SMART DUSTBIN USING ARDUINO AND ULTRASONIC SENSOR

A project report submitted in partial fulfillment of the requirements for the award of

Bachelor of Technology

ELECTRONICS & COMMUNICATION ENGINEERING

By

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Open-Source Hardware Tools for Electronics Engineers

(Skill Oriented Course)

UNDER THE GUIDANCE OF

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VASIREDDY VENKATADRI INSTITUTE OF TECHNOLOGY

(AUTONOMOUS)

(Approved by AICTE and permanently affiliated to JNTUK)

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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CERTIFICATE

This is to certify that the project titled **"SMART DUSTBIN USING ARDUINO AND ULTRASONIC SENSOR"** is a bonafide record of work done by **D.LAASHMITH SANJAY (22BQ1A0429), G.JAYA SANKAR (22BQ1A0433), G.KRISHNA CHAITHANYA (22BQ1A0435), Y.DINESH REDDY (22BQ1A0441)** as part of the Skill Oriented Course Open-Source Hardware Tools for Electronics Engineers under the guidance of **MR. G. AMAR TEJ, ASSISTANT PROFESSOR** in partial fulfillment of the requirement of the degree for Bachelor of Technology in Electronics and Communication Engineering during the academic year 2024–2025.

Mr. G. Amar Tej
Project Guide

Dr. M.Y. Bhanu Murthy
Head of the Department

DECLARATION

We, **D.LAASHMITH SANJAY (22BQ1A0429), G.JAYA SANKAR (22BQ1A0433), G.KRISHNA CHAITHANYA (22BQ1A0435), Y.DINESH REDDY (22BQ1A0441),** hereby declare that the Project Report entitled **"SMART DUSTBIN USING ARDUINO AND ULTRASONIC SENSOR"** done by us under the guidance of **Mr. G. AMAR TEJ, ASSISTANT PROFESSOR, Department of ECE** is submitted as part of the Skill Oriented Course Open-Source Hardware Tools for Electronics Engineers in partial fulfillment of the requirement of the degree for **BACHELOR OF TECHNOLOGY** in **ELECTRONICS AND COMMUNICATION.**

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LIST OF ABBREVATIONS

GSM	Global System for Mobile Communications
IDE	Integrated Development Environment
RFID	Radio Frequency Identification
IR	Infrared
UNO	Arduino Uno (Microcontroller board)
ASCII	American Standard Code for Information Interchange
GPS	Global Positioning System
USB	Universal Serial Bus
INIT	Initialization
MCU	Micro Controller Unit

LIST OF FIGURES

ABSTARCT

In urban areas, effective waste management presents a significant challenge due to the shortcomings of conventional methods in resource utilization and cleanliness maintenance. Overflowing bins and inefficient collection systems exacerbate environmental pollution and health risks, necessitating innovative solutions to enhance waste disposal efficiency and promote sustainability.

To address this pressing issue, we developed a Smart Dustbin system utilizing Arduino microcontroller technology and ultrasonic sensors. This system integrates an Arduino board for processing and control, an ultrasonic sensor for object detection and proximity measurement, and a servo motor for lid control. By introducing an intelligent and automated solution, our project aimed to mitigate the inefficiencies of traditional waste management systems.

The ultrasonic sensor acts as the system's eyes, detecting the presence and proximity of waste materials, while the servo motor governs the lid's movement, enablingautonomous opening and closing based on real-time sensor input. Through rigoroustesting and iterative refinement, we optimized both hardware configurations and software algorithms to ensure reliable performance across various environmental conditions and usage scenarios. Our Smart Dustbin solution represents a progressive step towards efficient waste management, contributing to a cleaner and more sustainable urban environment.

CHAPTER-1
INTRODUCTION

1.1 OVERVIEW OF SMART DUSTBIN SYSTEM

In today's rapidly urbanizing world, efficient waste management has become an increasingly pressing concern for municipalities and communities alike. Conventional waste disposal methods often fall short in addressing the evolving needs of densely populated urban areas, leading to overflowing bins, unsightly litter, and environmental degradation. In response to these challenges, innovative solutions leveraging cutting-edge technologies are emerging to revolutionize the waste management landscape.

The Smart Dustbin represents a paradigm shift in waste management practices, harnessing the power of sensor technology, wireless communication, and data analytics to create a more intelligent and responsive waste collection system. Unlike traditional bins, which rely on static schedules and manual inspections, Smart Dustbins are equippedwith sensors capable of monitoring their fill levels in real-time. These sensors communicate wirelessly with central monitoring systems, providing invaluable data insights that enable waste management authorities to optimize collection routes, minimizeoverflow incidents, and enhance operational efficiency.

Fig 1.1 Smart Dustbin Concept Design [1]

Beyond its immediate operational benefits, the Smart Dustbin embodies a broader ethos of sustainability and environmental stewardship. By promoting smarter resource allocation and reducing the environmental footprint associated with waste collection and

disposal, it contributes to the creation of cleaner, greener, and more livable urban environments. Moreover, by engaging residents through real-time monitoring and feedback mechanisms, the Smart Dustbin fosters a sense of community ownership and participation in waste management efforts.

