Internship Report

Group Members

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TITLE : IOT based Smart Dustbin and Waste Management System

INTRODUCTION

Dustbin is the storage container used for disposing waste by each and every person in the world. The main thing they look in their surroundings for disposing waste is the Dustbin.
The waste collection process is a critical aspect for the service providers. The traditional way of manually monitoring the wastes in waste bins is a complex, cumbersome process and utilizes more human effort, time and cost which is not compatible with the present day technologies. Irregular management of waste typically domestic waste, industrial waste and environmental waste is a root cause for many of the human problems such as pollution, diseases and has adverse effects on the hygiene of living beings. In order to overcome all these problems, we are proposing the idea of the smart waste management system which helps in auto-management of waste without human interaction in order to maintain a clean environment.

Currently, most municipal waste collection operations focus on emptying containers according to predefined schedules at a set frequency. This system is inherently inefficient, with half-full bins being emptied, poor use of city assets, and unnecessary fuel consumption. Smart solutions—for tracking waste levels, route optimization, and operational analytics—offer municipalities and waste service managers the ability to optimize waste management services, reduce operational costs, and better address the environmental issues associated with inefficient waste collection.

Most waste companies still operate using a traditional collection process, whereby bins are lifted on fixed days and static routes. This is highly inefficient, as trucks drive a considerable distance to collect bins that aren’t full. while ignoring others that are overfilled.

As a result, logistics costs are too high, customer service is poor and carbon emissions are through the roof.

Root cause is the lack of visibility on bin ‘demand’. Wouldn’t it be great if bins could do the talking? This is now possible by Internet of Things.

ABSTRACT

Every person in this world throws waste in the form of plastics, wet waste, dry waste and etc. Also, every person looks for a place or a plastic container to dispose that waste, that plastic container is the Dustbin which they look for. Dustbin is a plastic container where everyone can dispose their waste. Dustbin is used as a storage place to dispose waste, but we cannot estimate the exact amount of waste disposed by a society, and the dustbin cannot take more waste as the space should be available in it to take more. We need to know the level of waste in the dustbin and based on that we can intimate people to use the dustbin or not.

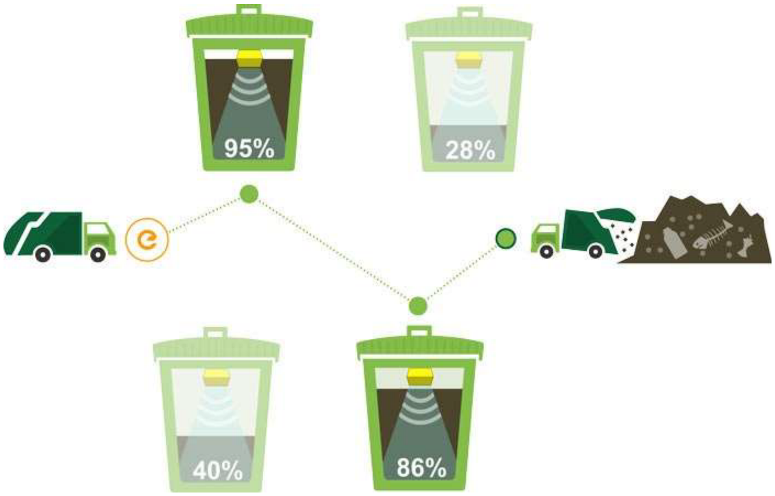
In this Smart Dustbin project, we have designed a prototype where the lid of the dustbin is opened, on detection of human hand and waste, and the level of waste available inside the dustbin is sent as notification in the form of LED. The main components we used in making this prototype are Arduino, NODEMCU, Servo Motor and Ultrasonic Sensors. The software component is the application named as Blynk which is used to get notification.

This dustbin can be a start to Smart Waste Management System where the officials can clean or empty the dustbin which depends on the notification received by them and not waiting for a call from a person of a society who informs the garbage trucks to come and take the waste from them.

LITERATURE REVIEW

First is the traditional method or the normal use of Dustbin in our daily life. Each and every person in the world disposes the waste in the dustbin and if the dustbin becomes full, he empties the waste inside the bin and again uses the same Dustbin. This is the basic use of a normal dustbin where no components are used, no coding is done and where everything is manual i.e. everything is done by hand. No batteries, no electronic components such as Arduino, NODEMCU are used. Only way of disposal is open the lid of the dustbin and dispose the waste in it and clean or empty it when it becomes full. When the same thing is applied in a neighbourhood or in a colony, the waste becomes more to dispose and if the dustbin is full people start throwing the waste around the dustbin which leads to different diseases.

The official who should empty the bin will be irregular in emptying the bin and the waste will be lying in that street for weeks causing unhealthy environment and leading to various diseases. The maintenance of the bin is also not proper where the lid is broken which leads in the overflowing of the waste from the bin. The advantages of using this method of disposal is the waste will be disposed in the bin and emptying the bin is easy as there are no electronic components used. In this method a plastic container storage bin will be present for disposal of waste but this method leads to various disadvantages than being advantageous. The various disadvantages are If the maintenance of the bin is not proper then the bin gets a stinky smell.



