CHAPTER 1

INTRODUCTION

With the increase in population year after year, the amount of waste generated is increasing tremendously. This has led to many hazardous problems. The accumulation of the waste in large areas of land results in the formation of landfills which have dangerous consequences. The odour of the rotten waste pollutes the surrounding environment by releasing a foul smell. The disposal of the waste in water bodies contaminates all the linking oceans and seas which affect the quality of drinking water and also the lives of the water animals. The toxic gases are released into the air and in turn the whole ecosystem is affected. Therefore, waste management is a very serious issue in today's era. If the waste produced is effectively handled at the source level, a IOT of things can be changed and prevented.

Figure 1: The Process of Waste Management

Waste management is all the activities and actions required to manage waste from its inception to its final disposal. This includes collection, transportation, treatment and disposal of waste together with monitoring and regulation. Waste collection methods vary widely among different countries and regions. Domestic waste collection services are often provided by local government authorities. Curb side collection is the most common method of disposal in most countries, in which waste is collected at regular intervals by specialized trucks. Waste collected is then transported to an appropriate disposal area. Nowadays, cities with developing economies experience exhausted waste collection services,

inadequately managed and uncontrolled dumpsites and the problems are worsening. Waste collection method in such countries is an on-going challenge and many struggle due to weak institutions and rapid urbanization. In the present world, we see the dustbins are placed on the roadside and dustbin is overflowing this overflow of dustbin is due to the increase in the population and the wastage from hotels, industries etc. This Project is implemented to place in the smart cities. In this proposed system, multiple dustbins from the different areas throughout the cities are connected using IOT technology. In this the dustbin is provided with low- cost embedded devices and it will sense the level of dustbin, then it is sent to the municipality officer. Then he will send the information to the truck driver to collect the waste. Ultrasonic sensor will sense the level of dust in dustbin.

Environment is essential for everyone and present everywhere, that supply all natural needs in an abundant manner but also, we have some responsibilities towards our environment. In several urban areas although the dustbins are provided so that it can be used by the people but its proper maintenance is also needed lacking of which unhygienic increases destroying our environment day by day also resulting severe adverse effects for mankind. This project presents some revolutionary remedies in this context. People are more interested to use such technologies which can reduce their time and effort in efficient manner. Automation is the most demandable feature now a day. For this purpose, smart dustbins are the much suitable approach.

Though the world is in a stage of up gradation, there is yet another problem that has to be dealt with Garbage. Pictures of garbage bins being overfull and the garbage being spilled out from the bins can be seen all around. This leads to various diseases as large number of insects and mosquitoes breed on it. A big challenge in the urban cities is solid waste management. Hence, smart dustbin is a system which can eradicate this problem or at least reduce it to the minimum level. Our present Prime Minister of India. Mr. Narendra Modi ji has introduced the concept of implementing 100 smart cities in India. “Swachh Bharat Abhiyan” was initiated to ensure a clean environment.

The main functions of the Smart dustbin are:

- Sends a "DUSTBIN FULL" warning message to municipal officials.
- The purpose of the project is to help manage waste management in urban and rural areas
- The project will send an SMS to municipal officials containing information about dustbin.
- SMS will be sent via GPS location
- Buzzer indicating a state of overflow.

This research project focuses on the Garbage Monitoring System using an ultrasonic sensor as a

distance measurement sensor, GPS will assist in sending a garbage bins location and GSM will assist in sending a message to municipal authorities.

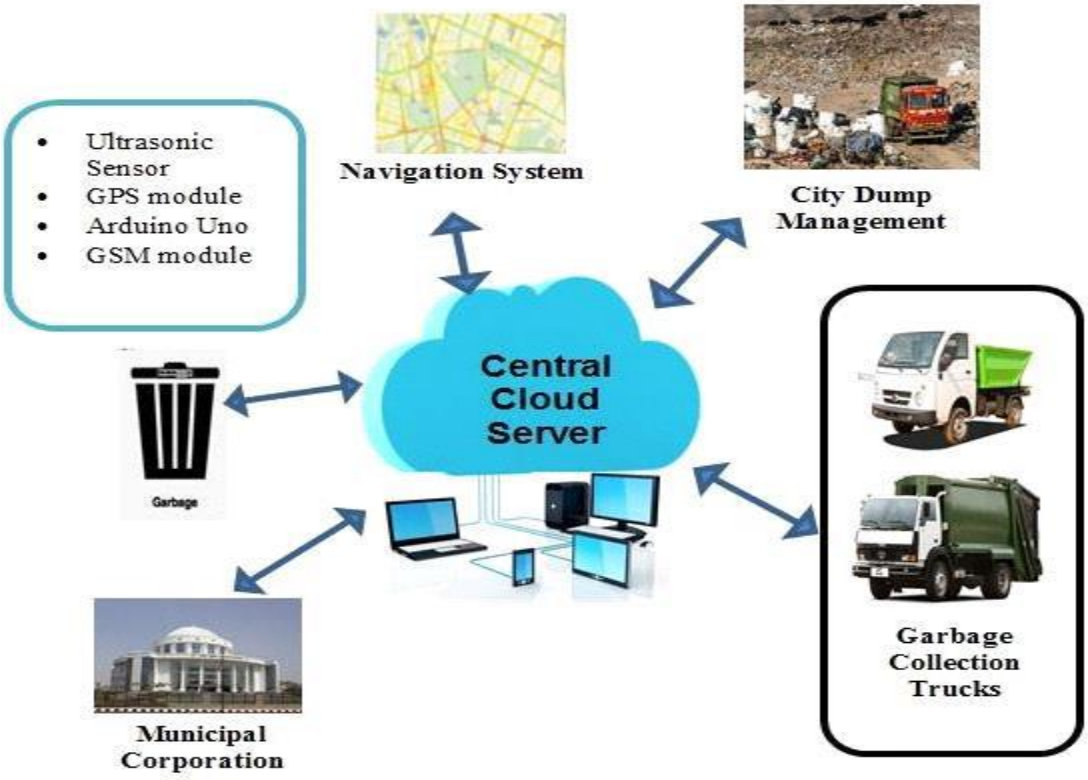

Figure 2: Basic Features of Smart Garbage Monitoring System

This results in wastage of vital resources used due to a lack of coordination and keeping an eye on data in clusters and poor infrastructure. With the latest advances in information technology, smart cities and smart infrastructures are prospering. Smart Cities is a small sustainable development model. It is based on the use of human capital and technology to improve urban integration with the growing popularity of Internet of Things (IoT) and the availability of actuators and low sensors, technological advantages can be pave the way to solve used to solve the problem of current urban.

IoT is the ecological unit of compatible objects available online. The 'object' in IoT may disable the portable device with the ability to disseminate information via IP address and the ability to communicate data directly from the base station. IoT is able to interact with various online applications. In this project a new method has been introduced to integrate IoT green environment into automatic waste disposal and provide an efficient solution.

CHAPTER 2

LITERATURE REVIEW

The Authors Ajay V P, Bradeep Kumar M, Kishanth A, Vaishnavi Kumar, R. Santhiya Devi, Amirtharajan Rengarajan, K. Thenmozhi, and Padmapriya Praveen Kumar Proposed the Paper called "Automatic Waste Segregation and Management". [1] This is done by using a microcontroller to control the whole circuit. Wastes are placed on the conveyor belt which is made to run on the wheels powered by DC Motor. Proximity Sensor is used to distinguish Ferrite waste from non-metallic waste. Based on the readings calculated from the sensor, the suitable dustbin is selected, which is placed on the Servo motor. The dust-bin is an integration of 2 compartments which are placed accordingly which sequentially separates the waste.

International Research Journal of Engineering and Technology (IRJET) Paper Called "Arduino Based Garbage Monitoring System using IoT" Ultrasonic Sensor: The sensor is used to detect the level of the dust in the dustbin.[2] It uses a sound transmitter and receiver. An ultrasonic sensor creates an ultrasonic pulse called ping and listen for the reflection of pulse. The sound pulse is created electronically using a sonar projector consisting of signal generator, power amplifier and electro-acoustic transducer array. A beam former is usually employed to concentrate the acoustic power into the beam.

S. Alizadeh and A. M. Taha, "An IoT-Based Architecture for Waste Management," 2019 IEEE International Conference on 53 Communications Workshops (ICC Workshops), Kansas City, MO, 2019, pp. 1-4. Paper Called "Smart Waste Collection Monitoring and Alert System via IoT" This paper presents an Internet of Things (IoT) based Smart Waste Collection Monitoring and Alert System to monitor the waste material at the selected site of garbage collection area. [3] The system is implemented using an ultrasonic sensor which is connected to Arduino UNO as to monitor waste bin garbage level. In this system, waste bin depth level will be sent via Arduino Ethernet Shield with an Internet connection to the Ubidots IoT Cloud. The Ubidots store the collected waste bin level data into IoT database and display the waste bin depth level on online dashboard for real-time visualization. The Ubidots Event manager invoke a notification alert to garbage collector mobile phone via a SMS when the waste bin is nearly filled for immediate waste collection. Therefore, the waste collection became more effective and systematic.