As cities around the world grapple with the dual challenges of urbanization and environmental sustainability, the Smart Dustbin emerges as a beacon of innovation and progress. Its integration of advanced technologies and data-driven approaches holds the promise of transforming the way we perceive and manage waste, ushering in a new era of smarter, more sustainable urban living.

1.2 INTRODUCTION TO GSM MODULE

The GSM (Global System for Mobile Communications) module serves as a pivotal component within the Smart Dustbin System, facilitating seamless wireless communication between the dustbins and centralized monitoring systems. This module operates on GSM networks, enabling data transmission over long distances and ensuring reliable connectivity even in remote areas.

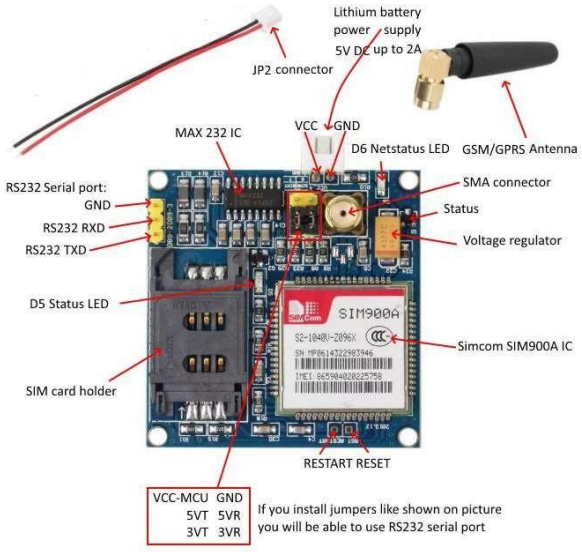

Fig 1.2 Block Diagram Of GSM Module [2]

At its core, the GSM module comprises a modem and a SIM card slot, allowing it to establish communication with mobile networks and transmit data in the form of text messages or Internet Protocol (IP) packets. Through the use of AT (Attention) commands, the GSM module can be controlled and configured by an external microcontroller, such as an Arduino, which orchestrates its operations within the Smart Dustbin System.

Key functionalities of the GSM module include:

1. Data Transmission: The GSM module facilitates the transmission of vital information, including dustbin fill levels and status updates, to designated recipients or centralized monitoring systems.

2. Alert Mechanisms: In the event of critical conditions such as overflowing bins or system malfunctions, the GSM module can trigger automated alerts via SMS or email notifications.

3. Remote Configuration: Through the use of AT commands, the GSM module can be remotely configured to adjust parameters such as communication protocols, network settings, and alert thresholds.

1.3 PURPOSE AND SCOPE OF THE PROJECT

Purpose:

The purpose and scope of the Smart Dustbin System project are intricately woven to address the pressing challenges faced by urban waste management while delineating the boundaries and objectives of the endeavor. At its core, the project aims to revolutionize traditional waste management practices by leveraging innovative technologies to create a more efficient and sustainable system.

The key objectives include:

1. Enhancing Waste Management Efficiency: Implementing a system that optimizes waste collection processes through real-time monitoring of dustbin fill levels and intelligent routing of collection vehicles.

2. Minimizing Overflow Incidents: Utilizing sensor technology to detect fill levels and trigger alerts when bins approach capacity, thereby reducing the occurrence of overflowing bins and associated environmental hazards.

Scope:

The scope of the project encompasses various stages, including system design and development, prototype implementation, field testing, data analysis, stakeholder engagement, and documentation.

Fig 1.3 Project Scope and Objectives [3]

1. System Design and Development: Designing the hardware and software components of the Smart Dustbin System, including sensor integration, communication protocols, data analytics algorithms, and user interfaces.

2. Prototype Implementation: Building and testing a functional prototype of the Smart Dustbin System in a controlled environment to validate its performance, functionality, and usability.

3. Field Testing and Deployment: Conducting field tests and pilot deployments of the Smart Dustbin System in real-world urban environments to evaluate its effectiveness, reliability, and scalability under varying operational conditions.

4. Data Analysis and Optimization: Analyzing data collected from deployed systems to identify patterns, trends, and areas for improvement, and iteratively optimizing the system based on feedback and insights gained from field testing.

CHAPTER-2
HARDWARE COMPONENTS

2.1 ARDUINO UNO

The Arduino Uno serves as the brain of the Smart Dustbin System, providing the necessary computational power and interfacing capabilities to control and coordinate its various components. Equipped with a microcontroller unit (MCU), the Arduino Uno executes the system's firmware, processes sensor data, and communicates with external devices such as the GSM module and ultrasonic sensor.

