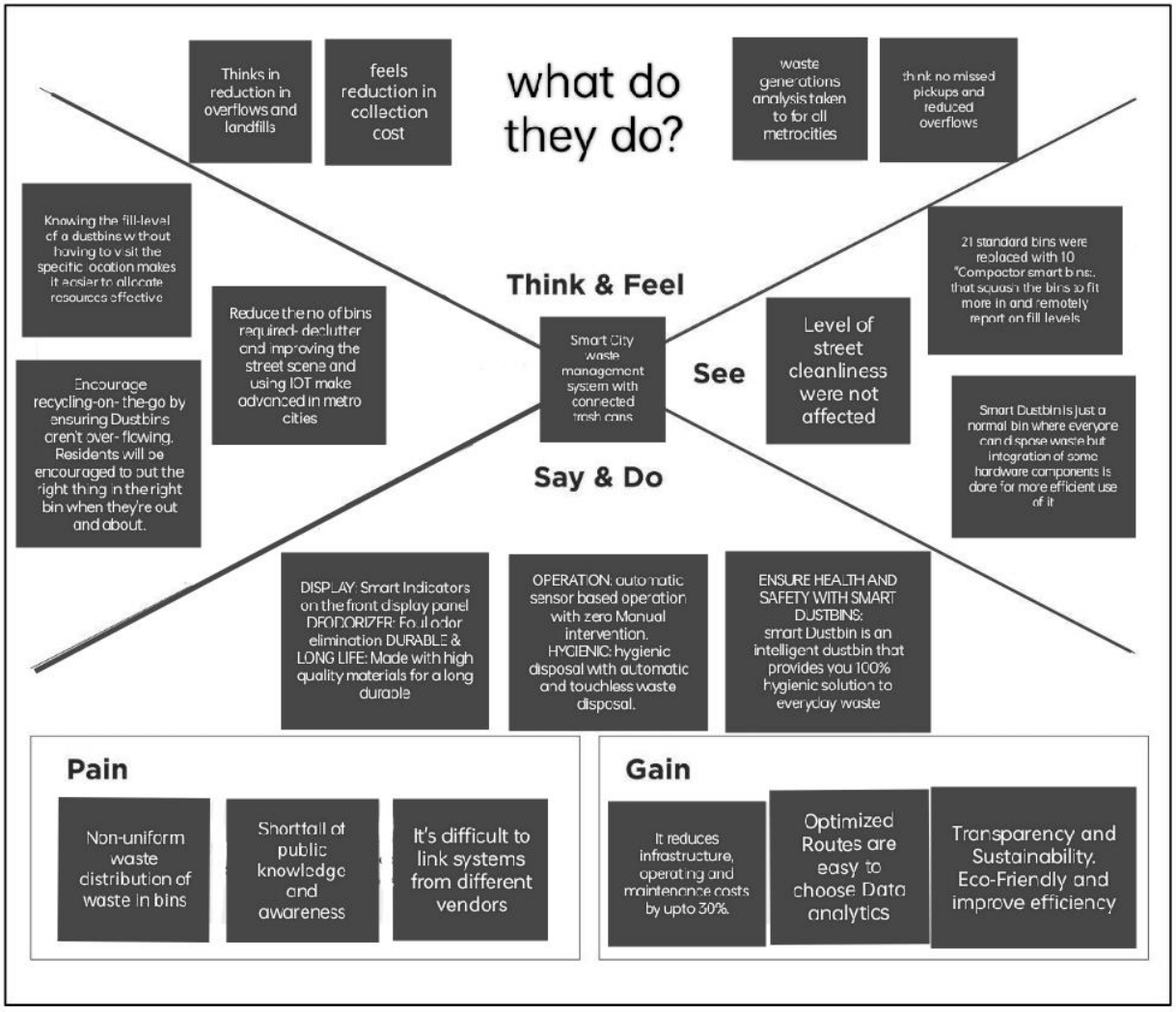
Purpose

It can analyze data collected from various sources, such as waste collection centers, recycling centers, and landfills, to identify trends in waste production, waste disposal, and recycling. This data can be used to create more efficient waste management plans and policies. It can also be used to analyze customer feedback and create targeted campaigns for waste management, such as information about recycling or composting.