2021 6th International Conference for Convergence in Technology (I2CT) Pune, India. Apr 02-04, 2021 Paper Called "Implementation of an Automatic Waste Segregator System using Arduino Uno" In this paper, a cost-effective Automated Waste Segregator system for the segregation of waste at the household level is implemented. [4] The proposed segregator system segregates the waste into three types, viz., metallic, wet and dry, and in addition, separating dry waste further into paper and plastic. Here, Arduino Uno board is used as the main controller and various sensors are used to detect each type of waste, which is segregated and thrown into the respective bins.

S. No	Title	Author	Objectives	Limitations
1	"Automatic Waste Segregation and Management"	Ajay V P, Bradeep Kumar M, Kishanth A, Vaishnavi Kumar, R. Santhiya Devi, Amirtharajan Rengarajan,	it is easy to use a solution for a segregation system through the smart dustbin which is also very cheap.	Complex to handle the operation. Monitoring feature not available
2	"Arduino Based Garbage Monitoring System using IoT"	International Research Journal of Engineering and Technology (IRJET	The principal objective of our task is to deal with all the loss around there and observing all the cycle.	Monitoring feature not available Response time is very high
3	"An IoT-Based Architecture for Waste Management,"	Aleyadeh and A. M. Taha.	It will give the real time information about the level of the dustbin.	In the existing system there is no indication whether the dustbin is over flown

Table 1: Literature Survey of Previous Papers

CHAPTER 3

PROBLEM STATEMENT

The greatest problem regarding waste management in developing countries begins at the very starting point of the process. Due to lack of proper systems for disposal and collections, wastes and garbage's end up in the roads and surrounding. According to a report Zurburg 2002, the amount of waste generation in 2010 was around 20,000 tons per day, and it is estimated that by 2025 the amount will be no less than around 47000 tons per day. With the existing methods of collecting and disposal it is near impossible to manage such amount of waste in the future as around 30% of waste end up on the roads and public places due to ineffective disposing and collecting methods. Not only that, there is even no systematic methodology for the collected garbage for treating and recycling thus most of them end up in landfilling and river water, making the environment unhealthier. The prime impediment of implementing smart waste management system based on IoT in a developing country is the social and economic infrastructure of the country itself. The initial stage of this system comprises of proper disposal and collection, which is the biggest challenge. In addition, to motivate and influence people to follow proper waste disposal methods is also important.

3.1 EXISTING SYSTEM

In the existing system there is no indication whether the dustbin is over flown. It is more time-consuming task and it is less effective. It leads to the wastage of time since the truck will go and clean whether the dustbin is full or empty. This system needs high cost. This system will create a unhygienic environment and make the city unclean. In this system the level of the dustbin will not be known and create the bad smell spreads and cause illness to human beings. It also makes more traffic and noise.

3.2 DRAWBACKS OF EXISTING SYSTEM

- There is no dustbin status indicator.
- There is no Google map system.
- There is no message or buzzer system to know the dustbins fill level.
- There is no GSM or messaging system

3.3 PROPOSED SYSTEM

In present day the dustbin is overflown, the proposed system will help to avoid the overflow of dustbin. It will give the real time information about the level of the dustbin. It will send the message immediately when the dustbin is full. Deployment of dustbin based on actual needs. Cost of this system is minimum the resources are available easily. Improves environment quality by reducing the smell and make the cities clean. It has effective usage of dustbins.

3.4 OBJECTIVES OF PROPOSED SYSTEM

- The principle objective of our task is to deal with all the loss around there and observing all the cycle. To build up a brilliant dustbin for clean climate.
- The point of the framework is a mechanized alarm based keen receptacle or trash assortment framework to caution the specialists like company or nearby garbage removal group.
- We propose the shrewd container framework to help the city staffs for clearing the flooding trash.
- This issue can be over load work in existing strategy by presenting current strategies for our undertaking are quick execution measure.
- To abstain from spreading of infections because of unloading of waste in the open territory and consuming of waste.
- Monitors the trash canisters and advises about the degree of trash gathered in the trash receptacles continuously utilizing IOT.
- To keep our Environment clean and green.

CHAPTER 4

SOFTWARE AND HARDWARE REQUIREMENTS

4.1 SOFTWARE REQUIREMENTS

1. Windows 7/10/11 OS with Min 4GB RAM and 250GB Hard Disk
2. Arduino IDE
3. Local Server & Web Page for Monitoring

4.2 HARDWARE COMPONENTS

1. Ultrasonic Sensor

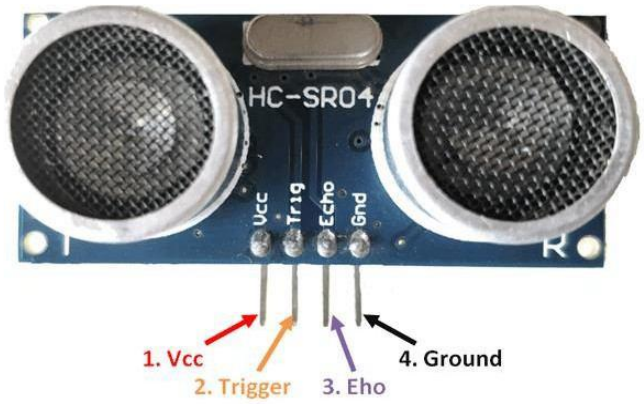

Figure 3: Ultrasonic Sensor

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e., the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

2. Arduino Uno R3

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Figure 4: Arduino Uno R3

3. GPS

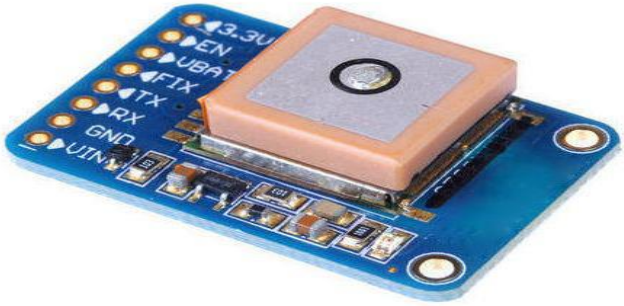

Figure 5: GPS

These GPS modules are compatible with Arduino and Raspberry Pi, making it easy for you to start to try out. The Air 530 Module in Grove - GPS(Air530) is a high performance, highly integrated multi-mode satellite positioning and navigation module. It supports GPS / Beidou / Glonass / Galileo / QZSS / SBAS, which makes it suitable for GNSS positioning applications such as car navigation, smart wear and drone. And Air530 module is also supporting NMEA 0183 V4.1 protocol and compatible with previous versions.

4. GSM

GSM (Global System for Mobile Communications, originally Groupe Special Mobile), is a standard developed by the European Telecommunications Standards Institute (ETSI). It was created to describe the protocols for second-generation (2G) digital cellular networks used by mobile phones and is now the default global standard for mobile communications – with over 90% market share, operating in

over 219 countries and territories.

Figure 6: GSM Module

5. **Buzzer**

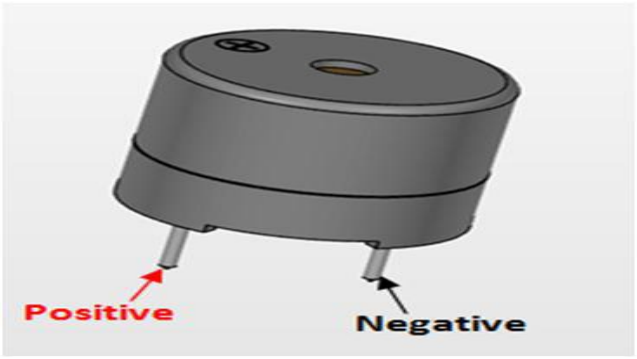

Figure 7: Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, train and confirmation of user input such as a mouse click or keystroke.

6. **Connecting Wires**

Figure 8: Connecting Wires

7. **NodeMCU**

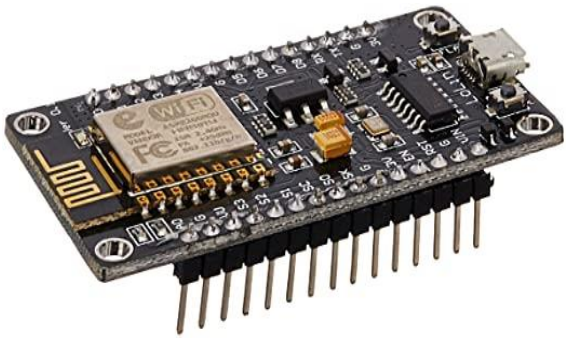

Figure 9: NodeMCU (WIFI Module)

NodeMCU is an open-source firmware for which open-source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). Strictly speaking, the term "NodeMCU" refers to the firmware rather than the associated development kits. NodeMCU was created shortly after the ESP8266 came out. On December 30, 2013, Espressif Systems began production of the ESP8266.NodeMCU started on 13 Oct 2014, when Hong committed the first file of nodemcu-firmware to GitHub. Two months later, the project expanded to include an open-hardware platform when developer Huang R committed the Gerber file of an ESP8266 board, named devkit v0.9.