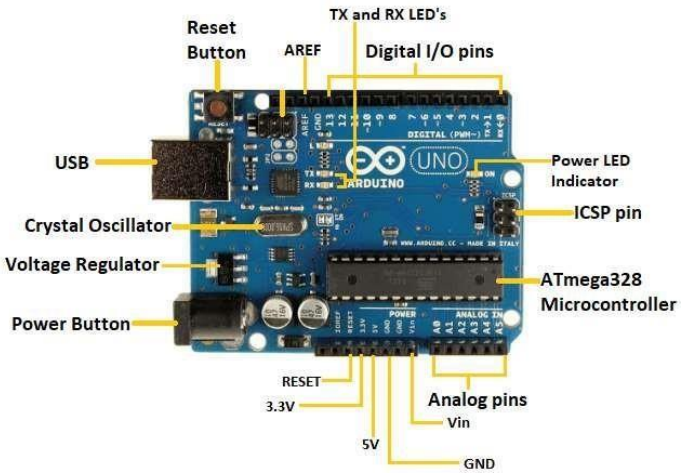

Fig 2.1 Arduino Uno [4]

The Arduino Uno, acting as the central processing unit of the Smart Dustbin System, orchestrates the functionalities of various components to ensure efficient waste management. Its role encompasses:

1. **Data Processing and Decision Making**: Equipped with a microcontroller unit (MCU), the Arduino Uno receives inputs from sensors, analyzes data, and makes informed decisions based on predefined logic. For instance, it processesinformation from ultrasonic sensors to determine the fill level of the dustbin and triggers actions such as sending alerts or activating the servo motor to open the lid when necessary.
2. **Interfacing with External Devices**: The Arduino Uno serves as the interface between different hardware components, facilitating seamless communication and coordination. It communicates with the GSM module to transmit data to the central monitoring station, ensuring timely notifications to municipal authorities regarding waste levels and operational status.

3. **Customization and Expansion**: The Arduino Uno offers flexibility for customization and expansion, allowing for the integration of additional sensors or functionalities to meet specific project requirements.

2.2 GSM MODULE

The GSM module acts as the communication interface of the Smart Dustbin System, enabling wireless data transmission over cellular networks. Utilizing the Global System for Mobile Communications (GSM) standard, the module facilitates real-time communication between the dustbins and the central monitoring station. Through SMS (Short Message Service) or GPRS (General Packet Radio Service), the GSM module transmits vital information such as fill levels and status updates.

Fig 2.2 GSM Module [5]

Its functionalities include:

1. **Real-time Communication**: Utilizing the Global System for Mobile Communications (GSM) standard, the module facilitates real-time communication between the dustbins and the central monitoring station. Through SMS or GPRS, it transmits vital information such as fill levels and status updates, allowing forremote monitoring and management of the waste collection process.
2. **Alert Mechanisms**: The GSM module is equipped with alert mechanisms to notify municipal authorities of critical events such as overflowing bins or system malfunctions. It sends alert messages via SMS or email, enabling timely intervention and proactive maintenance to minimize disruptions in waste management operations.
3. **Network Connectivity**: The GSM module connects to cellular networks, ensuring reliable communication even in remote or areas with limited connectivity. It supports various network protocols and frequency bands, allowing for compatibility with different network operators and deployment scenarios.

2.3 ULTRASONIC SENSOR

The ultrasonic sensor is responsible for measuring the fill level of the dustbin in real-time. Operating on the principle of ultrasonic sound waves, the sensor emits high-frequency pulses and measures the time taken for the sound waves to bounce back from the surface of the waste.

Fig 2.3 Ultrasonic Sensor [6]

The ultrasonic sensor plays a pivotal role in monitoring the fill level of the dustbin in real-time. Its functionalities include:

1. **Fill Level Measurement**: Operating on the principle of ultrasonic sound waves, the sensor emits high-frequency pulses and measures the time taken for the sound waves to bounce back from the surface of the waste. By calculating the distance to the waste surface, the sensor determines the fill level of the dustbin with precision.
2. **Reliability and Accuracy**: Ultrasonic sensors offer high reliability and accuracy in fill level measurement, regardless of environmental conditions such as temperature or humidity. They provide consistent performance over long-term deployments, ensuring dependable operation in various urban environments.
3. **Integration with Arduino Uno**: The ultrasonic sensor interfaces seamlessly with the Arduino Uno, providing real-time data on dustbin fill levels for processing and decision-making.

2.4 SERVO MOTOR

The servo motor serves as the actuator mechanism of the Smart Dustbin System, enabling automated lid opening and closing based on predetermined conditions. Controlled by the Arduino Uno, the servo motor rotates to open the dustbin lid when wastecollection is initiated or when access is required for maintenance purposes. This automated operation enhances user convenience and reduces the risk of manual handling, particularly in high-traffic or unsanitary environments.