Traditional Bin- If the bin is not emptied immediately after it gets full then various flies, mosquitoes and other insects will be around it which leads to a cause of various diseases. If the bin does not have a lid then the waste is overflowed out of the bin causing damage to the environment. The second method is the use of dustbin with different segregations like green and blue bins which are placed together or the dustbin where only recyclable waste should be disposed. This method also has the same advantages and disadvantages as mentioned above because this method also does not use any hardware components or any electronic items like the above method. Only the bins are segregated in many types indicating which waste should be disposed in a particular bin.

ALGORITHM

1) Start.

2) Scan your dustbin’s unique barcode on the barcode reader attached on the bin for authentication and verification purpose by the web system.

3) After successful verification, put waste in the segregation section.

4) If in case of inappropriate waste disposal, fine would be charged in accordance to your identity generated as a result of scanning your barcode and identifying your identity in record from the database.

5) Just get your hand or any object near the sensor to open the lid without the need for any physical contact to encourage sanitation and hygiene.

6) Dispose off your waste according to the sensor’s instruction.

Dustbin Level Indicator

```
#include <ESP8266WiFi.h>
const int trigPin = D5;
const int echoPin = D6;
long duration;
int distance;

void send_event(const char *event);
float level;

const char* ssid = "Orange";
const char* password = "arkp8783iop";

const char *host = "maker.ifttt.com";
const char *privateKey = "mCbD-9xOx_oiTCiBVbSpwby5FD02YrYIM7maXDz6jvL";
WiFiServer server(80);

void setup() {
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
Serial.begin(9600);
Serial.print("Connecting to Wifi Network");
Serial.println(ssid);
WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED) {
```

```
delay(500);
Serial.print(".");
}
Serial.println("");
Serial.println("Successfully connected to WiFi.");
Serial.println("IP address is : ");
Serial.println(WiFi.localIP());
server.begin();
Serial.println("Server started");


}

void loop() {

digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance = duration * 0.0340 / 2;
Serial.println("Distance");
Serial.println(distance);
level =((28 -distance)/28.0)*100;
Serial.println("level");
Serial.println(level);

delay(1000);


WiFiClient client = server.available();

if (client)
{
Serial.println("Web Client connected ");
String request = client.readStringUntil('\r');
client.println("HTTP/1.1 200 OK");
client.println("Content-Type: text/html");
client.println("Connection: close"); // the connection will be closed after completion of the response
client.println("Refresh: 10"); // update the page after 10 sec
client.println();
client.println("<!DOCTYPE HTML>");
client.println("<html>");
client.println("<style>html { font-family: Cairo; display: block; margin: 0px auto; text-align:
center;color: #333333; background-color: ##f3ffee;}");
client.println("body{margin-top: 50px;}");
client.println("h1 {margin: 50px auto 30px; font-size: 50px; text-align: center;}");
client.println(".side_adjust{display: inline-block;vertical-align: middle;position: relative;}");
client.println(".text1{font-weight: 180; padding-left: 5px; font-size: 50px; width: 170px; text-align: left; color: #3498db;}");
client.println(".data1{font-weight: 180; padding-left: 1px; font-size: 50px;color: #3498db;}");
client.println(".data{padding: 1px;}");
client.println("</style>");
client.println("</head>");
client.println("<body>");
client.println("<div id=\"webpage\">");
client.println("<h1>IoT Based Dustbin</h1>");
client.println("<div class=\"data\">");
client.println("<div class=\"side_adjust text1\">Status:</div>");
client.println("<div class=\"side_adjust data1\">");
client.print(level);
client.println("<div class=\"side_adjust text1\">% filled</div>");
client.println("</div>");
client.println("</div>");
client.println("</body>");
client.println("</html>");
//client.println("<h1>Level Indicator</h1>");

if ( level >= 70) {
send_event("dustbin_event");
}

}
}

void send_event(const char *event)
{
Serial.print("Connecting to ");
Serial.println(host);

// Use WiFiClient class to create TCP connections
WiFiClient client;
const int httpPort = 80;
if (!client.connect(host, httpPort)) {
Serial.println("Connection failed");
return;
}

// We now create a URI for the request
String url = "/trigger/";
url += event;
url += "/with/key/";
url += privateKey;

Serial.print("Requesting URL: ");
Serial.println(url);
```

```
// This will send the request to the server
client.print(String("GET ") + url + " HTTP/1.1\r\n" +
"Host: " + host + "\r\n" +
"Connection: close\r\n\r\n");
while(client.connected())
{
if(client.available())
{
String line = client.readStringUntil('\r');
Serial.print(line);
} else {
// No data yet, wait a bit
delay(50);
};
}

Serial.println();
Serial.println("closing connection");
client.stop();
}
```