8. 16x2 LCD

Figure 10: LCD

The Liquid Crystal library allows you to control LCD displays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usually tell them by the 16-pin interface. The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display.

CHAPTER 5

SYSTEM DESIGN AND ARCHITECTURE

5.1 ARCHITECTURE DIAGRAM

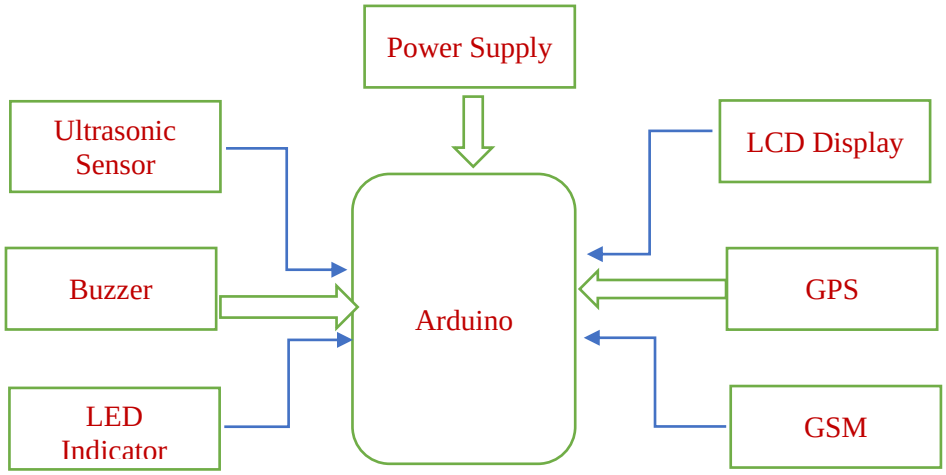

Figure 11: Architecture Diagram

This proposed IOT Garbage Monitoring framework is an inventive framework which will assist with keeping the urban areas clean. This framework screens the trash receptacles and advises about the degree of trash gathered in the trash containers by means of a site page. For this the framework utilizes ultrasonic sensors set over the receptacles to recognize the trash level and contrast it and the trash canisters profundity and smell sensor is utilized to identify the awful scent from trash container. The framework utilizes hub MCU gadget, LCD screen, ultrasonic sensor and smell sensor. The framework is controlled by a 12V stock. The LCD screen is utilized to show the situation with the degree of trash gathered in the containers. Though a site page is worked to show the status to the client checking it progressively. The LCD screen shows the situation with the trash level.

5.2 DATA FLOW DIAGRAM

This section shown the results of data gathered during this project implementation. All of the data and information details were collected to evaluate the system performance. The result consists of two parts. The first part is an Ultrasonic sensor distance result that indicate the depth level of waste bin data display in the serial monitor on Arduino IDE. The second part is obtained from depth level of waste bin data collection through IoT Cloud on Ubidots Dashboard which is an online display. By creating a device in Dashboard, we can collect and store the waste bin depth level data on the specified device.

The notification alert can be invoked when certain value of device data changes more or less from the specified value.

