AY 2023-24
PROJECT REPORT
ON

Smart garbage segregation and monitoring system

Submitted for

ECL 502: Project Phase 1

By
SEJAL JAIN (21240)
SEMESTER V
BTECH ECE

SCHOOL OF ELECTRONICS

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA
HIMACHAL PRADESH

December 2023

BONAFIDE CERTIFICATE

This is to certify that the project titled '**Smart Garbage Segregation and Monitoring system'** is a bonafide record of the work done by

SEJAL JAIN (21240)

in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in ECE of the INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA, HIMACHAL PRADESH, during the year 2021 - 2025.

under the guidance of

Dr. Naveen Cheggoju

Project viva-voce held on: 24th November 2023

Internal Examiner External Examiner

ORIGNALITY / NO PLAGARISM DECLARATION

We certify that this project report is our original report and no part of it is copied from any published reports, papers, books, articles, etc. We certify that all the contents in this report are based on our personal findings and research and we have cited all the relevant sources which have been required in the preparation of this project report, whether they be books, articles, reports, lecture notes, and any other kind of document. We also certify that this report has not previously been submitted partially or as whole for the award of degree in any other university in India and/or abroad.

We hereby declare that, we are fully aware of what constitutes plagiarism and understand that if it is found at a later stage to contain any instance of plagiarism, our degrees may be cancelled.

SEJAL JAIN (21240)

ABSTRACT

Smart garbage segregation system and monitoring system is an innovative approach to enhance waste management practices. The system utilizes internet of things (IoT) technology to monitor the waste bin status, segregation the garbage into different categories, and optimizes the waste collection process. The proposed system consists of various sensors, microcontrollers, and wireless communication modules that work together to achieve the desire goals. The system not only provides an efficient way to manage waste but also promotes environmental sustainability by reducing the amount of waste going to landfills. This paper presents an abstract of the smart garbage segregation and monitoring system, highlighting its various components and their functionalities.

The proposed consist of GSM module that works together to achieve the desired goals. The system's ability to send SMS notification to various components and their functionalities.

Keywords: *Waste segregation, Sustainable development, Garbage disposal, IoT.*

ACKNOWLEDGEMENT

We would like to thank the following people for their support and guidance without whom the completion of this project in fruition would not be possible.

We would like to express our sincere gratitude and heartfelt thanks to Dr. Naveen Cheggoju for their unflinching support and guidance, valuable suggestions, and expert advice. Their words of wisdom and expertise in subject matter were of immense help throughout the duration of this project.

We also take the opportunity to thank our director and all the faculty of School of Computing/Electronics, IIIT Una for helping us by providing necessary knowledge base and resources.

We would also like to thank our parents and friends for their constant support.

SEJAL J AIN (21240)

TABLE OF CONTENTS

LIST OF ACRONYMS

IoT	Internet of things
IC	Integrated circuit
DO	Digital output
AO	Analog output
Vcc	voltage at common collector
IR	Infrared Sensor

LIST OF FIGURES

Chapter 1

Introduction

1.1 Overview

The world's population is growing at an unprecedented rate, leading to an increase in the amount of waste produced. Efficient waste management is crucial to maintain environmental sustainability, prevent pollution, and reduce public health risks. Traditional waste management practices involve collecting and disposing of waste without considering the environmental impact.

To address these issues, a smart garbage segregation and monitoring system has been proposed. The system utilizes Internet of Things (IoT) technology to monitor waste bins' status, segregate the garbage into different categories, and optimize the waste collection process. The proposed system consists of various sensors, microcontrollers, wireless communication modules, and a GSM module that work together to achieve the desired goals.

The system's sensors monitor the waste bin's fill level, humidity, and temperature, enabling the authorities to optimize the waste collection process. The waste is segregated into different categories based on its type, such as plastic, paper, and metal. The system then sends a notification to the authorities to collect the waste when it reaches a particular fill level, ensuring that the waste collection process is efficient and timely.

Moreover, the system promotes environmental sustainability by reducing the amount of waste going to landfills. By segregating the waste, recyclable materials can be repurposed, reducing the environmental impact of waste disposal.

This paper aims to present an overview of the smart garbage segregation and monitoring system, highlighting its various components, their functionalities, and the benefits of implementing such a system.