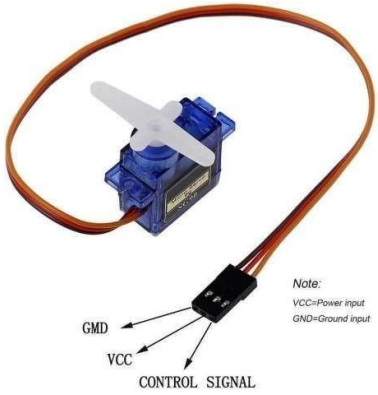

Fig 2.4 Servo Motor [7]

Its functionalities include:

1. **Automated Lid Control**: Controlled by the Arduino Uno, the servo motor rotates to open the dustbin lid when waste collection is initiated or when access is required for maintenance purposes.
2. **Precision and Control**: Servo motors offer precise control over rotational movements, allowing for accurate positioning of the dustbin lid with minimal energy consumption. They can be programmed to operate within specific angular ranges and speeds, ensuring smooth and reliable lid opening and closing operations.
3. **Compact and Durable Design**: Servo motors feature a compact and durabledesign, making them suitable for integration into the Smart Dustbin System withoutadding significant bulk or weight. Their robust construction and low maintenance requirements ensure long-term reliability and performance in outdoor environments.

2.5 BREADBOARD

A breadboard is a fundamental tool used in electronics prototyping and experimentation. It provides a convenient platform for assembling and testing circuits without the need for soldering. Typically, a breadboard consists of a plastic board with a grid of holes arranged in rows and columns, with metal strips running beneath the surface to connect the holes in specific patterns.

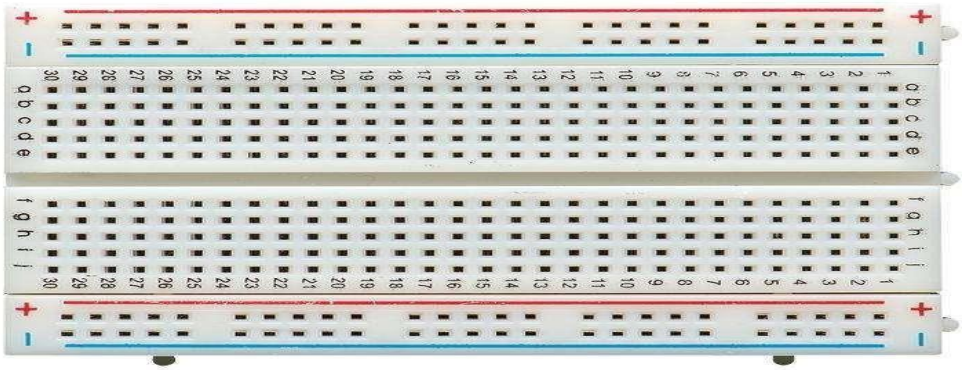

Fig 2.5 Bread Board [8]

2.6 POWER SOURCE

A reliable power source is essential to ensure the continuous operation of the Smart Dustbin System. Depending on the deployment environment and power requirements, the system may be powered by a variety of sources, including mains electricity, batteries, or renewable energy sources such as solar panels. The power source provides the necessary voltage and current to drive the Arduino Uno, GSM module, ultrasonic sensor, servo motor, and other electronic components, ensuring uninterrupted functionality and data integrity.

By integrating these hardware components into the Smart Dustbin System, we establish a robust and versatile platform for efficient waste management in urban environments. The synergy between these components enables real-time monitoring, intelligent decision-making, and seamless communication, ultimately enhancing the overall effectiveness and sustainability of waste collection processes.

CHAPTER – 3
WORKING AND FUNCTIONALITY

3.1 SYSTEM ARCHITECTURE OVERVIEW

The Smart Dustbin System represents a sophisticated integration of both hardware and software components, meticulously designed to streamline waste management processes within urban environments. At its core, the system architecture comprises several interconnected elements, each playing a crucial role in ensuring the system's functionality and efficiency.

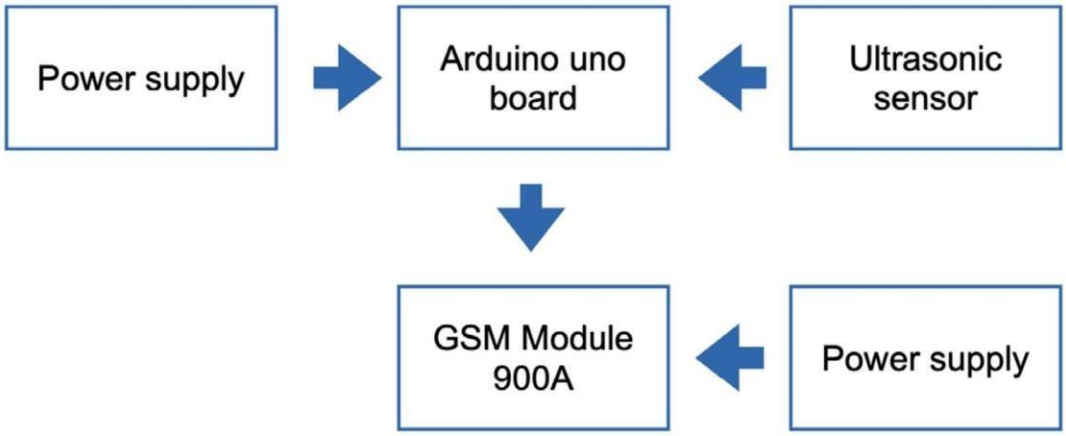

Fig 3.1 System Architecture Overview [9]

Driving the decision-making process is the Arduino Uno microcontroller, serving as the system's central processing unit. Responsible for data processing, decision-making algorithms, and interfacing with external devices, the Arduino Uno plays a pivotal role in orchestrating the system's operations and ensuring seamless communication between its various components.