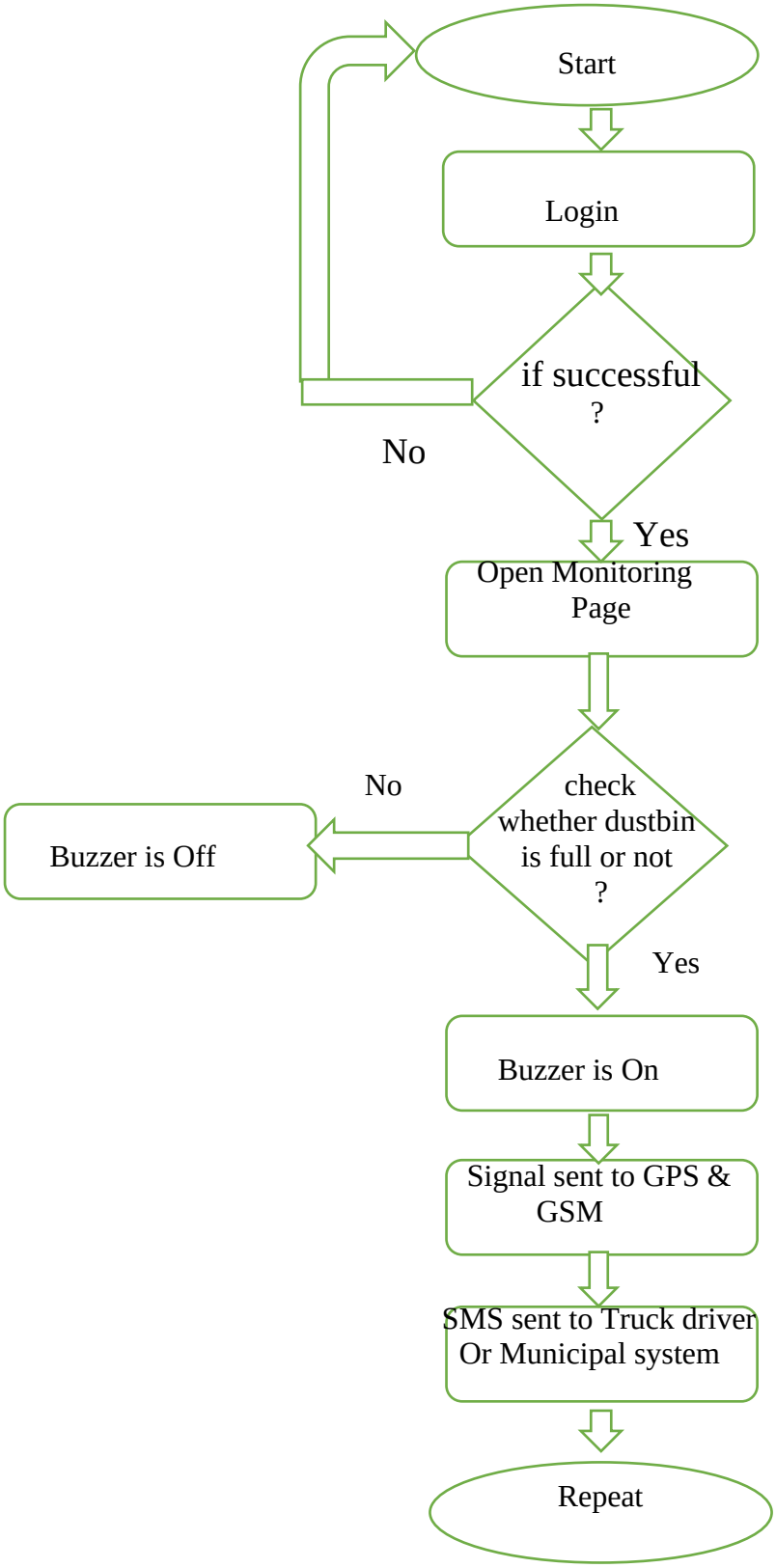

Figure 12: Data flow diagram

5.3 FRAMEWORK DESIGN

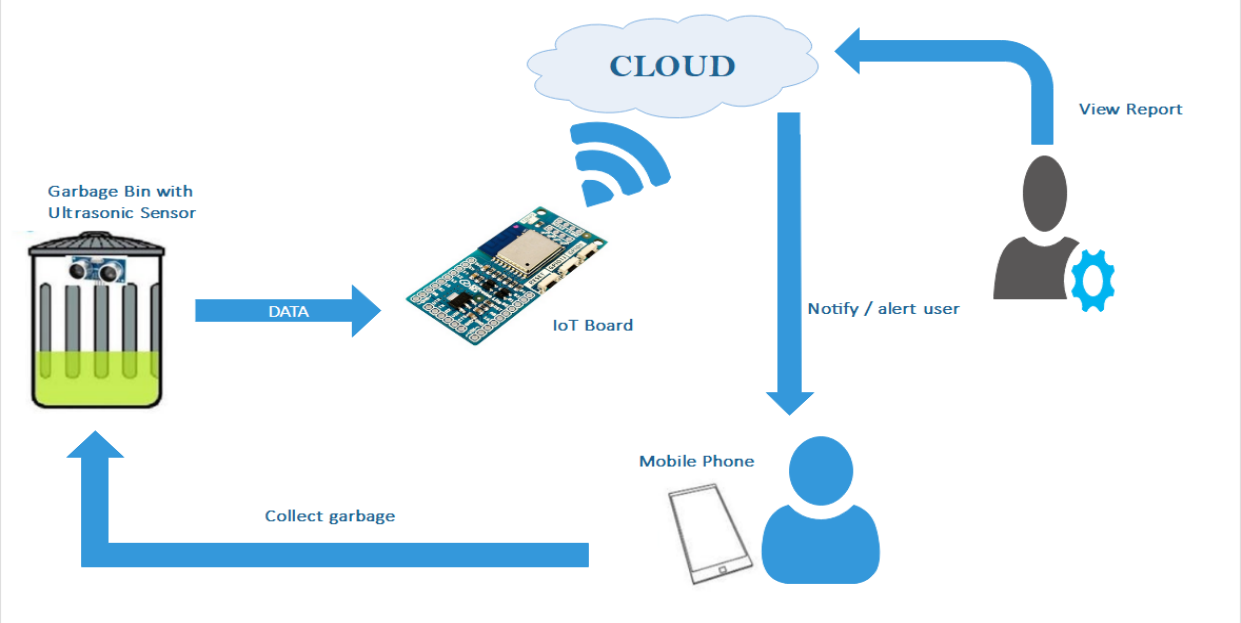

Figure 13: Framework Design

Figure 13: shows the framework for garbage monitoring system based on IoT. An ultrasonic sensor that embedded inside garbage bin will check the distance of garbage and compare it with garbage bin depth. Data collected from the ultrasonic sensor will be sent to the IoT Board. An IoT Board will send it to the cloud and if the garbage it loaded, the cloud will notify the user through mobile phone. On the other hand, Admin able to view the report of the garbage. After getting the notification, the user will collect the garbage at the hostel.

5.3 CONTEXT DIAGRAM

Figure 14 shows the context diagram for garbage monitoring system. In this diagram, an ultrasonic will send a garbage detail to the cloud and cloud will send notification to the user's mobile phone. The admin can view log report of garbage details.

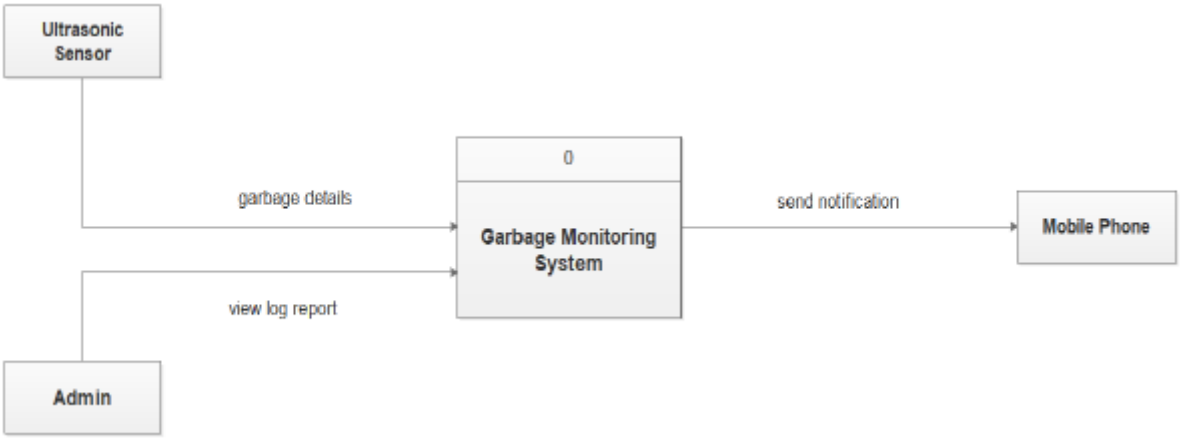

Figure 14: Context Diagram

5.4 ENTITY REALATIONSHIP DIAGRAM

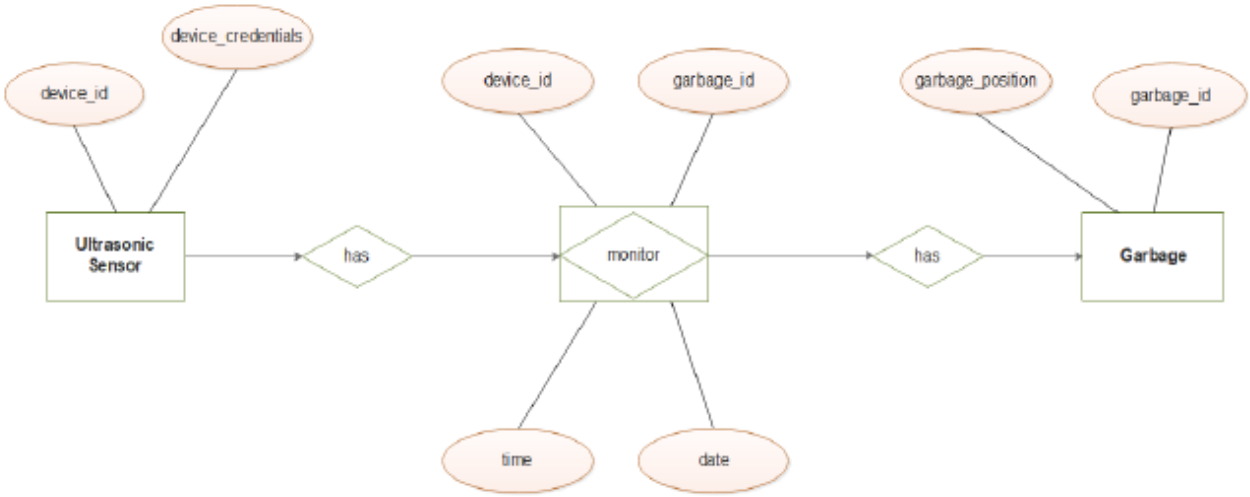

Figure 15: Entity Relationship Diagram (ERD)

Figure 15 shows the relationship between an ultrasonic sensor with the garbage. In this diagram, an ultrasonic sensor monitors the garbage and compare the garbage with bin depth to check if the bin is full or not.

CHAPTER 6

METHODOLOGY

This chapter discusses the methods that have been used from the beginning which is planning phase until the end of this project. Methodology used has been discussed more details to give more understanding the whole development processes of this project. For this project, Iterative and incremental model has been chosen in developing the project. By using this model, project can be developed through repeated cycles.

The advantages of this model are analyzing risk better than other model and it support changing requirement. The developing process of this model can still be proceeding even there is some problem arise or there is any changes needed in the middle of development process.

Iterative and incremental model included six phases which consist of planning phase, requirement analysis phase, design phase, implementation phase, testing phase and deployment phase.

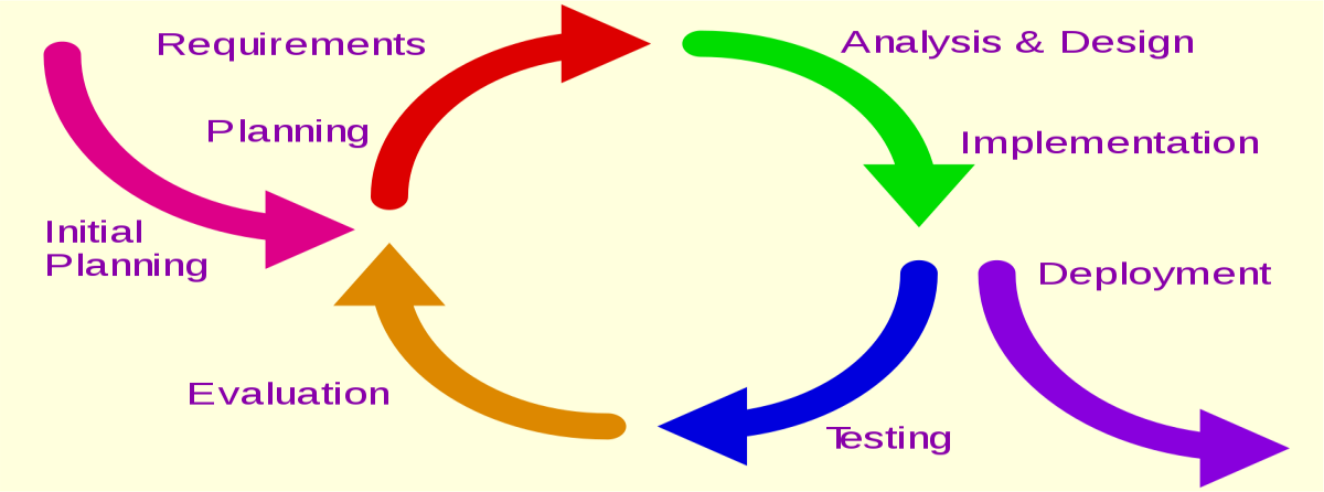

Figure 16: Iterative and Incremental Model

6.1 METHODOLOGY PHASES

1. **Planning Phase**

Planning phase is the first phase and the most important phase in an early phase of development project. The planning for this project is to develop a garbage monitoring system based on Internet of

Things (IoT). This suggestion project needs to be discussed and get supervisor agreement before proceeding to another phase. To make this system possible, an ultrasonic sensor will be used to detect the level of the garbage in the garbage bin. This system will be able to notify the user whenever the garbage bin is full. All the required materials have been prepared.