At the core of this system is the Arduino microcontroller, serving as the central processing unit for collecting and processing data from various sensors. Infrared and ultrasonic sensors facilitate automatic segregation of recyclable and non-recyclable materials.

IoT connectivity enables real-time communication with a central server, allowing remote monitoring and control. The system also incorporates data logging and analysis, capturing information on waste composition, bin levels, and segregation efficiency. An intelligent routing algorithm optimizes waste collection routes based on bin fill levels, reducing fuel consumption

and minimizing environmental impact. The user interface, accessible via web or mobile applications, enhances user engagement by providing real-time monitoring, alerts, and historical data access.

The Smart Garbage Segregation and Monitoring System using Arduino offers a range of benefits. Firstly, it contributes to environmental conservation by increasing recycling rates and reducing the impact of landfills and incineration. Secondly, the implementation of a smart routing algorithm leads to cost savings by minimizing fuel consumption and operational costs in waste collection.

Thirdly, the system supports data-driven decision-making, providing valuable insights to optimize waste management strategies and resource allocation. Lastly, by involving the community through a user-friendly interface, the system promotes awareness and encourages responsible waste disposal practices. In conclusion, this innovative system represents a significant step forward in modernizing waste management practices for a cleaner and greener future. Furthermore, the system fosters transparency and accountability by providing stakeholders with access to real-time and historical data.

This transparency encourages a collaborative and responsible approach to waste disposal among waste management authorities, government agencies, and the community. The educational opportunities presented by the user interface further contribute to building an environmentally conscious society. Additionally, the system's adaptability to urban planning is noteworthy, as the data it generates can inform future infrastructure development, waste disposal facility placement, and overall urban planning strategies for more sustainable cities.

Lastly, the global scalability of the system, owing to its modular design, positions it as a versatile solution that can be adapted to various geographical locations, making it a transformative force in reshaping waste management practices worldwide. In summary, the Smart Garbage Segregation and Monitoring System stands as a comprehensive and impactful solution with far-reaching benefits for both local communities and the broader global landscape. Beyond the local impact, the system's adaptability to urban planning holds promises for sustainable city development. The wealth of data it generates regarding waste generation patterns and trends becomes a valuable tool for urban planners, guiding decisions related to infrastructure development and waste facility placement. The scalable nature of the system positions it not only as a local solution but as a global catalyst for positive change in waste management practices.

This adaptability, combined with its modular design, allows the system to transcend geographical boundaries, offering transformative potential on a global scale. In essence, the Smart Garbage Segregation and Monitoring System serves as a beacon of innovation, offering a holistic approach to waste management that reverberates across sectors. Its impact spans public health, resource optimization, transparency, education, and urban planning, making it a dynamic force in shaping sustainable and resilient communities worldwide.

1.2 Arduino

Arduino is an open-source software and hardware company, that designs and manufactures single- board microcontrollers and kits to build digital devices. The Board developed by them are termed as Arduino boards that are capable of reading inputs like – dept info using radar, light on a sensor, press of a button, etc.

Chapter 2

Review of Literature

This section covers the work done by various researches using different technologies for segregating the waste. Authors Aksan Surya Wijaya et al. presented the smart waste-bin that can manage the waste in a smart city project. The system consists of sensors to measure the weight of waste and the level of waste inside the bin. The system also adapts with the network environment, to manage all information from waste management. Load cell calibration approach, simplifies calibration process so it can be attached to commonly used waste-bin without modification. The level sensors also can be attached to common waste-bin.

Authors Shahrani Ashok Ghatage et al. proposed a system IoT based Garbage Management (monitor and acknowledgment) System shall provide the smart solution regarding the overflowing of garbage bins. The System uses ultrasonic sensors to sense the level of garbage in the bin, flame sensor to detect the fire and moisture sensor to separate out wet and dry garbage

Existing Prototype :