Automatic Dustbin Lid Opener

```
#include <Servo.h>   //servo library
Servo servo;
int trigPin = 5;
int echoPin = 6;
int servoPin = 7;
int led= 10;
long duration, dist, average;
long aver[3];   //array for average


void setup() {
   Serial.begin(9600);
   servo.attach(servoPin);
   pinMode(trigPin, OUTPUT);
   pinMode(echoPin, INPUT);
   servo.write(0);        //close cap on power on
   delay(100);
   servo.detach();
}

void measure() {
 digitalWrite(10,HIGH);
digitalWrite(trigPin, LOW);
delayMicroseconds(5);
digitalWrite(trigPin, HIGH);
delayMicroseconds(15);
digitalWrite(trigPin, LOW);
pinMode(echoPin, INPUT);
duration = pulseIn(echoPin, HIGH);
dist = (duration/2) / 29.1;    //obtain distance
}
void loop() {
  for (int i=0;i<=2;i++) {   //average distance
    measure();
   aver[i]=dist;
    delay(10);            //delay between
measurements
  }
 dist=(aver[0]+aver[1]+aver[2])/3;

if ( dist<50 ) {
//Change distance as per your need
 servo.attach(servoPin);
  delay(1);
 servo.write(0);
 delay(3000);
 servo.write(150);
 delay(1000);
 servo.detach();
}
Serial.print(dist);
```

Web Application code with Wildfly server and MySQL database XHTML CODE

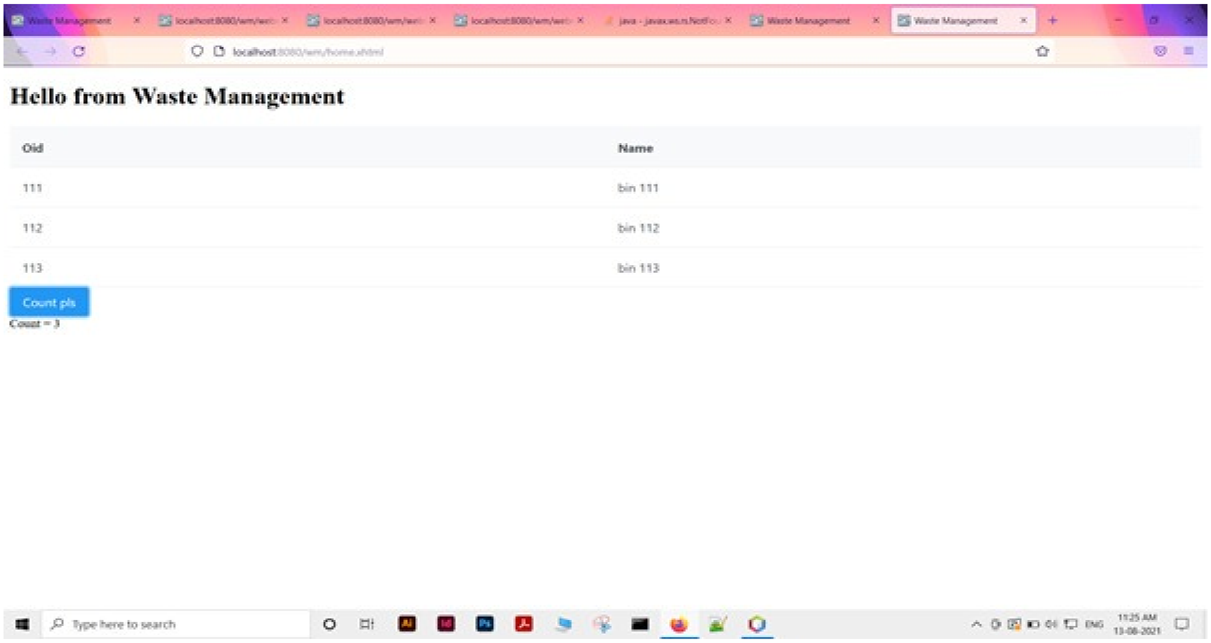
```
<?xml version='1.0' encoding='UTF-8' ?>

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">

<html xmlns="http://www.w3.org/1999/xhtml"

    xmlns:h="http://xmlns.jcp.org/jsf/html"

    xmlns:p="http://primefaces.org/ui">

    <h:head>

      <meta charset="UTF-8"/>

      <meta name="viewport" content="width=device-width, initial-scale=1.0"/>

        <title>Waste Management</title>

    </h:head>

    <h:body>

    <h1>Hello from Waste Management kbsdk</h1>

        <p:dataTable value="#{home.bins}" var="bin">
        <p:column headerText="Oid"> <h:outputText value="#{bin.oid}"/> </p:column>

        <p:column headerText="Name"> <h:outputText value="#{bin.name}"/> </p:column>

        </p:dataTable>



        <div>

        <h:form>

     <p:commandButton value="Count pls" actionListener="#{wsClientBean.onSomething}"

        update=":bingo" />

        </h:form>

        <h:outputText value="Count = "/>

        <h:outputText id="bingo" value="#{wsClientBean.countREST}"/>

        </div>

    </h:body>

</html>
```