2. Requirement Analysis Phase

For this phase, a lot of information about the system is gathered. As the system is about garbage monitoring system based on Internet of Things (IoT), a lot of information about the previous or latest technology of garbage monitoring system is identified. The most important information needed is a user requirement. After requiring a user requirement, information about garbage, ultrasonic sensor, Internet of Things, Cytron UNO, and Node MCU are identified.

3. Design Phase

Design phase is the third phase or stage that is used to show the flow of the system so that it will be successful. After a process of gathering all the information required in this system, a framework is done to show the flow of the whole system. A framework is important to make a flow system be easy to be understood. In this phase, a design of context diagram, data flow diagram and entity relationship diagram to show the flow of the system specifically. Then, a setup of an ultrasonic sensor with breadboard, Cytron Uno, and Node MCU is created. This system is able to show the flow of garbage monitor system based on Internet of Things (IoT).

4. Implementation Phase

After gathering all the information and design has been created, this phase is to develop a connection for an ultrasonic sensor using code. If there is any errors or changes needed, it will be solved at this phase.

5. Testing Phase

During testing phase, the system will be tested. During this phase, if there is any problem arise or any changes needed, it will be solved immediately by turning back to design phase to make a revision of the flow.

6. Deployment Phase

After the system has been completely developed and there are no more errors after testing, the system will be deployed for its end of this product.

CHAPTER 7

IMPLEMENTATION

Implementation method is a systematic structured approached to integrate software-based service or component into the workflow of an organizational structure or an individual end-user. During implementation, the project team creates the actual product. Product implementation can be an exciting phase for the customer because their idea for the project becomes something tangible. Project developers begin building and coding the software.

Meanwhile, the system will be testing to prove that every expected output and objective of the system achieved.

7.1 CODE FOR ARDUINO

```
#include <SoftwareSerial.h>
SoftwareSerial esp8266(2,3);
 #include <LiquidCrystal.h>
LiquidCrystal lcd(8,9,10,11,12,13);//RS,EN,D4,D5,D6,D7
#include <Servo.h>
#define buzzer 4
#define trigPin1 A4  //// front
#define echoPin1 A5
int lvl1=0;
long duration, distance,sensor1,sensor2,sensor3; // us variable
int onetime=0,onetime1=0 ;
int wet=0,moisture=0,object=0,cabin2=0,c1=0,c2=0;
int powers=0,powers1=0,powers2=0,powers3=0;
void setup()
{
 Serial.begin(115200);
 esp8266.begin(9600);
 lcd.begin(16, 2);//initializing LCD
 lcd.setCursor(0,0);
 lcd.print("Smart Garbage Monitoring System");
 delay(3000);
 pinMode(buzzer,OUTPUT);
```

```
 pinMode(trigPin1, OUTPUT);
 pinMode(echoPin1, INPUT);
 delay(3000);
}
void loop()
{
 ultrasensor(trigPin1, echoPin1);
 sensor1 = distance;
 delay(10);
 esp8266.println(sensor1);
 lvl1=(20-sensor1)*7;
 esp8266.println(lvl1);
 if(lvl1<0){lvl1=0;}
 if(lvl1>100){lvl1=100;}
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("Dustbin Level");
 lcd.setCursor(6,1);
 lcd.print(lvl1);
 delay(1000);
 if(lvl1>80)   //Dustbin Data
 {
  if(onetime==0)
  {
    lcd.clear();
   lcd.setCursor(0,0);
   lcd.print("-send msg-");
   digitalWrite(buzzer,HIGH);
   tracking();
   digitalWrite(buzzer,LOW);
   onetime=1;
  }
 }
 else
```

```
 {
  onetime=0;
 }
 ////////////////////////////////////////////
 String data = "";
 data+= "{";
 data+= "\"anloga\":";
data+= "\""+String(powers2)+"\"";
 data+= "}";
Serial.print(data);
 delay(10);
 Serial.print('\n');
 delay(200);
 ////////////////////////////////////////////
}
 void init_sms()
 {
  esp8266.println("AT+CMGF=1");
  delay(400);
  esp8266.println("AT+CMGS=\"+919XX8X3XX16\"");   // use your 10 digit cell no. here //
  delay(400);
 }
 void init_sms1()
 {
  esp8266.println("AT+CMGF=1");
  delay(400);
  esp8266.println("AT+CMGS=\"+917XX56XX92\"");   // use your 10 digit cell no. here
  delay(400);
 }
 void send_data(String message)
 {
  esp8266.println(message);
  delay(200);
 }
```

```
void send_sms()
{
 esp8266.write(26);
}
 void tracking()
{
 init_sms();
 send_data("dustbin-001  is almost full:\n");
 send_sms();
 delay(6000);
 init_sms1();
 send_data("dustbin-001  is almost full:\n");
 esp8266.print(" Level in %");
  esp8266.print(lvl1);
 send_sms();
 delay(6000);
}
void ultrasensor(int trigPin,int echoPin)
{
 digitalWrite(trigPin, LOW);  // Added this line
 delayMicroseconds(2); // Added this line
 digitalWrite(trigPin, HIGH);
 delayMicroseconds(10); // Added this line
 digitalWrite(trigPin, LOW);
 duration = pulseIn(echoPin, HIGH);
 distance = (duration/2) / 29.1;
}
```

The above code for Arduino which is connected with the all the other components which is completely controlled by Arduino. Also it contains the monitoring information web based digital view with help of local IP address which id hosted by local machine and only it’s controlled by the administrator.

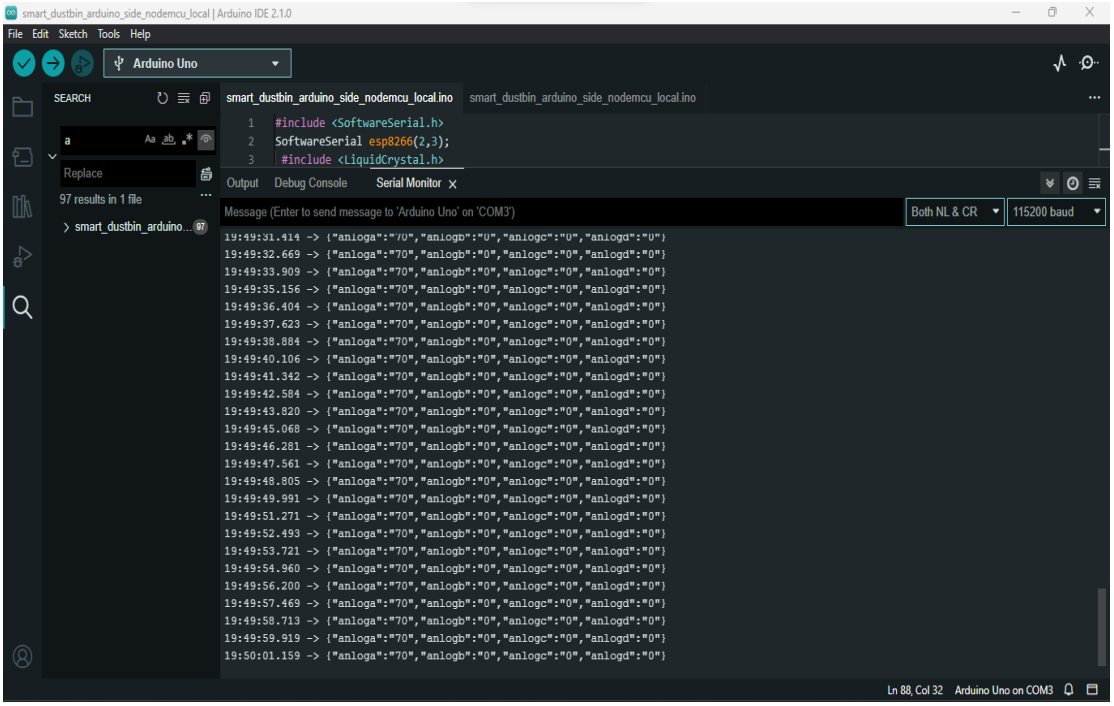

Figure 17: Arduino live updating data to server

When the Arduino board and port is selected in Arduino IDE if code don’t have any errors the code will uplode to Arduino bored with help of Type B male USB .