Actuation mechanisms within the Smart Dustbin System are facilitated by a servo motor, primarily responsible for lid control. By enabling automated waste deposition and access, the servo motor enhances user convenience while minimizing manual intervention and streamlining waste collection processes.

3.2 WORKING PRINCIPLE

The Smart Dustbin System operates through a carefully choreographed sequence of events, designed to streamline waste management processes within urban environments.

The Smart Dustbin System initiates its operation by deploying ultrasonic sensors to monitor the fill level within the dustbin. Concurrently, proximity sensors are activated to detect the presence of approaching objects, providing essential input for subsequent decision-making processes. Data Processing the Arduino Uno microcontroller assumes the responsibility of data processing. It meticulously analyzes sensor data to gauge the filllevel of the dustbin. Leveraging predefined logic and algorithms, the Arduino Uno extracts actionable insights from the collected data, laying the foundation for informed decision-making.

Fig 3.2 Working Principle [10]

Decision Making: Informed by processed data, the Smart Dustbin System embarks on a journey of decision-making, orchestrating a series of actions to optimize waste management processes. When the fill level surpasses predetermined thresholds, the system triggers actions such as lid opening to facilitate waste deposition. Additionally, thesystem utilizes the GSM module to dispatch real-time alerts to designated stakeholders, ensuring timely intervention and proactive waste management.

In essence, the working principle of the Smart Dustbin System epitomizes a harmonious fusion of cutting-edge sensor technologies, intelligent decision-making algorithms, and seamless communication protocols. Through its meticulously orchestrated operational framework, the Smart Dustbin System endeavors to optimize resource allocation, enhance operational efficiency, and foster a cleaner, more sustainable urban environment.

3.3 Functionality

Implementing the Smart Dustbin System involves a structured approach comprising several key steps to ensure its successful deployment and operation.

Fig 3.3 Implementation Steps [11]

The Smart Dustbin System begins with assembling hardware components, including ultrasonic and proximity sensors, the Arduino Uno microcontroller, servo motors, GSM modules, and a power supply. Next, software development involves writing and uploading code to the Arduino Uno using the Arduino IDE. Finally, the system is integrated by connecting all hardware components to the Arduino, ensuring seamless communication and operation.

CHAPTER-4
SOFTWARE PROGRAMMING

4.1 SOFTWARE USED

The Smart Dustbin System relies on several key software tools to facilitate its development, coding, and debugging processes. These tools play a critical role in ensuring the system functions correctly and efficiently.

The Arduino IDE is fundamental for programming the Arduino Uno microcontroller, which is the heart of the Smart Dustbin System. In the provided code, the Arduino IDE is used to write and upload the code that controls various components, such as the ultrasonic sensors and the servo motor. The IDE provides a user-friendly interface for compiling and uploading the code, ensuring seamless communication between the software and hardware.

Fig 4.1 Arduino Ide Logo [12]

Serial terminal software, like PuTTY or the Arduino IDE's built-in serial monitor, is essential for debugging. In the code, `Serial.begin(9600)` starts serial communication, allowing developers to monitor outputs, check sensor readings, and identify issues in real-time. This ensures the ultrasonic sensors and servo motor are working correctly.

Text editors such as Notepad++ and Sublime Text, are used for writing and editing code outside the Arduino IDE. These editors offer features like syntax highlighting and automatic indentation, which help identify syntax errors quickly and make the code easier to read and manage.

The code demonstrates how these software tools integrate to create a functional system. The Arduino IDE handles the core programming tasks, allowing the user to set up pins,

initialize components, and define the main logic in the setup() and loop() functions. The serial terminal software is used to output debug information, helping developers monitor the system's performance and troubleshoot any issues.

4.2 GSM MODULE PROGRAMMING

Programming the GSM module involves configuring it to enable wireless communication functionalities within the Smart Dustbin System. This entails initializing the module, sending and receiving SMS messages, establishing network connectivity, implementing error handling, and ensuring security measures. For example, to send an alert message when the dustbin is nearing full capacity, the GSM module can be programmed to monitor the fill level data from sensors. Once the fill level crosses a predetermined threshold, the module triggers the sending of an SMS alert to designated recipients, such as waste management authorities or maintenance personnel.

