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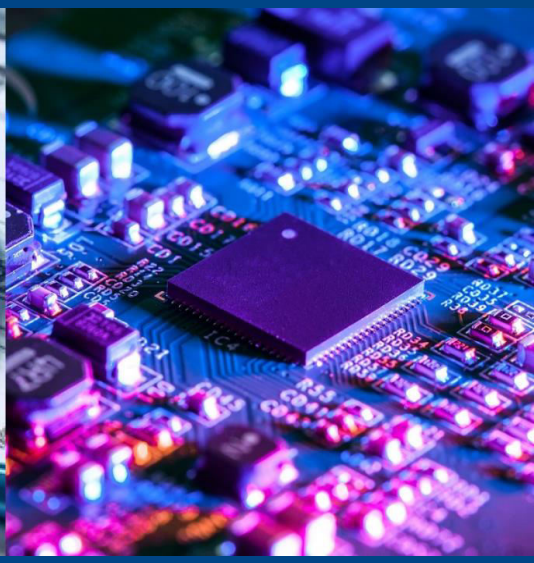

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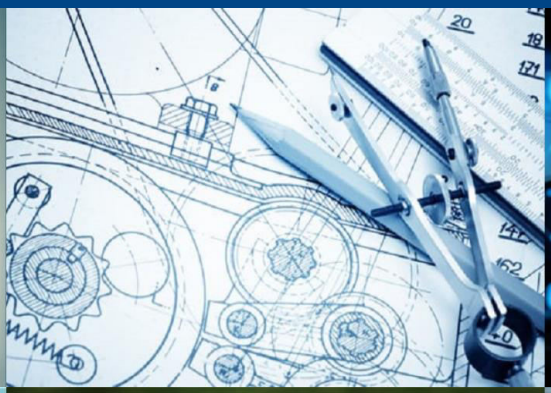

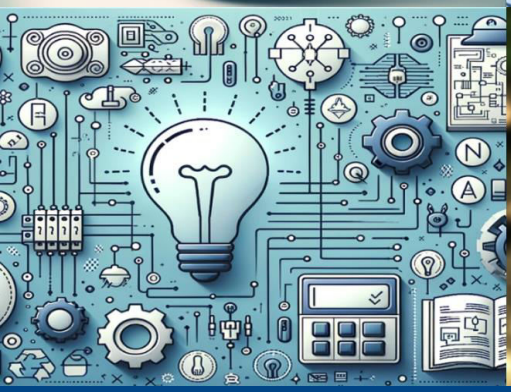

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Smart Dustbin using Arduino with GSM Module

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ABSTRACT: The primary objective of this project is to design and develop a smart dustbin system that promotes cleanliness and supports an eco-friendly environment. This work is inspired by the Swachh Bharat Mission, which emphasizes the importance of proper waste management. With the rapid advancement of technology, there is a growing need to incorporate intelligent systems into everyday applications. In this context, a smart dustbin is designed using the Arduino microcontroller platform. The proposed system is a microcontroller-based solution equipped with ultrasonic sensors to monitor user presence and garbage levels. Improper maintenance of conventional dustbins can lead to unhygienic conditions and environmental pollution, adversely affecting public health. To address this issue, the system integrates an Arduino UNO, ultrasonic sensors, a servo motor, and supporting components such as jumper wires and a power supply.The dustbin lid operates automatically: it opens when a user approaches within a specified range, remains open for a short duration to allow waste disposal, and then closes automatically. This touchless operation enhances hygiene and user convenience. Additionally, the system is designed to be cost-effective, making it accessible to a wide range of users, from households to public institutions. Furthermore, the system contributes to the development of smart cities by reducing manual effort in waste management. It continuously monitors the fill level of the dustbin and detects whether it is full or empty. When the bin reaches its capacity, a notification is sent via a GSM module, ensuring timely waste collection. Overall, this smart dustbin system offers an efficient, automated, and scalable solution for modern waste management challenges.

KEYWORDS: Smart Dustbin, Arduino, GSM Module, Ultrasonic Sensor, Waste Management, IoT

I. INTRODUCTION

Environmental cleanliness is a fundamental requirement for healthy living. Improper waste disposal and poorly maintained dustbins contribute to pollution and health hazards. Although dustbins are widely installed in urban areas, their maintenance remains inadequate.