JAVA CODE

```
package com.rajat.wastemanagement.controllers;

 import com.rajat.wastemanagement.entities.Bin;

import com.rajat.wastemanagement.facades.BinFacade;

import jakarta.annotation.PostConstruct;

import javax.inject.Named;

import javax.enterprise.context.SessionScoped;

import java.io.Serializable;

import java.util.List;

import java.util.logging.Level;

import java.util.logging.Logger;

import javax.inject.Inject;


@Named(value = "home")

@SessionScoped

public class Home implements Serializable {
```

```
@Inject

private BinFacade binFacade;

private List<Bin> bins;



/**

* Creates a new instance of Home

*/

public Home() {

}

public List<Bin> getBins() {

    if (bins == null) {

    init();
```

```
        }

        return bins;

    }



    @PostConstruct

    private void init() {

Logger.getLogger(this.getClass().getSimpleName()).log(Level.INFO, "init()");

        bins = binFacade.findAll();

    }

}
```



Hello from Waste Management

Oid	Name
111	bin 111
112	bin 112
113	bin 113

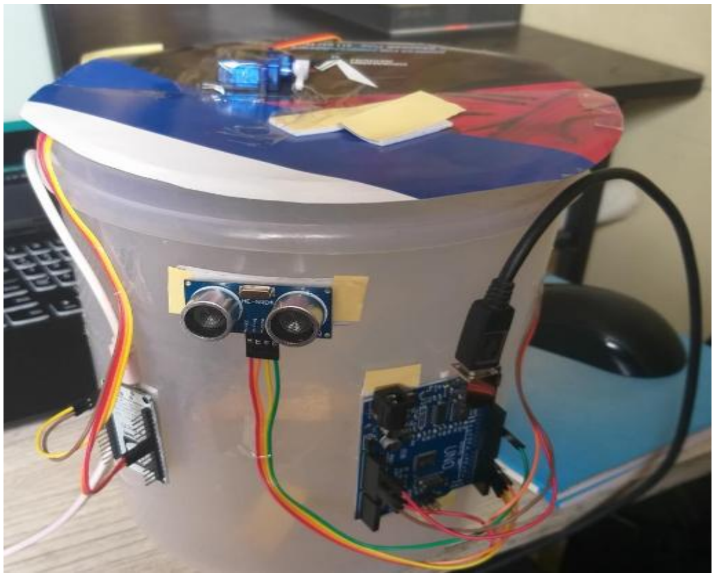
Count = 3

DISCUSSION ON IMPLEMENTATION

With the increase in population we have an increase in the garbage around urban areas. Here we propose a smart dustbin that operates automatically to help solve this issue using IOT and sensor based circuitry. Usual dustbins require to be opened by pressing foot against its lever and then throwing garbage. Also a person needs to keep track when it is full so that it can be emptied and does not overflow.

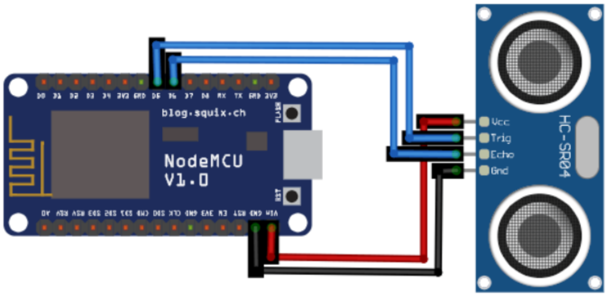
So here's the solution...

Our system consists of a sensor in order to detect human hand signal and on detection it opens automatically without anyone needing to press its lever.
The dustbin opens automatically when it receives the signal and closes its hatch. Also the dustbin consists of a level sensing ultrasonic sensor that constantly measures the level of garbage in the bin and automatically detects if it is about to fill up. The dustbin now consists of a smart circuitry that transmits this information over the web to signal the main garbage collector of the facility to empty the particular garbage bin. We used IFTTT to develop the online web part for the iot system.

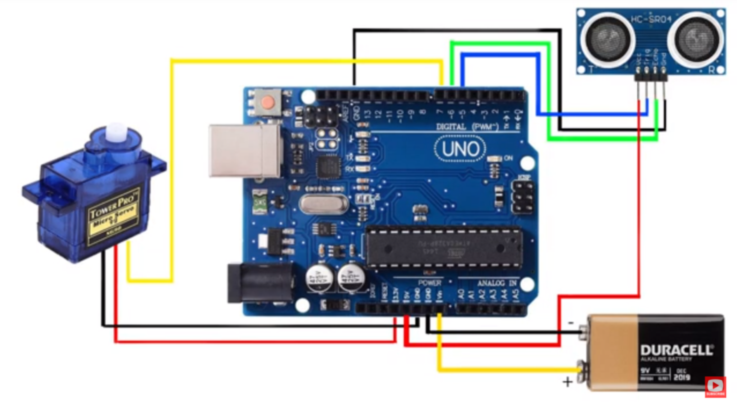


This bin is of a vast usage in offices, homes and even in public places for garbage management. Thus we get a fully automated smart dustbin that allows for automated garbage cleaning. Smart Dustbin is just a normal bin where everyone can dispose waste but integration of some hardware components is done for more efficient use of it. Smart Dustbin is integrated with some hardware components such as Arduino, NODEMCU, Servo Motor, and Ultrasonic sensors. These components help in opening the lid, on detection of human hand and waste and also sending the notification in the form of LED. The code required to perform the above-mentioned operation is dumped in Arduino and NODEMCU.