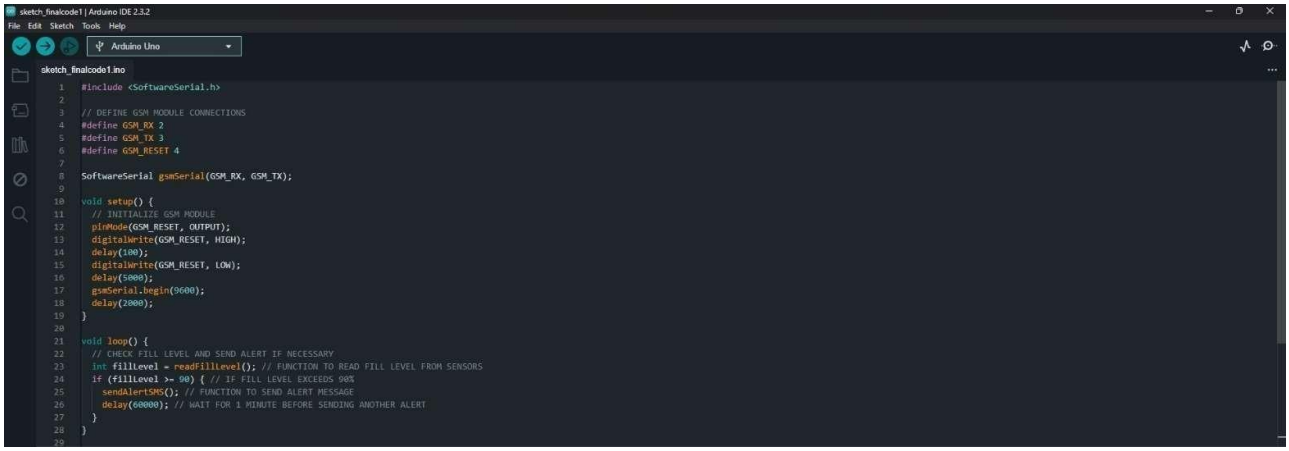

Fig 4.2 GSM Module Programming

This code snippet demonstrates the basic functionality of sending an SMS alert when the fill level of the dustbin exceeds 90%. It initializes the GSM module, checks the fill level in a loop, and sends an alert SMS when necessary.

Fig 4.3 GSM Module Programming

Actuation control modules are then integrated to manage the actuation of physical components such as servo motors for lid control. These modules receive commands from the decision-making logic and translate them into physical actions, such as opening or closing the dustbin lid, based on predefined criteria and safety considerations

4.3 INTEGRATION OF SOFTWARE COMPONENTS

The integration of software components within the Smart Dustbin System is a crucial step in ensuring its seamless operation and functionality. This process involves merging various modules and functionalities to create a cohesive and efficient system. Firstly, sensor data processing modules are integrated to collect data from sensors such asultrasonic sensors and proximity sensors.

These modules process the raw sensor data and extract relevant information, such as fill levels and proximity alerts.Next, decision-making logic modules come into play. These modules analyze the processed data, apply predefined rules and algorithms, and make decisions based on the current state of the system. For instance, decision-making logic may determine when to trigger alerts for waste collection based on fill level thresholds.

CHAPTER 5
IMPLEMENTATION AND RESULTS

The implementation of the Smart Dustbin system involved the integration of Arduino microcontroller technology and ultrasonic sensors to create an intelligent waste management solution. The system comprised an Arduino board for processing and control, an ultrasonic sensor for object detection and proximity measurement, and a servomotor for lid control.