Problem Statement Definition

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 waste is one of the primary problems of the present era. The Traditional way of manually monitoring the waste in waste bin is a cumbersome process and utilizes more human efforts, time and cost which can easily be avoided with our present technologies.

Empathy Map


Thinks in reduction in overflows and landfills
feels reduction in collection cost
what do they do?
waste generations analysis taken to for all metrocities
think no missed pickups and reduced overflows
Knowing the fill-level of a dustbins without having to visit the specific location makes it easier to allocate resources effective
Think & Feel
21 standard bins were replaced with 10 "Compactor smart bins", that squash the bins to fit more in and remotely report on fill levels
Reduce the no of bins required- declutter and improving the street scene and using IOT make advanced in metro cities
Smart City waste management system with connected trash cans
See
Level of street cleanliness were not affected
Encourage recycling-on-the-go by ensuring Dustbins aren't over-flowing. Residents will be encouraged to put the right thing in the right bin when they're out and about.
Smart Dustbin is just a normal bin where everyone can dispose waste but integration of some hardware components is done for more efficient use of it
Say & Do
DISPLAY: Smart Indicators on the front display panel DEODORIZER: For il odor elimination DURABLE & LONG LIFE: Made with high quality materials for a long durable
OPERATION: automatic sensor based operation with zero Manual intervention. HYGIENIC: hygienic disposal with automatic and touchless waste disposal.
ENSURE HEALTH AND SAFETY WITH SMART DUSTBINS: smart Dustbin is an intelligent dustbin that provides you 100% hygienic solution to everyday waste
Pain
Non-uniform waste distribution of waste in bins
Shortfall of public knowledge and awareness
It's difficult to link systems from different vendors
Gain
It reduces infrastructure, operating and maintenance costs by upto 30%.
Optimized Routes are easy to choose Data analytics
Transparency and Sustainability. Eco-Friendly and improve efficiency

Ideation & Brainstorming

Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	This project deals with the problem of waste management in 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	The bin which we are using here contains compactor which is used to push trash inside so that we get 4-8 times more space than normal dustbin.
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 ondistinct 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 corporatefunctions.
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 modelfor 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.

Functional Requirement & Non Functional Requirement

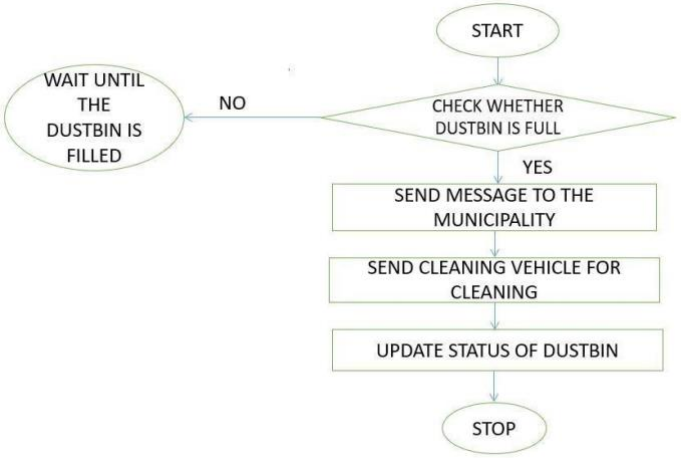
Functional Requirements: • Taking sensor reading from the Sensor Circuit • Pushing the data to a MySQL database. • Retrieving information from database for Calculation garbage bin which fulfils the condition for garbage collection, example: Collect garbage from bins whose level is over 80% of bin. • A client side script to get Garbage collection live Monitoring. Non-functional Requirement: • The project requires a user interface for monitoring and manually intervening (if required) in the efficient and timely collection of garbage from the selected Garbage bins.