The waste is first placed in front of the ultrasonic sensor. The sensor detects the waste and makes the lid of the dustbin to open and the waste is disposed inside the dustbin. This process repeats and goes on like a cycle.Now the waste is collected inside the bin. The NodeMCU is connected to a Wi-Fi hotspot or a connection that is known by giving its SSID and PASSWORD which are required to connect to a particular network connection. The ultrasonic sensor detects the level of distance of waste inside the bin and is indicated through LED's in the Blynk app. There will be three widgets, each representing a LED. There are three colors: Green LED, This LED indicates that the waste level is very low inside the bin and more waste can be added inside the dustbin. Orange LED, This LED indicates that the waste is half-filled inside the dustbin and more waste can be added into it. Red LED, This LED indicates that the dustbin is full and the waste inside the dustbin needs to be emptied. The LED indication happens in real time and also very fast. It reduces the work of corporation employees of going and checking every Dustbin in various Areas.It will be helpful for corporations and also to the public by making the Dustbins empty when it will be full.



Circuit Diagram of NodeMCU ESP8266 and Ultrasonic sensor, which detects the level of trash in the dustbin ,which then sends the signal to wifi connected web server to show its level and as soon as the level reaches > 70% it notifies us through our Email using IFTTT service

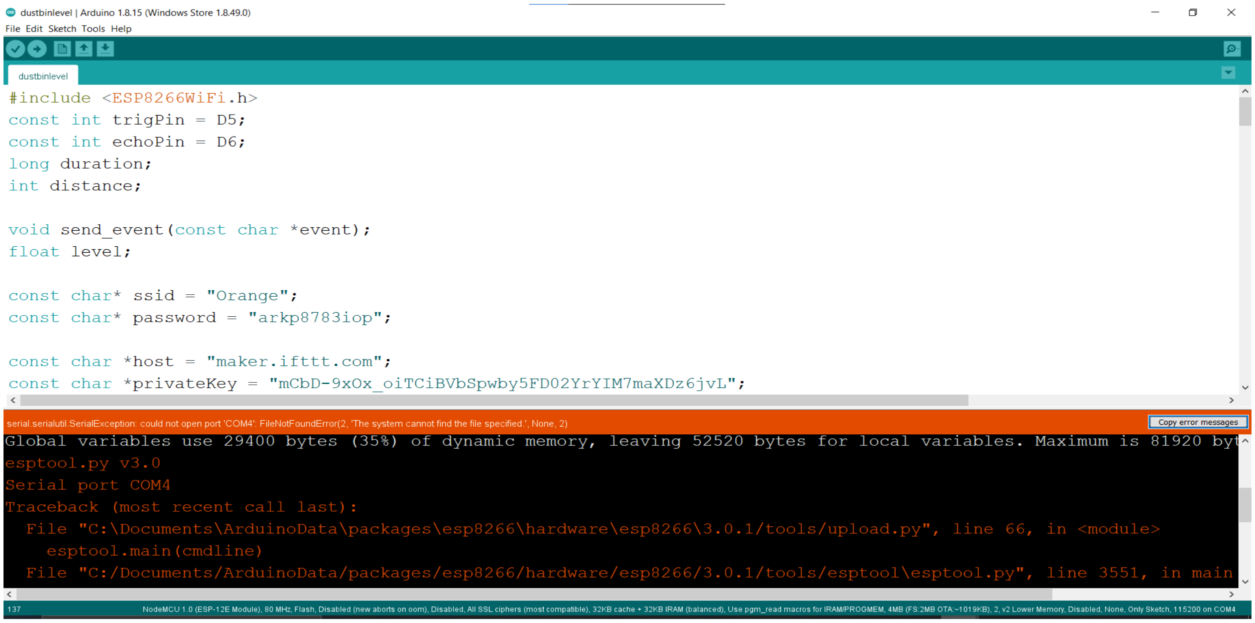


Circuit Diagram showing Arduino and Servo Motor which opens the lid of the dustbin automatically.