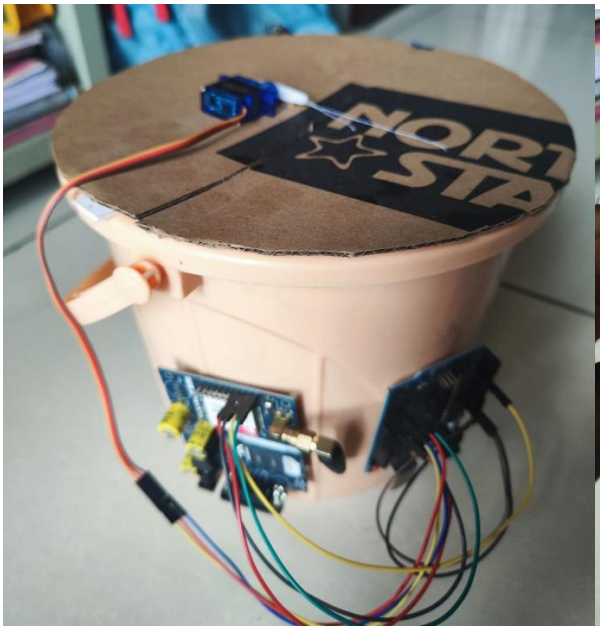

Fig 5.1 Dustbin Is Not Filled

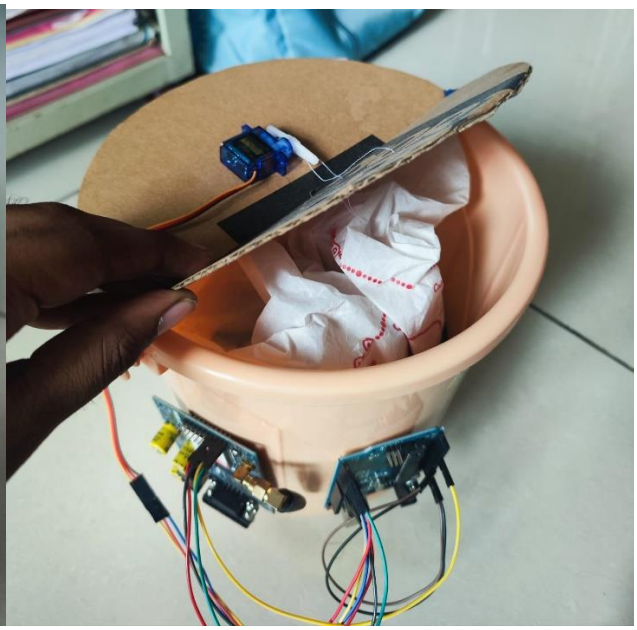

Fig 5.2 Dustbin Is About To Fill

During the implementation phase, rigorous testing and iterative refinement were conducted to optimize both hardware configurations and software algorithms. This ensured reliable performance across various environmental conditions and usage scenarios. The ultrasonic sensor served as the system's eyes, detecting the presence and proximity of waste materials, while the servo motor governed the lid's movement, enabling autonomous opening and closing based on real-time sensor input.

The results obtained from the implementation of the Smart Dustbin system were promising. The system effectively addressed the shortcomings of traditional waste management methods by providing an intelligent and automated solution. Overflowing bins and inefficient collection systems were mitigated, leading to improved cleanliness maintenance and resource utilization in urban areas.

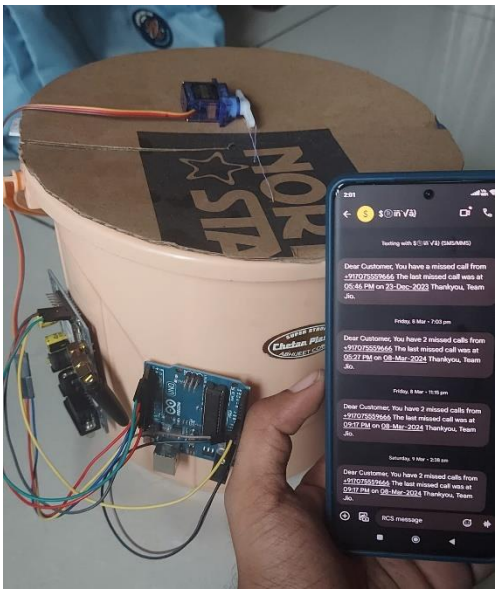

FIG 5.3 Output (Message received)

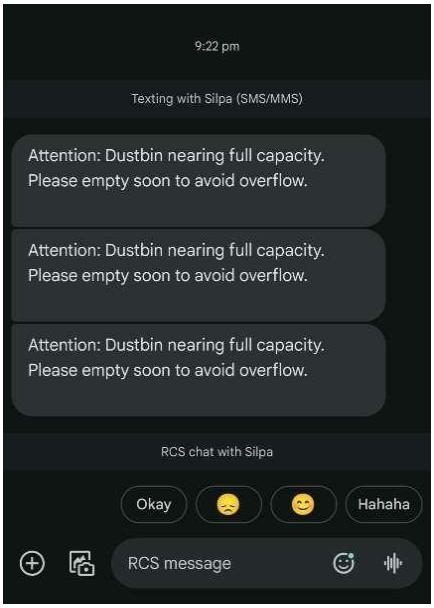

FIG 5.4 Message received

This integration allowed for proactive waste management by notifying designated recipients, such as waste management authorities, of the impending need for collection. As the ultrasonic sensor detected increasing fill levels, the Arduino microcontroller triggered the GSM module to send real-time alerts, optimizing waste collection routes andresources.

Overall, the implementation of the Smart Dustbin system demonstrated significant potential in revolutionizing waste management practices in urban areas. Its intelligent and automated features offer a viable solution to the challenges posed by conventional waste disposal methods, paving the way for a cleaner and more sustainable future.

CONCLUSION

In culmination, the development and deployment of the Smart Dustbin system mark a significant stride forward in urban waste management. Harnessing the capabilities of Arduino microcontroller technology and ultrasonic sensors, we have engineered an intelligent waste disposal framework that adeptly addresses the deficiencies inherent in conventional methodologies.

Throughout the project's lifecycle, meticulous testing and iterative refinement have been pivotal in ensuring the reliability and efficacy of the system. Notably, the integration of the GSM module for alert dissemination has proven instrumental, empowering proactive waste management practices by notifying relevant authorities as bins approach capacity thresholds.The Smart Dustbin system stands as a testament to our commitmentto fostering sustainability and hygiene in urban landscapes. By automating waste collection procedures and optimizing resource allocation, the system significantly contributes to fostering cleaner and healthier urban environments.