With advancements in automation and embedded systems, smart solutions are being developed to address such issues. Smart dustbins are one such innovation that enhances waste management efficiency. These systems reduce human effort and ensure timely garbage collection.

The proposed system integrates sensing, automation, and communication technologies to create an intelligent waste management solution. It aligns with initiatives like clean city missions and supports sustainable urban development.

II. LITERATURE REVIEW

Several researchers have proposed smart waste management systems using IoT and embedded technologies. Existing systems focus on:

- Monitoring garbage levels using sensors
- Sending alerts through wireless communication
- Reducing overflow and manual inspection

However, many systems lack affordability and ease of implementation. This project aims to provide a low-cost and efficient alternative using widely available components.

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III. SYSTEM OVERVIEW

The proposed smart dustbin system consists of:

- Automatic lid operation using proximity detection
- Garbage level monitoring using ultrasonic sensors
- Notification system using GSM communication

Main Functionalities

1. Automatic lid opening and closing
2. Real-time garbage level detection
3. SMS alert when the bin is full
4. LED indication of fill levels

IV. METHODOLOGY

The system operates in three main stages:

4.1 Sensing

Two ultrasonic sensors are used:

- Sensor 1: Detects user presence to open the lid
- Sensor 2: Measures garbage level inside the bin

4.2 Processing

The Arduino microcontroller processes sensor data and:

- Controls the servo motor
- Updates LED indicators
- Triggers GSM alerts

4.3 Communication

The GSM module sends SMS notifications when the bin is full.

V. HARDWARE COMPONENTS

5.1 Arduino UNO

The Arduino UNO is based on the ATmega328P microcontroller and serves as the central processing unit. It handles input from sensors and controls output devices.

Key Features:

- 14 digital I/O pins
- 6 analog inputs
- USB interface
- 16 MHz clock speed

5.2 Ultrasonic Sensor

This sensor measures distance using sound waves.

Working Principle:

Distance is calculated using:

D=T×C2D = \frac{T \times C}{2}D=2T×C

Where:

- DDD = Distance
- TTT = Time
- CCC = Speed of sound

5.3 Servo Motor

A servo motor is used to control the lid movement with precision. It rotates to a specific angle based on signals from Arduino.

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5.4 GSM Module

The GSM module (SIM900A) enables communication via SMS.

Functions:

- Send messages
- Receive commands
- Network communication

5.5 LEDs

Four LEDs indicate the fill level of the dustbin:

- Level 1: Low
- Level 2: Medium
- Level 3: High
- Level 4: Full

VI. CIRCUIT DESIGN

The system includes:

- Arduino connected to sensors and actuators
- Ultrasonic sensors connected to digital pins
- Servo motor connected to PWM pin
- GSM module connected via serial communication
- LEDs connected to output pins