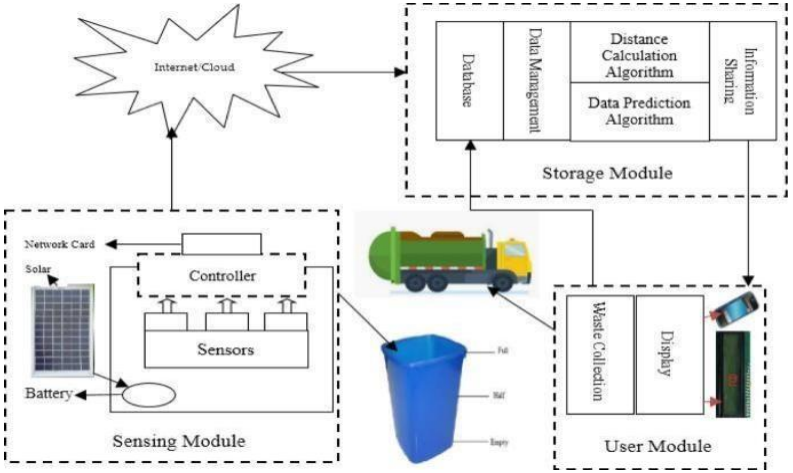
DATA FLOW DIAGRAM:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the rightamount of the system requirement graphically. It shows how data enters and leaves the system, what changes the

DFD for smart waste management for metropolitan cities.

information, and where data is stored.





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	Acceptanc
Authorised Person(Manages web app)	Login	USN-1	As an authorised person, I gave user id and passwordfor every workers and manage them.	I can acces page /dashboard
Admin	Login	USN-2	As a admin, I will manage garbage level monitor. When garbage gets filling alert, I will post location andgarbage Id to trash truck.	I can manag garbage monitoring
Truck Driver	Login	USN-3	As a driver, I'll follow the route sent by user to reachthe filled garbage location.	I can driv reachthe garb fille route in dy routegiven
Garbage Collector	Login	USN-4	As a garbage collector, I'll collect all the garbage from garbage bin and load it to the truck and send them to landfill.	I can colle garbagean to truck.
Municipality	Login	USN-5	As a municipality, I'll check the process are happeningin discipline manner without any issues.	I can mana theprocess good.

Solution and Technical Architecture

SOLUTION ARCHITECTURE

DESIGN

To segregate the different types of wastes by using modern technologies and giving notifications to the respective sectors while the waste is filled 45% and 75% of the bin by using trash talker.

USABLE

Easy to segregate.
It helps in reducing environmental pollution.
Saves dumping area spaces.
Usage of sector alarm prevents the overflow of wastes.

RELIABLE

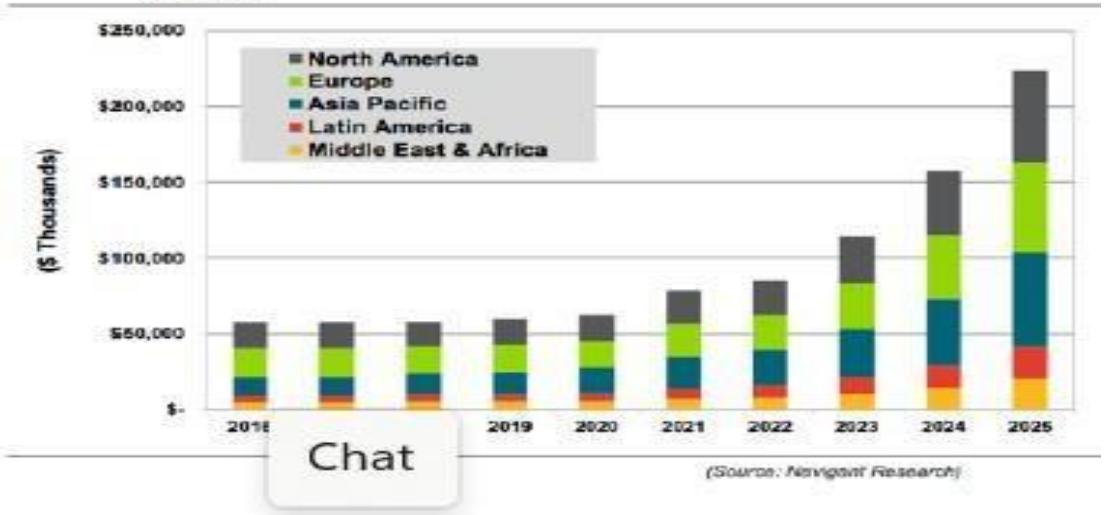
By implementing this we can make our environment clean and control the spreading of infectious diseases from garbage.