1. **Smart Alert System(2019):**

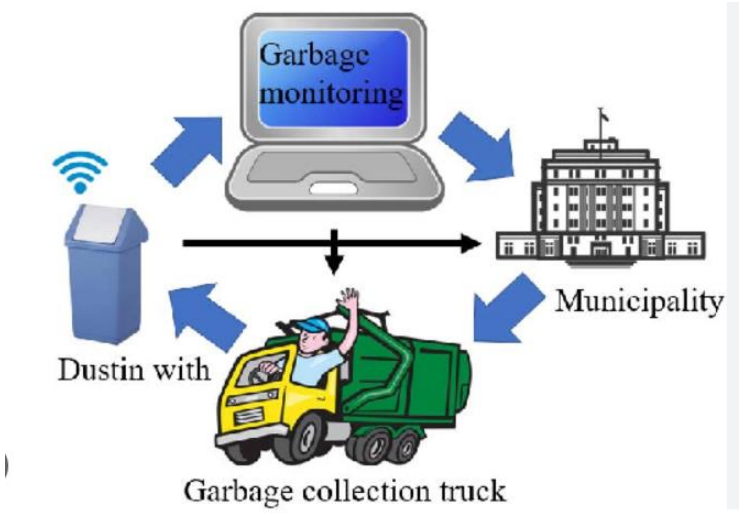

Fig 1:Smart Alert System

Segregates garbage using RFID tag technology.

Garbage collected is recorded. The RFID tags are used for automatically identifying and giving alerts to the users based on the values in the RFID tags.

2. **SAF-Sutra (2014)**

Fig 2: SAF-Sutra Cross view

Monitor and is remotely built. Its interaction with the user takes place using the mobile along with the web application. It Covers less area and is user friendly with low Electricity Consumption.

3. **Smart System and the (IoT) for waste management (2020)**

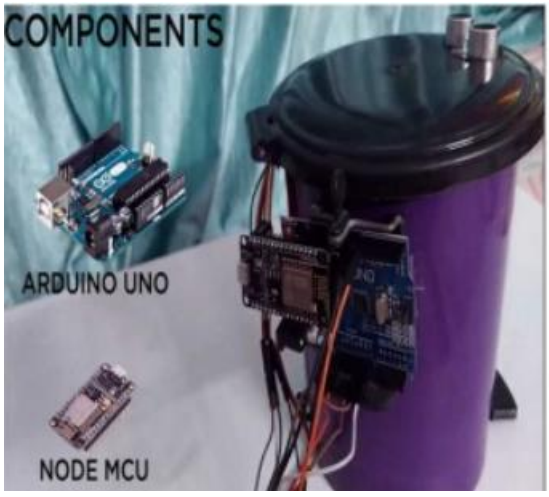

Fig 3: Cross View

The smart garbage bin is capable of monitoring internal garbage levels, compact them, and free 25% of the space with each compactness. Covers less Area.

Chapter 3

Methodology

3.1 Objectives:

- Develop a smart garbage bin that can automatically segregate waste based on its type, such as organic, recyclable, or non-recyclable waste.
- Implement sensors and other monitoring technologies to detect the level of garbage in the bins and notify waste management systems when they need to be emptied.
- Use data analytics and machine learning algorithms to optimize waste collection routes and schedules, reduce transportation costs, and minimize the carbon footprint of waste management operations.
- Raise public awareness of waste segregation and recycling through the provision of real-time data and feedback on the waste disposal process.
- Promote sustainable waste management practices and help to reduce environmental pollution and degradation caused by improper waste disposal.

3.2 Designing steps:

3.2.1 module-1

Assembling the required components-

a) SG90 Micro-servo motor:

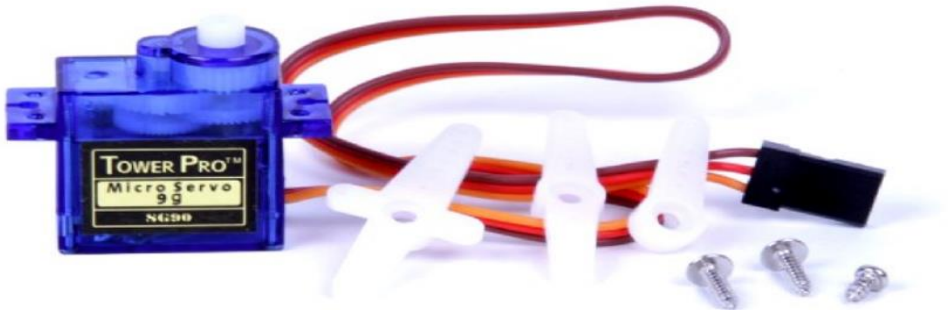

Fig. 4: SG90 Micro-servo motor

Tiny and lightweight with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware, or library to control these servos. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with 3 horns (arms) and hardware.

b) Arduino UNO

Fig. 5: Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins, six analogy inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. It can be used to build a wide range of electronics projects, from simple LED blinkers to complex robots.