TESTING, ERRORS AND DEBUG

Port Not Recognised Error

While installing the NodeMCU ESP8266, our computer was unable to recognise the externally connected ESP8266, usually the firmware and its drivers are installed within the ESP8266 but due to this error we had to externally install its drivers and firmware for it to work perfectly


dustbinlevel | Arduino 1.8.15 (Windows Store 1.8.49.0)
File Edit Sketch Tools Help
dustbinlevel
Copy error messages

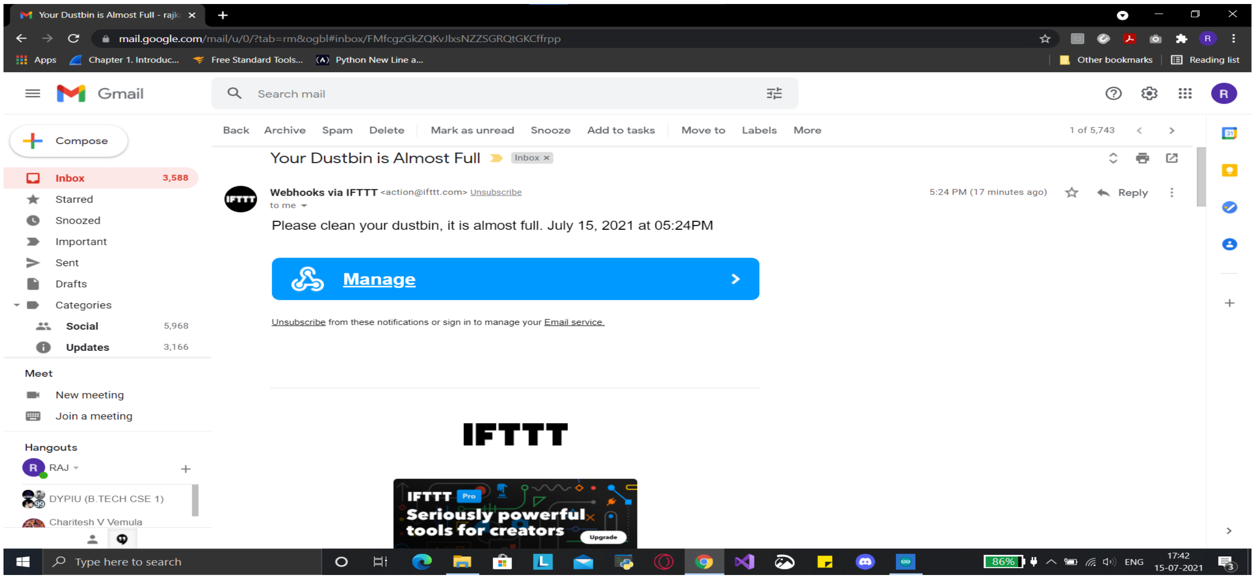
```
#include <ESP8266WiFi.h>
const int trigPin = D5;
const int echoPin = D6;
long duration;
int distance;

void send_event(const char *event);
float level;

const char* ssid = "Orange";
const char* password = "arkp8783iop";

const char *host = "maker.ifttt.com";
const char *privateKey = "mCbD-9xOx_oiTCiBVbSpwby5FD02YrYIM7maXDz6jvL";
```

```
serial.serialutil.SerialException: could not open port 'COM4': FileNotFoundError(2, 'The system cannot find the file specified.', None, 2)
Global variables use 29400 bytes (35%) of dynamic memory, leaving 52520 bytes for local variables. Maximum is 81920 byt
esptool.py v3.0
Serial port COM4
Traceback (most recent call last):
  File "C:\Documents\ArduinoData\packages\esp8266\hardware\esp8266\3.0.1/tools/upload.py", line 66, in <module>
    esptool.main(cmdline)
  File "C:/Documents/ArduinoData/packages/esp8266/hardware/esp8266/3.0.1/tools/esptool\esptool.py", line 3551, in main
```

```
137    NodeMCU 1.0 (ESP-12E Module), 80 MHz, Flash, Disabled (new aborts on oom), Disabled, All SSL ciphers (most compatible), 32KB cache + 32KB IRAM (balanced), Use pgm_read macros for IRAM/PROGMEM, 4MB (FS:2MB OTA:~1019KB), 2, v2 Lower Memory, Disabled, None, Only Sketch, 115200 on COM4
```

Testing IFTTT notifications

When the dustbin gets above 70% the ESP sends signal to the web server which then sends the signal to our mail through IFTTT notifying that the dustbin is about to get full.