7.2 CODE FOR NODEMCU (WI-FI MODULE)

```
#include <ESP8266WiFi.h>
const char* ssid = "Network_Name"; //ssid of your wifi  //
const char* password = "password"; //password of your wifi
WiFiServer server(80);
////////////////////////////////////
#include <Arduino_JSON.h>
String inputData = "";
boolean data_complete = false;
String vala;
String valb;
String valc;
String vald;
////////////////////////////////////
void setup()
```

```
{
  Serial.begin(115200);
  inputData.reserve(200);
  Serial.println("Hello");
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);
  WiFi.begin(ssid, password); //connecting to wifi
  while (WiFi.status() != WL_CONNECTED)// while wifi not connected
  {
    delay(500);
    Serial.print("."); //print "...."
  }
  Serial.println("");
  Serial.println("WiFi connected");
  server.begin();
  Serial.println("Server started");
  Serial.println(WiFi.localIP());  // Print the IP address
}
void loop()
{
  while(Serial.available() > 0)
  {
WiFiClient client = server.available(); // Check if a client has connected
 /* if (!client)
  {
   return;
  }   */
  String s = "HTTP/1.1 200 OK\r\nContent-Type: text/html\r\n\r\n <!DOCTYPE html> <html> <head> <title>.....</title> <style>";
  s += "a:link {background-color: RED;text-decoration: none;}";
  s += "table, th, td </style> </head> <body> <h1  style=";
  s += "font-size:250%;";
  s += " ALIGN=CENTER> Dustbin data</h1>";
  s += "<p ALIGN=CENTER style=""font-size:200%;""";
  s += "> <b> Location -001</b></p> <table ALIGN=CENTER style=";
```

```
  s += "width:10%";
  s += "> <tr> <th>Level : </th>";
  s += "<td ALIGN=CENTER >";
  s += vala;
  //s += "</td> </tr> <tr> <th>Tds Value : </th> <td ALIGN=CENTER >";
  //s += valb;
  //s += "</td> </tr> <tr>  <th>Water Level</th> <td ALIGN=CENTER >";
  //s += valc;
  //s += "</td></tr> <tr> <th>Water intake</th> <td ALIGN=CENTER >";
  //s += vald;
  s += "</td>  </tr> </table> ";
  s += "</body> </html>";
  client.print(s); // all the values are send to the webpage
  delay(100);
  {
   Serial.println("Parsing input failed!");
   return;
  }
  if (myObject.hasOwnProperty("anlogd")) {
    Serial.print("myObject[\"anlogd\"] = ");
    vald = (const char*) myObject["anlogd"];
    Serial.println(vald);
    Serial.println((const char*) myObject["anlogd"]);
  }
  // JSON vars can be printed using print or println
  Serial.print("myObject = ");
  Serial.println(myObject);
  Serial.println();
}
```

This is code for the Wi-Fi module for wireless internet connection. When the code is uploaded to nodemcu it connects the available internet access. The local port help to upload the all the live data to the server with Ip address of the current connected network.

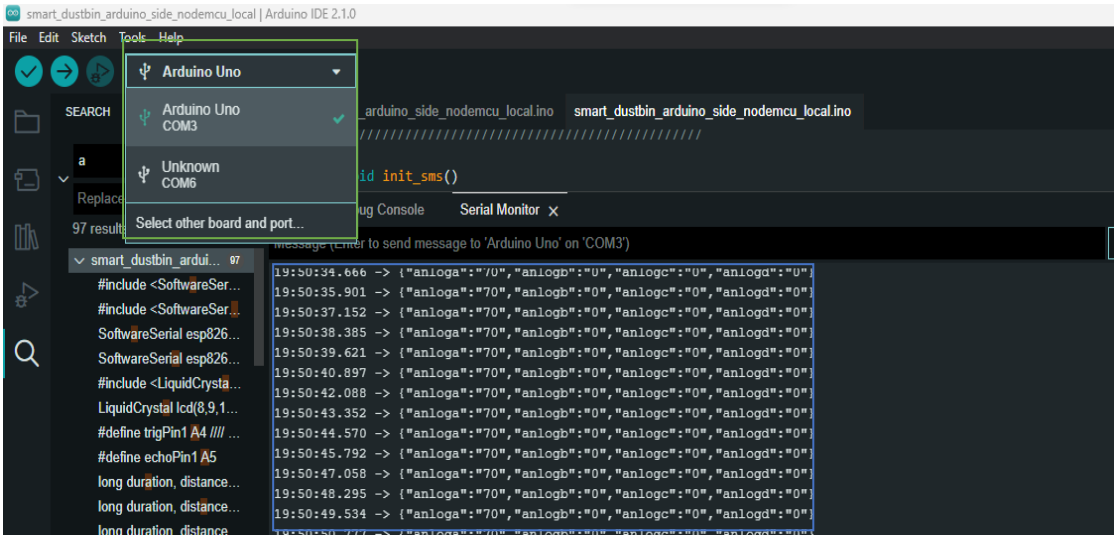

Figure 18: All Data is Uploading to Local Machine (Wi-Fi Module)

Figure 15: shows connection of ultrasonic sensor with ESP8266 and Cytron Uno. Cytron Uno is used to give 5V power to the ultrasonic sensor meanwhile for trigPin is set as D1 and echoPin is D2 at ESP8266. Live data uploading to local Machine.

CHAPTER 8

SYSTEM TESTING

Software testing in an essential phase in the development life cycle of an application. Testing ensures that the developed system meets its functional and non-functional requirements. Two important terms in software testing are Verification and Validation. Verification is the process of evaluating work-products like requirement specs, design specs and test cases etc. of different development phases to make sure that they meet the requirements for that phase. It ensures that the system is built in the right way. Whereas Validation is the process of evaluating the software at the end of the development phase to make sure that it meets the business requirements. It is used to make sure that the product fulfills its intended use and that the end product is built right. In this chapter mainly validate the Admin Login and Dustbin Level Indication to make sure it meets the requirements set initially.

8.1 LOGIN SCREEN TEST CASES

Test Id	Test Case Title	Test Condition	System Behavior	Result
T01	User Test Login	Correct format of User Details entered.	Proceed to Verify Page.	Admin Verification.
T02	Username & Password (If correct)	Enter login Credentials	Check the input with Server.	Taking to Home page.
T03	Username & Password (If it’s Incorrect)	Verify the Credentials	Check the login Credentials	Showing Incorrect Popup.

Table 2: Login Screen Test case

- Admin only able to login with portal with provided username and password.
- If Admin enters the correct credentials the page will redirect to home page. Then admin perform all the task and monitor and update the data.
- If the admin not entered the username and password the error message will popup top of the window.

8.2 DUSTBIN WORKING TEST CASES

Test Id	Test Case Title	Test Condition	System Behavior	Result
T01	Garbage Level Indication	If the garbage level is < 80%	Show the Real-time dustbin data	Buzzer sound is Low.
T02	Garbage Level & Buzzer Behavior	If the garbage level is > 80%	Buzzer sound is HIGH	Send the Message to the Driver.
T03	Dustbin Behavior when it reached limit	If dustbin is full and Buzzer is HIGH	Send the notification along with live location.	Send the message to the Truck driver

Table 3: Dustbin SMS System Working Test cases

- When the dustbin level is reached 80% or above the buzzer will high at the same time the GPS and GSM module sends the message to the Truck driver.
- Suppose the dustbin level is below the limit the buzzer will low and keep updating the data to server.
- Ensuring the Ultrasonic distance 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 Wi-Fi.