The board can be programmed using the Arduino Integrated Development Environment (IDE), which is a free, open-source software that supports the C and C++ programming languages. The IDE allows you to write, upload, and debug code to the Arduino board. The Arduino Uno board is widely used by hobbyists, educators, and professionals to prototype and build electronic projects.

c) Buzzer:

Fig. 6: Buzzer

An audio signalling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound.

Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.

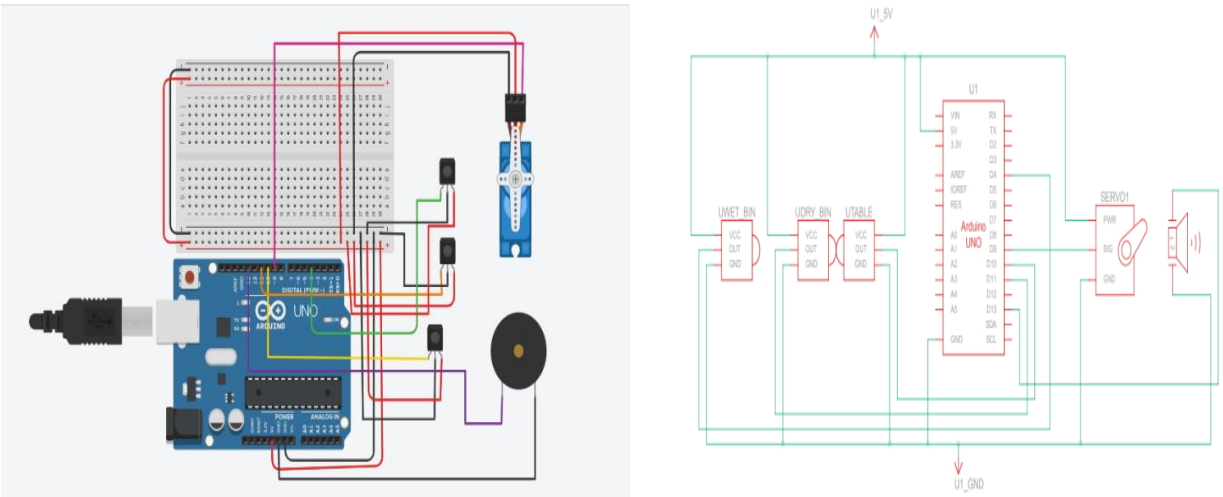

Fig 7: Schematic/Block diagram

- Implemented all the components on the Arduino and turn on the Arduino.
- First, putting the wet and dry garbage on the spark-fun moisture sensor.
- After putting the garbage, the sensor senses the moisture and segregate in the dustbin respective of it is an dry or wet garbage.
- If the garbage is wet it will fall over the wet dustbin and if it is dry it will fall over

the dry dustbin.

- Signal to system and the monitor system will alert that the system is filled.
- Eventually when the dustbin is filled the IR sensor senses the dustbin to send the notification.

Chapter 4
RESULTS & DISCUSSION

- **Working description:**

  - Here, Aluminum sheet works as the segregator in the system.
  - SG90servo motor rotates the sheet as per the type of waste which leads to conduction of current if the waste is wet, and thus pushes the waste accordingly.
  - Buzzer beeps when 75% of either side is full.
  - LCD displays the kind of waste dumped and its respective moisture level.
  - GSM module is employed to notify the user through SMS whenever the respective side (Wet or Dry) is 75% full on his/her mobile phone.