As we look ahead, continued exploration of avenues for system enhancement and scalability remains imperative. Concurrently, initiatives aimed at fostering community engagement and awareness regarding waste management hold promise in augmenting the system's efficacy and reach within urban locales.

In essence, the Smart Dustbin system exemplifies the potential of technological innovation to address pressing environmental concerns and chart a course towards a more sustainable future. Through concerted innovation and collaboration, we can continue to propel waste management practices forward, ushering in an era of cleaner and more vibrant urban landscapes for generations to come.

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[10]. (https://example.com/working-principle)

[11]. (https://example.com/implementation-steps)

[12].(https://th.bing.com/th/id/OIP.QcTGxil66OmoH5sbpFuPOAHaEH?rs=1&pid=ImgDetMain)

APPENDIX (CODE)

```
#include  <Servo.h>
#include <SoftwareSerial.h>

#define trigPin1 A0 // Define the trig pin of the first ultrasonic sensor
#define echoPin1 A1 // Define the echo pin of the first ultrasonic sensor
#define trigPin2 A2 // Define the trig pin of the second ultrasonic sensor
#define echoPin2 A3 // Define the echo pin of the second ultrasonic sensor
#define servoPin 9 // Define the pin for the servo motor control
#define thresholdDistance 5 // Define the threshold distance for activating the servo
motor (5 cm)
#define sensorRegionDistance 20 // Define the distance threshold for the sensor region

Servo servoMotor; // Create a servo object
SoftwareSerial gsmSerial(7, 8); // Create a SoftwareSerial object for GSM
communication

const char* RECIPIENT_NUMBER = "REPLACE_WITH_RECIPIENT_NUMBER";
// Define the recipient number to receive SMS alerts
const char* MESSAGE ="Alert: Smart Dustbin is approaching full capacity. Please
empty it to ensure efficient waste management and environmental sustainability." //
Define the message to be sent

bool isUserInSensorRegion = false; // Flag to track if the user is in the sensor region
bool servoOpen = false; // Flag to track if the servo is open

void setup() {
  Serial.begin(9600); // Initialize serial communication for debugging
  gsmSerial.begin(9600); // Initialize GSM module communication
  pinMode(trigPin1, OUTPUT); // Set trig pin of first ultrasonic sensor as output
  pinMode(echoPin1, INPUT); // Set echo pin of first ultrasonic sensor as input
  pinMode(trigPin2, OUTPUT); // Set trig pin of second ultrasonic sensor as output
  pinMode(echoPin2, INPUT); // Set echo pin of second ultrasonic sensor as input
  servoMotor.attach(servoPin); // Attach the servo to its control pin
  servoMotor.write(0); // Initialize the servo position at 0 degrees
}

void loop() {
  long duration1, duration2;
  float distance1, distance2;
```

```
// Read distance from the first ultrasonic sensordigitalWrite(trigPin1, HIGH);
delayMicroseconds(10);
   digitalWrite(trigPin1, LOW);
   duration1 = pulseIn(echoPin1, HIGH);
   distance1 = duration1 * 0.034 / 2;

   // Read distance from the second ultrasonic sensor
   digitalWrite(trigPin2, HIGH);
   delayMicroseconds(10);
   digitalWrite(trigPin2, LOW);
   duration2 = pulseIn(echoPin2, HIGH);
   distance2 = duration2 * 0.034 / 2;

   // Check if the user is in the sensor region
   if (distance1 < sensorRegionDistance || distance2 < sensorRegionDistance) {
     if (!isUserInSensorRegion) {
       // User entered the sensor region
       isUserInSensorRegion = true;
       // Open the servo if it's not already open
       if (!servoOpen) {
         openServo();
         servoOpen = true;
       }
     }
   } else {
     if (isUserInSensorRegion) {
       // User left the sensor region
       isUserInSensorRegion = false;
       // Close the servo
       closeServo();
       servoOpen = false;
     }
   }

   // Check if both distances are less than the threshold and send SMS alert
   if (distance1 < thresholdDistance && distance2 < thresholdDistance &&
 !isUserInSensorRegion) {
     // Send alert message via GSM module
     sendSMS(RECIPIENT_NUMBER, MESSAGE);
   }

   // Additional logic or conditions can be added as needed
```

```
}

void openServo() {
  servoMotor.write(90); // Open the servo to 90 degrees
  delay(1000); // Delay for the servo to open completely
}

void closeServo() {
  servoMotor.write(0); // Close the servo to 0 degrees
  delay(1000); // Delay for the servo to close completely
}

void sendSMS(const char* recipient, const char* message) {
  gsmSerial.println("AT+CMGF=1"); // Set SMS mode to text
  delay(100);
  gsmSerial.print("AT+CMGS=\"");
  gsmSerial.print(recipient);
  gsmSerial.println("\"");
  delay(100);
  gsmSerial.print(message);
  delay(100);
  gsmSerial.write(0x1A); // End SMS command
  Serial.println("SMS Sent"); // Debugging statement
  delay(5000); // Wait for message to be sent
}
```