FUNCTIONAL ELEMENTS

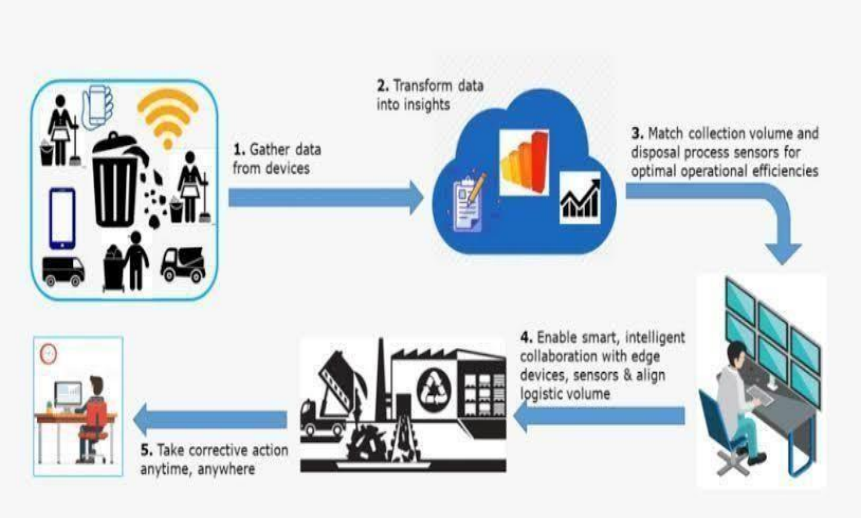
Our aim is to separate Organic waste, Paper waste, Plastic waste, Metal waste. In the separate bins Raspberry Pi camera with 12MP HQ and resolution 1080p.

GRAPH

Chart 1 *Annual Smart Waste Collection Technology Revenue by Region, World Markets: 2016-2025*



Technical Architecture



Guidelines:

1. Our proposed model provide real time monitoring to the garbage bins placed in various locations.
2. The garbage bins are build with a sensor module(Ultrasonic sensor) which continuosly monitors the garbage bin.
3. Any moment the garbage level passes over the critical level (i.e 80%),the system generates a notification to the monitoring panel (admin panel /garbage cleaning team) and so the cleaning team collects the garbage from the identified garbage bin.

User Stories

The society model of the 21st century has been increasingly influenced by cities in their context. According to the United Nations data, by 2050, approximately 70% of the population will live in urban centers, and this rapid growth of people living in cities has been of great concern, since towns do not always grow in a sustainable way. 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.

Taking into account the creation of a real prototype of the smart container and the implementation of a new waste management mobile application and corresponding

Web version, and based on the case study experiments, it was concluded that the proposed system can efficiently improve the way people deal with their garbage and optimize economic and material resources.

In future work, the application developed for this solution can be evolved by adding new facilities that can bring to the end user more significant interactions with the management system besides integration with a platform, to calculate the best path in collection routes, seeking efficiency with a lower cost of operating the fleet of trucks. In addition, the investment and operation costs of this solution will be a very interesting study and can be performed as future work.