CHAPTER 9

SNAPSHOTS

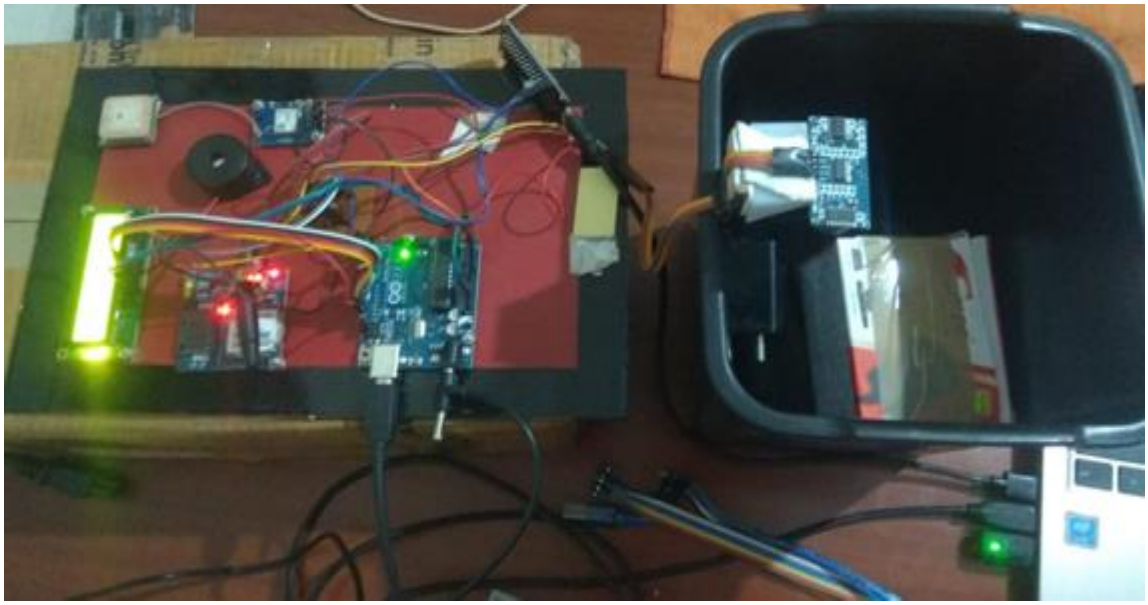

Figure 19: Circuit Board and Dustbin attached with Ultrasonic sensor

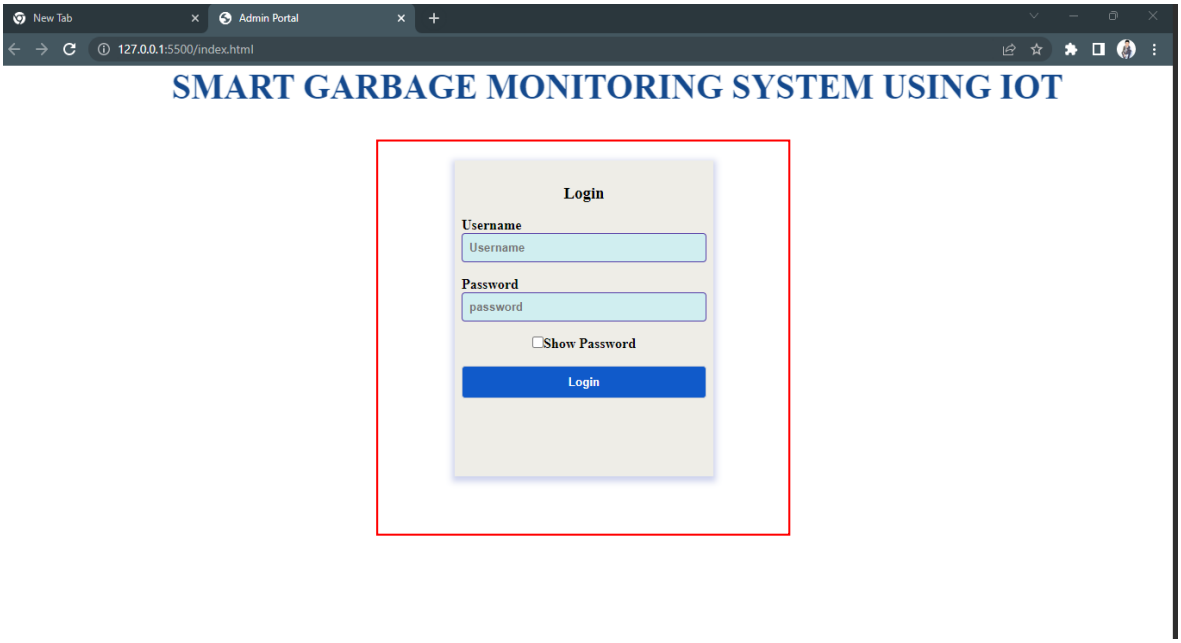

Figure 20: Admin Portal Login Page

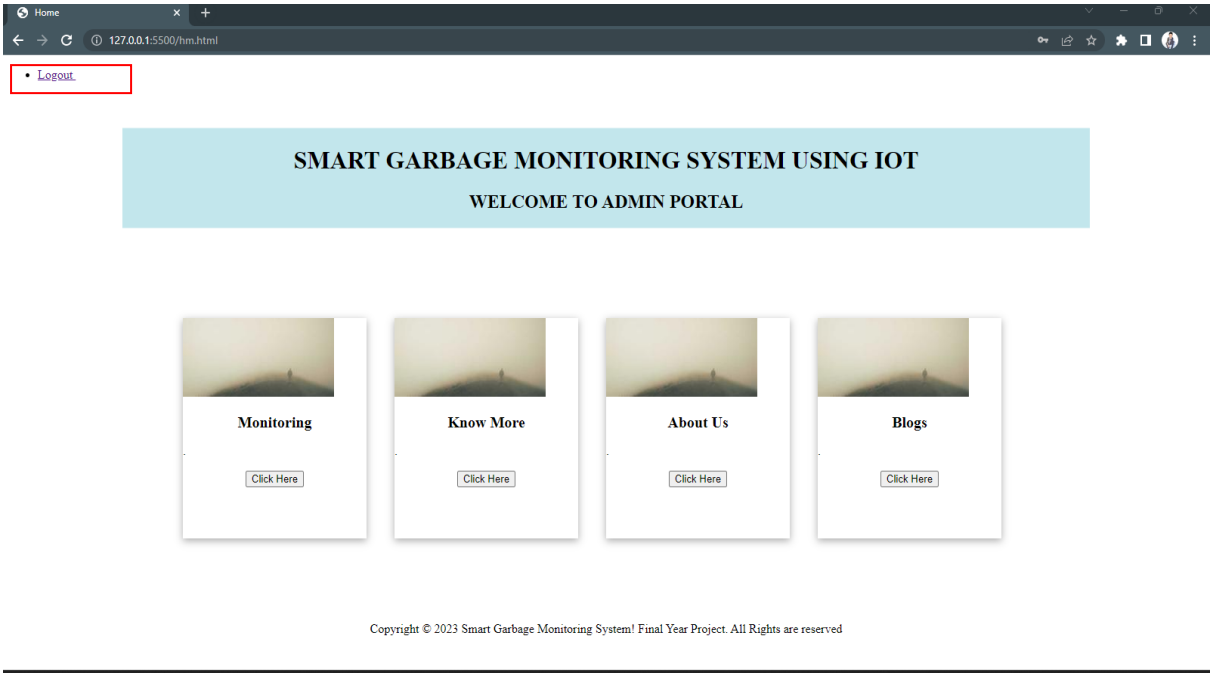

Figure 21: Admin Home Control Page

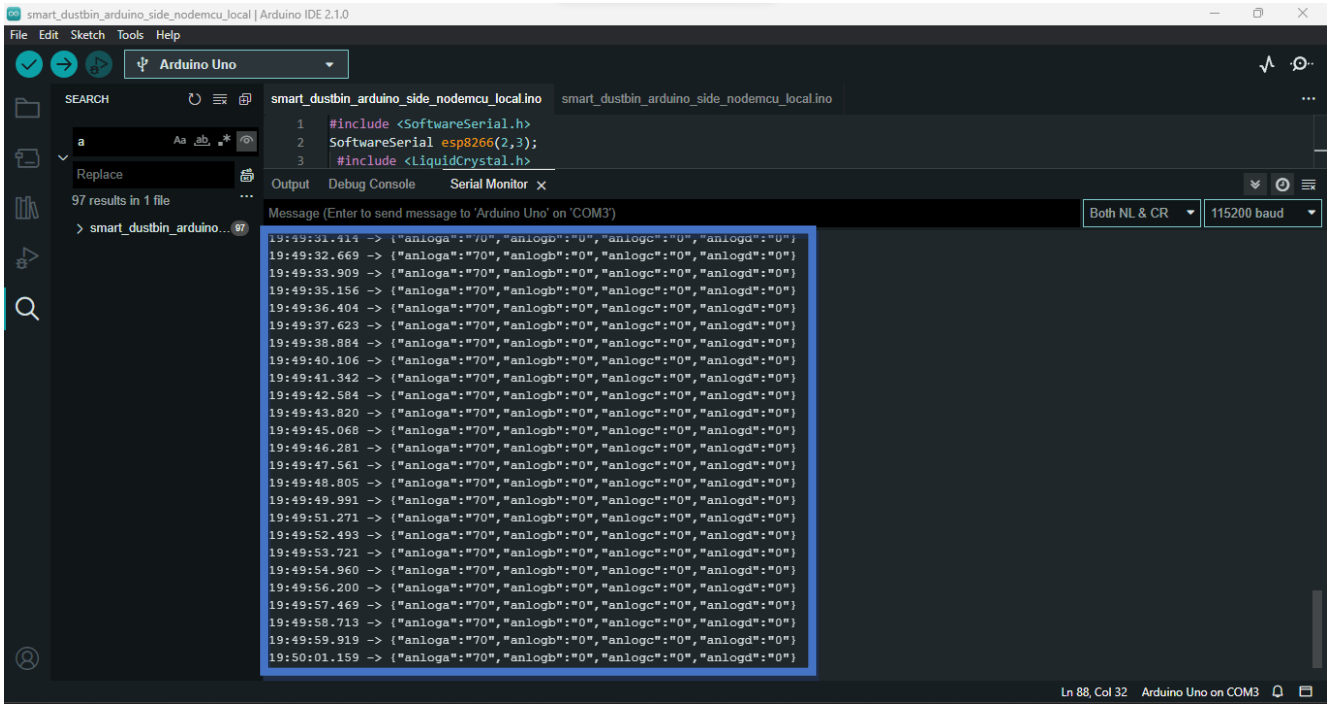

Figure 22: Dustbin Live Data showing on Arduino IDE

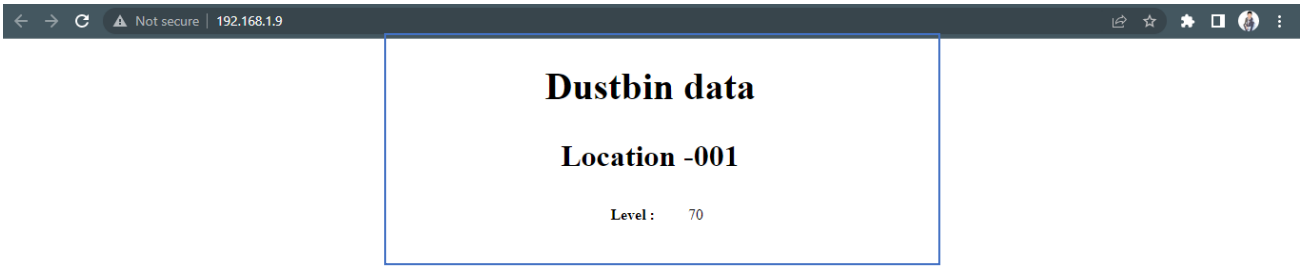

Figure 23: Live Dustbin Level Showing on Website (Monitoring)