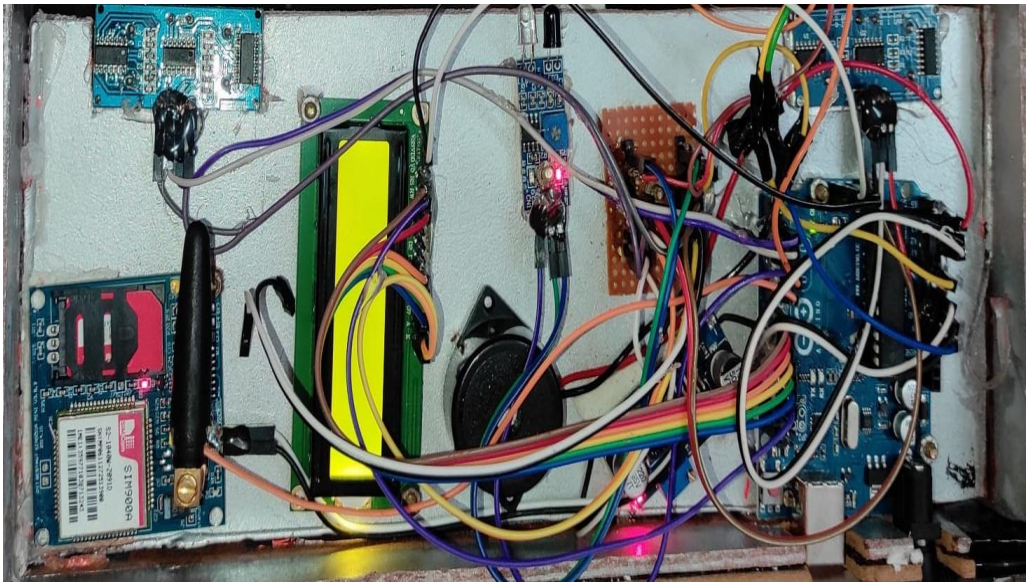

Fig.8: Interface view of system

RESULTS:

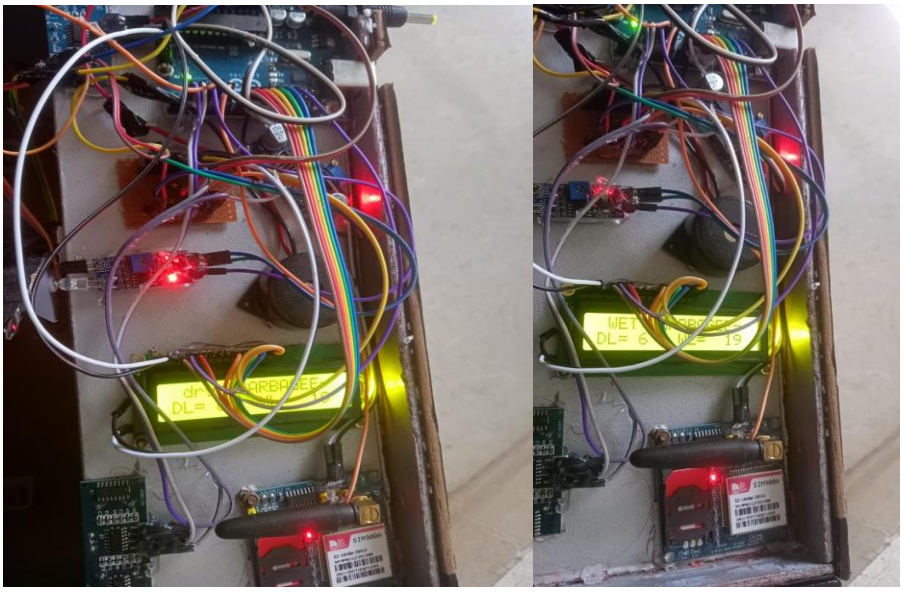

Fig 9: 16x2 LCD displays the type of waste (Wet/Dry) dumped by the user

- System is tested with Dry and Wet waste for respective segregation, LCD shows the type and moisture level of the waste introduced by the user to the aluminum Shaft.

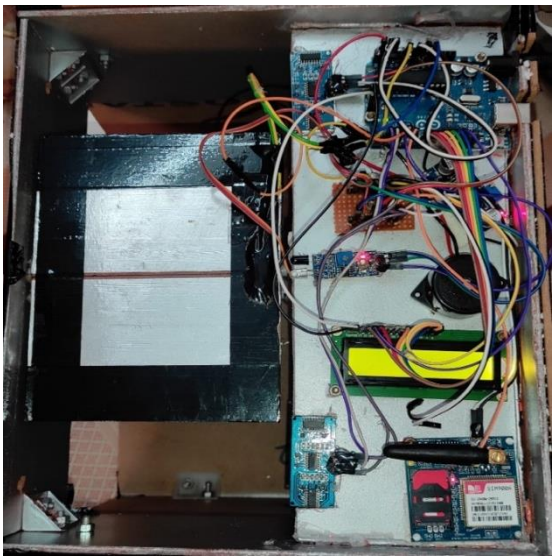

Fig.10 : Prototype

Chapter 5

Conclusion and future scope

4.1) Overall summary

In conclusion, the smart garbage segregation and monitoring system through, SMS is an innovative and efficient solution to the challenge of waste management. By using SMS technology, the system makes it easier for users to report any issues nd for administration to monitor and manage waste disposal. Moreover, the system's waste segregation features ensure that recycle materials are properly sorted and disposed of, helping to reduce the impact of waste on the environment.