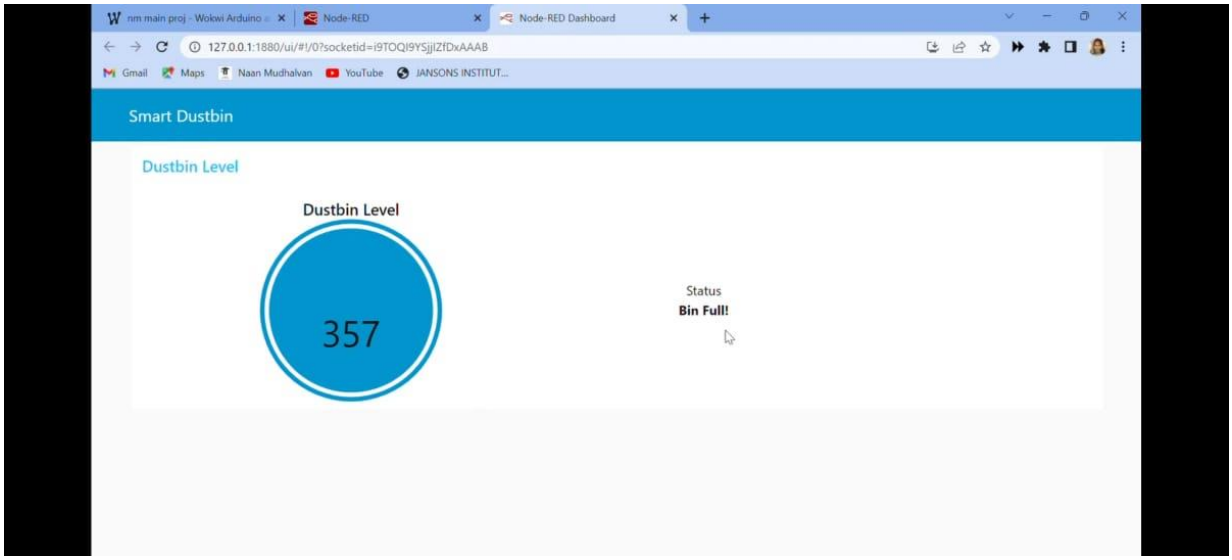
Coding & Solutions

Feature 1

An typical waste management system comprises collection, transportation, pre-treatment, processing, and final abatement of residues. Various types of waste can be collected separately.

Results

Performance Metrics



Advantages and Disadvantages

Advantages of Smart Waste Management

➡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 upto 30%.

➡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".

Disadvantages of Smart Waste Management

➡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 unemployment's for unskilled people.

➡The training has to be provided to the people involved in the smart waste management system.

Conclusion

Monitoring the fullness of bins through the use of sensors, it is possible to achieve a more efficient system than the current existing. Our idea of "Smart waste management system", mainly concentrates on Monitoring the waste management, providing a smart technology for waste system, avoiding human intervention, reducing human time and effort and which results in healthy and waste ridden environment. The proposed idea can be implemented for smart cities where the residents would be busy enough with their hectic schedule and wouldn't have enough time for managing waste. The bins can be implemented in a city if desired where there would be a large bin that can have the capacity to accumulate the waste of solid type for a single apartment. The cost could be distributed among the residents leading to cheaper service provision.

FUTURE ENHANCEMENTS:

There are several future works and improvements for the proposed system,

1. Change the system of user's authentication and atomic lock of bins which would help in securing the bin from any kind of damage or theft.

2. Concept of green-points that would encourage the involvement of the residents or the end users making the idea successful and helping to achieve joined efforts for the waste management and hence fulfilling the idea of Swachch Bharath.

3. Having a case study or data analytics on the type and times the waste is collected on the type of days or season making the bin filling predictable and removing the dependency on electronic components and fixing the coordinates.

4. Improving graphical interfaces for the Server and complete Android applications has possibility of extending the system adding other use cases and applications for smart cities.

5. Moreover, the proposed solution is flexible and decoupled with respect to the determination of optimal number of bins and vehicles or to the algorithm that define the best route for vehicles. Therefore, future works can be made in the study of models that offer the best results in terms of decision-making.

Source Code

```
#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQtt
#include "Ultrasonic.h"
Ultrasonic ultrasonic(2, 4);
float distance;


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

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

#define ORG "xhx8c5"//IBM ORGANISATION ID
#define DEVICE_TYPE "dustbin"//Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "123321" //Device ID mentioned in ibm watson IOT Platform
#define TOKEN "12345677"     //Token
String data3;
```

```
//float h, t;


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



//---------------------------------------
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the predefined client
id by passing parameter like server id,portand wificredential
void setup()// configureing the ESP32
{
  Serial.begin(115200);


  delay(10);
  Serial.println();
  wificonnect();
  mqttconnect();
}

void loop()// Recursive Function
{

  distance = ultrasonic.read(CM);

  Serial.print("Distance in CM: ");
  Serial.println(distance);
  delay(1000);

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

```
/*.....retrieving to Cloud.....*/

void PublishData(float distance) {
  mqttconnect();//function call for connecting to ibm
  /*
     creating the String in in form JSon to update the data to ibm cloud
  */
  String payload = "{\"distance\":";
  payload += distance;

  payload += "}";


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


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

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

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

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

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

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

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

  Serial.print("callback invoked for topic: ");
  Serial.println(subscribetopic);

  for (int i = 0; i < payloadLength; i++) {
    //Serial.print((char)payload[i]);
    data3 += (char)payload[i];
  }

  Serial.println("data: "+ data3);

data3="";


}
```

GitHub & Project Video Demo Link

https://youtu.be/ME4_WPEizbY

Git hub link-

https://github.com/DasariSankirthana/Smartcity-waste-Management-System-with-connected-trashcans