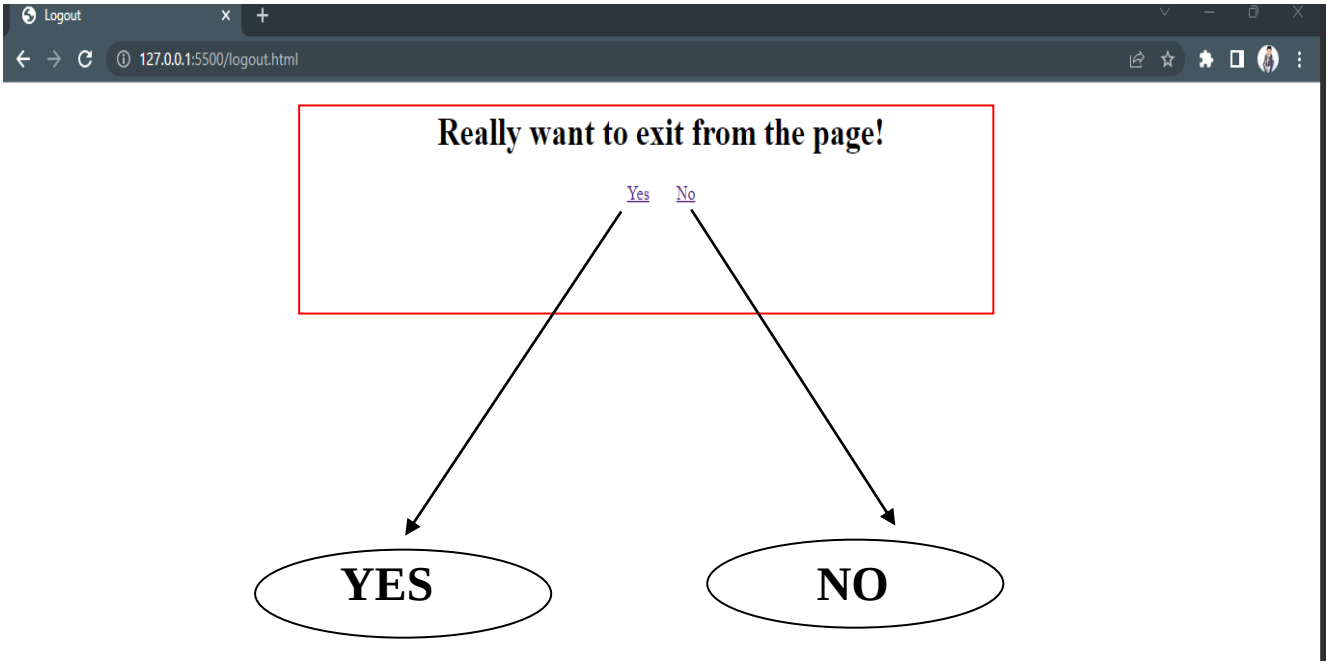

Figure 24: Logout Page

Figure 25: Dustbin is almost full

Figure 26: GPS Module sends the SMS

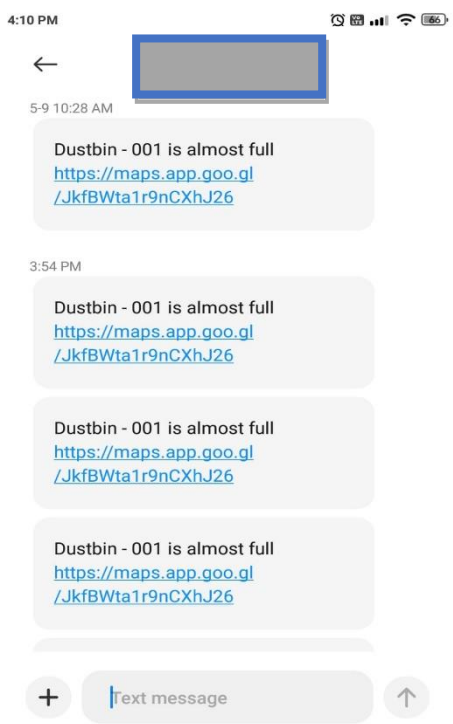

Figure 27: GPS Module Sent Message

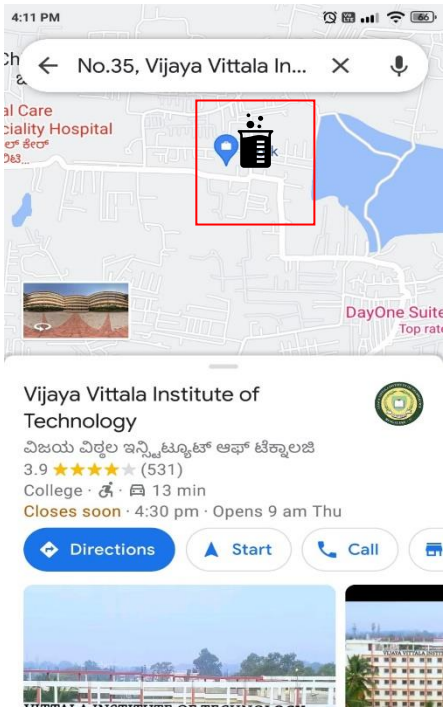

Figure 28: Dustbin Google Map Location

CHAPTER 10

RESULTS AND DISCUSSIONS

While completing this project proposal, there are a few constraints that come up. First, the reading of sensors is less accurate and need to be extra careful of handling the sensors. Second, notification to the mobile phone cannot be done because the cloud platform used is an open-source platform and cannot be used to send an alert or notification to the users. Development of the system need to be done thoroughly to decrease the possibility of errors.

However, the added value has been added to this system to make the system more reliable. Normalization is being used to eliminate the outliers which can help to increase the accuracy of the distance reads by an ultrasonic sensor.

9.1 EXPECTED RESULTS

Garbage Monitoring System using Internet of Things is an innovative and systematic system to monitor and collect the garbage. This system is expected to optimize the management, resources, cost, and reduces manpower to handle the garbage collection.

This project able to help the employees at the hostel handling the garbage collection for each block. Furthermore, employees do not have to check each of garbage bins daily when there are no notifications for collecting the garbage. With an accurate reading of distance and immediate notifications, the garbage can be collected before it overloaded.

Figure 29: Final Results of the Project

CHAPTER 11

CONCLUSION AND FUTURE ENHANCEMENTS

In this project, an integrated system of Wi-Fi modem, IoT, GSM, Ultrasonic Sensor is introduced for efficient and economic garbage collection. The developed system provides improved database for garbage collection time and waste amount at each location. We analyzed the solutions currently available for the implementation of IoT. By implementing this project, we will avoid over flowing of garbage from the container in residential area which is previously either loaded manually or with the help of loaders in traditional trucks. It can automatically monitor the garbage level & send the information to collection truck. The technologies which are used in the proposed system are good enough to ensure the practical and perfect for solid garbage collection process monitoring and management for green environment.

Trash assortment as of late was treated in a somewhat stale manner. We have proposed a more effective waste administration framework dependent on Internet of Things idea that have smart administration of all trash receptacles situated all through city with proposed highlights like asset improvement, cost decrease and too time the executives. We have utilized IOT and API for send online notice in speedy time. To make our framework eco-more amiable and utilize common assets.

10.1 RECOMMENDATION AND FUTURE WORKS

After the project proposal is completed, the development of the system proceeds to be implemented by making the prototype and whole garbage monitoring system. As the Garbage Monitoring System using Internet of Things are the monitoring system, it will be better if there is any sensor can put the garbage outside the bins into the bins.

Then, it recommended if the bins can move around like a robot while putting all the garbage into the bins. By this way, the environment will be cleaner and there is no more problems or issues regarding garbage.

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