4.2) Future Scope

Looking ahead, the future scope of the Smart Garbage Segregation and Monitoring System through SMS is promising. We can introduce intensive monitoring through an App (Blink-it App) for additional Details of the waste segregation taking place.

Furthermore, the system could be integrated with other smart city technologies, such as smart transportation and energy management systems, to create a more holistic and integrated approach to sustainable urban development.

The system could also be extended to cover a wider geographical area.

In conclusion, the Smart Garbage Segregation and Monitoring System through SMS is a highly innovative and effective solution to the challenges of waste management, with significant potential for future development and expansion.

References

[1] https://iopscience.iop.org/article/10.1088/1742-6596/1818/1/012225/pdf, P. Ranjana et al 2021 J. Phys.: Conf. Ser. 1818 012225.

[2]https://www.researchgate.net/publication/344049998_SAFSutra_A_Prototype_of_Remote_Smart_Waste_Segregation_and_Garbage_Level_Monitoring_System

[3]https://www.sciencedirect.com/science/article/pii/S2199853123001506.

[4] Rana, P., Rana, V., & Kumar, N. (2019). A review of IoT based smart garbage monitoring system for efficient waste management. Materials Today: Proceedings, 19, 238-244.

[5] Zia, A., Irfan, M., & Nawaz, M. (2019). Smart waste management system for smart cities using IoT. Future Generation Computer Systems, 91, 94-105.

Appendix A

Code Attachments

The following is the partial / subset of the code. Code of some module(s) have beenwillfully suppressed.

A.1 Sample Code

```
#include <Servo.h>

#define IRsensorDryBin 11
#define IRsensorWetBin 4
#define TableIRsensor 10
#define servopin 9
#define moisture A0
#define buzzer 13

// defines variables

int Table value = 0;
int DryBinIRvalue = 0;
int WetBinIRvalue = 0;
int Moisture Value = 0;
int pos = 0;    // variable to store the servo position


Servo myservo;  // create servo object to control a servo

void setup() {
  // put your setup code here, to run once:

 pinMode(IRsensorWetBin, INPUT);
 pinMode(IRsensorDryBin, INPUT);
 pinMode(TableIRsensor, INPUT);
 pinMode(moisture, INPUT);
 pinMode(buzzer, OUTPUT);

 myservo.attach(servopin);  // attaches the servo on pin 9 to the servo object
 Serial.begin(9600); // // Serial Communication is starting with 9600 of baudrate speed
}
```

```
 void loop() {
// put your main code here, to run repeatedly:

myservo.write(90);
TableIRvalue = digitalRead(TableIRsensor);
delay(2000);

   if(TableIRvalue == 0)
{
  //Serial.println("Object Detected!");
     MoistureValue = analogRead(moisture);
// Serial.println(MoistureValue);
     if(MoistureValue > 900)
  {
  //Serial.println("DRY WASTE");
  myservo.write(55);
  delay(3000);
  myservo.write(90);


  }
  else{
//Serial.println("WET WASTE");
  myservo.write(110);
  delay(3000);
  myservo.write(90);


}
}

   else{
//Serial.println("No Object Detected!");
}

   DryBinIRvalue = digitalRead(IRsensorDryBin);
    if(DryBinIRvalue == 1)
{
   Serial.println("Dry Bin is Full!");
   digitalWrite(buzzer,HIGH);
   delay(4000);
   digitalWrite(buzzer,LOW);
}

    WetBinIRvalue = digitalRead(IRsensorWetBin);
    if(WetBinIRvalue == 1)
```

```
    {
      Serial.println("Wet Bin is Full!");
      digitalWrite(buzzer,HIGH);
      delay(4000);
      digitalWrite(buzzer,LOW);
    }

}
```