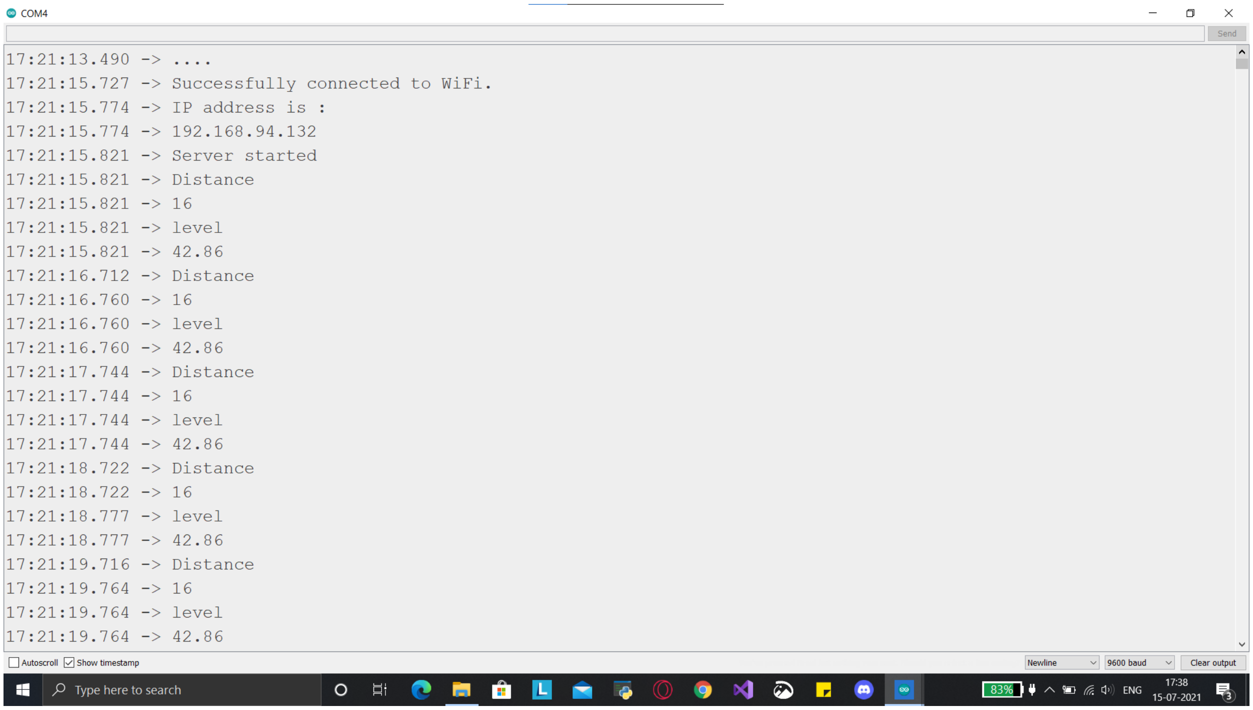


Your Dustbin is Almost Full

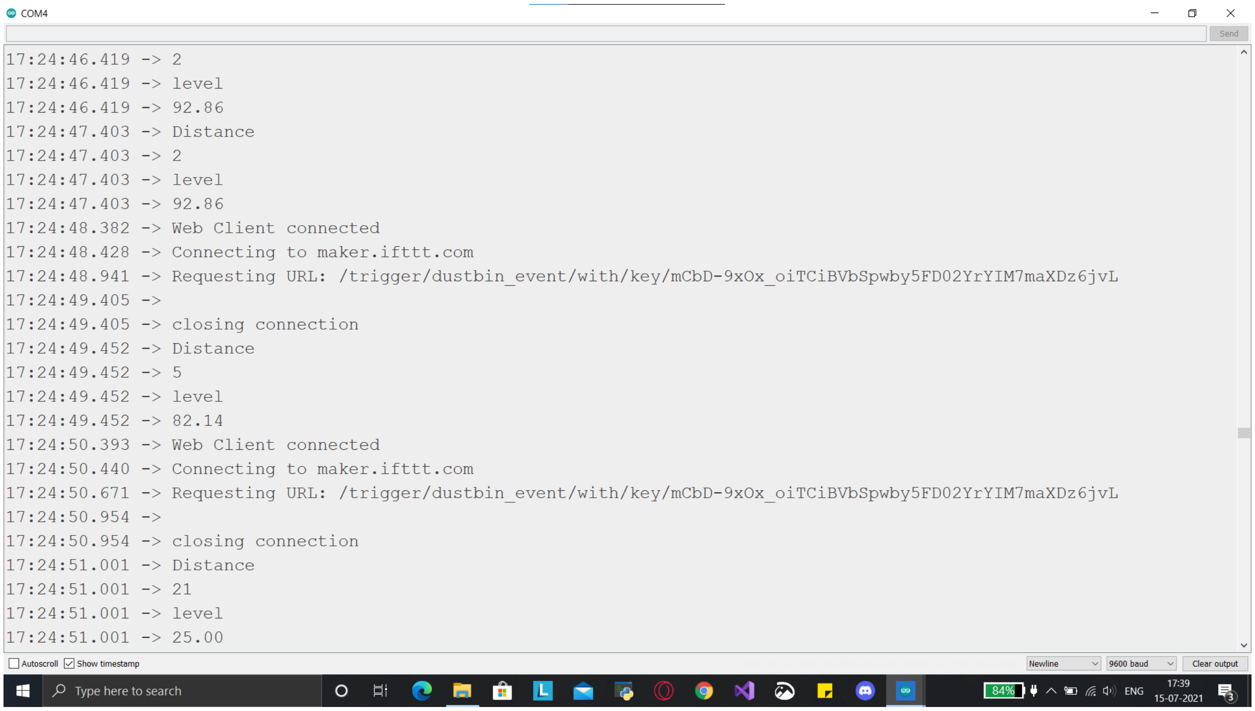
Webhooks via IFTTT <action@ifttt.com> Unsubscribe
to me
5:24 PM (17 minutes ago)

Please clean your dustbin, it is almost full. July 15, 2021 at 05:24PM

Unsubscribe from these notifications or sign in to manage your Email service.



```
17:21:13.490 -> ....
17:21:15.727 -> Successfully connected to WiFi.
17:21:15.774 -> IP address is :
17:21:15.774 -> 192.168.94.132
17:21:15.821 -> Server started
17:21:15.821 -> Distance
17:21:15.821 -> 16
17:21:15.821 -> level
17:21:15.821 -> 42.86
17:21:16.712 -> Distance
17:21:16.760 -> 16
17:21:16.760 -> level
17:21:16.760 -> 42.86
17:21:17.744 -> Distance
17:21:17.744 -> 16
17:21:17.744 -> level
17:21:17.744 -> 42.86
17:21:18.722 -> Distance
17:21:18.722 -> 16
17:21:18.777 -> level
17:21:18.777 -> 42.86
17:21:19.716 -> Distance
17:21:19.764 -> 16
17:21:19.764 -> level
17:21:19.764 -> 42.86
```



```
17:24:46.419 -> 2
17:24:46.419 -> level
17:24:46.419 -> 92.86
17:24:47.403 -> Distance
17:24:47.403 -> 2
17:24:47.403 -> level
17:24:47.403 -> 92.86
17:24:48.382 -> Web Client connected
17:24:48.428 -> Connecting to maker.ifttt.com
17:24:48.941 -> Requesting URL: /trigger/dustbin_event/with/key/mCbD-9xOx_oiTCiBVbSpwby5FD02YrYIM7maXDz6jvL
17:24:49.405 ->
17:24:49.405 -> closing connection
17:24:49.452 -> Distance
17:24:49.452 -> 5
17:24:49.452 -> level
17:24:49.452 -> 82.14
17:24:50.393 -> Web Client connected
17:24:50.440 -> Connecting to maker.ifttt.com
17:24:50.671 -> Requesting URL: /trigger/dustbin_event/with/key/mCbD-9xOx_oiTCiBVbSpwby5FD02YrYIM7maXDz6jvL
17:24:50.954 ->
17:24:50.954 -> closing connection
17:24:51.001 -> Distance
17:24:51.001 -> 21
17:24:51.001 -> level
17:24:51.001 -> 25.00
```

For more Testing you can see our recorded video on youtube or google drive :

https://youtu.be/mK-AR3ST3VM

https://drive.google.com/drive/folders/1zX2mfCHXkpi9nAlIIqu9uE2letw0PtY4?usp=sharing

CONCLUSION

IOT based Dustbins help the people to manage the waste easily and help them reduce the work of calling or waiting for the specific person to make the area clean and makes a heathier environment to live. They won't be any kind of diseases and the people will be fit and are not prone to diseases caused by these waste materials. The mission Swachh Bharat can also be implemented easily. This system assures the cleaning of dustbins soon when the garbage level reaches its maximum. It will take power supply with the help of Battery. If the dustbin is not cleaned in a specific time, then the record is sent to the Sweeper or higher authority who can take appropriate action against the concerned contractor. It ultimately helps in keeping the surrounding clean and the waste management can be much easier.

END USER FEEDBACK

Many times, in our city we see that the garbage bins or dustbins placed at public places are overloaded. It creates unhygienic conditions for people as well as ugliness to that place leaving bad smell.
To avoid all such situations a project called IoT Based Smart Dustbin management will be helpful.

We tested it on some of the users and they were quite happy with the prototype we built, as it not only eliminated the risks of harmful diseases but also provided them a convenient way to dispose of waste. Users that didn't follow the dry-waste separation pedagogy were being taught of the do's and don'ts that they should follow while disposing of waste materials.

Also it allowed garbage collectors to sophisticatedly collect garbage through their smart devices, as their devices showed the level of dustbins located in their area, and allowed them to collect the ones that were almost or fully filled.

These dustbins were interfaced with microcontroller based system having IR wireless systems along with central system showing current status of garbage, on mobile web browser with html page by Wi-Fi. Hence the status will be updated. Major part of our project depends upon the working of the Wi-Fi module; essential for its implementation. The project is very helpful to reduce human resources and efforts along with the enhancement of a smart city vision.

FUTURE SCOPE

The above method is just a stepping stone for implantation of IOT. There can be many enhancements done for this prototype which can be a revolutionary change in maintaining our environment clean and healthy. The few enhancements that can be done are: The implementation of more collective bins placed side by side where it automatically detects the type and waste and places in the correct bin color which is assigned for that type. These dustbins can be placed with a GPS tracker where the dustbins in a particular locality can be located easily and the waste can be emptied. This method can lead to a Smart Waste Monitoring System.

ACKNOWLEDGEMENTS

We wish to thank our senior faculty Dr. Bahubali Shiragapur, for providing their valuable advices and improvements and also to Suraj Shetty Sir to make us familiar with the components and new ideas , which pushed us out of our comfort zones and inspired us and encouraged us for completing this project, without their support we might've not been able to to complete this project successfully.

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