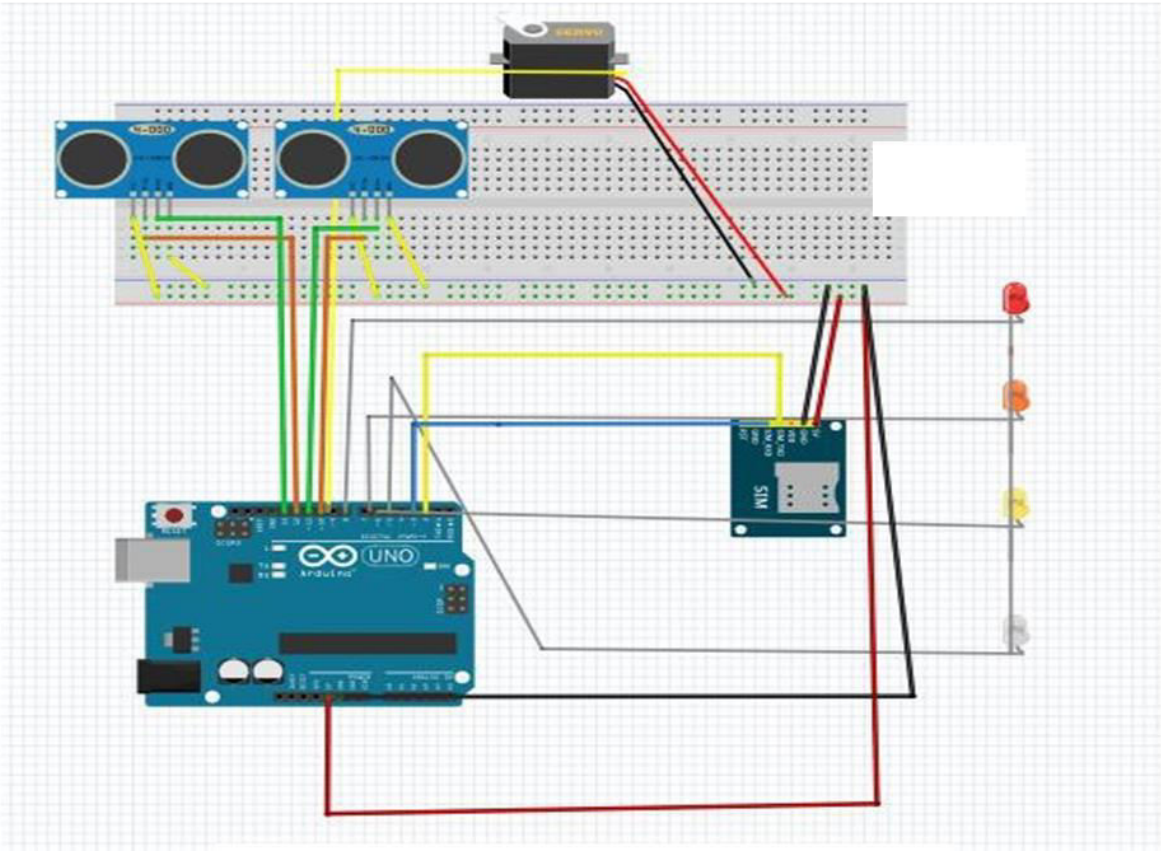

Fig 2.Circuit Diagram of Arduino Connection

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VII. SOFTWARE IMPLEMENTATION

7.1 Development Environment

- Arduino IDE
- Embedded C/C++ programming

7.2 Key Functional Modules

1. Distance measurement
2. Servo control
3. LED indication
4. GSM communication

7.3 Algorithm

1. Initialize system
2. Detect object near lid
3. Open lid using servo
4. Measure garbage level
5. Display level via LEDs
6. If full → send SMS alert
7. Repeat process

VIII. WORKING PRINCIPLE

When powered on:

- The ultrasonic sensor detects a user approaching
- The servo motor opens the lid
- After a delay, the lid closes automatically

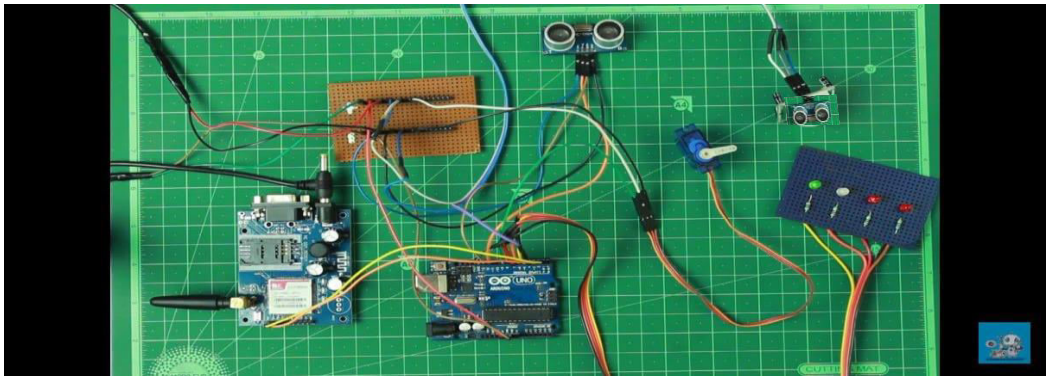
Simultaneously:

- The second ultrasonic sensor monitors garbage level
- LEDs indicate fill status
- When the bin is full, a message is sent via GSM

IX. RESULTS AND TESTING

The system was tested under various conditions:

- Accurate lid operation
- Reliable distance measurement
- Correct LED indication
- Successful SMS transmission



The system demonstrated efficient performance and reliability.

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Advantages

- Reduces manual monitoring
- Improves hygiene
- Low power consumption
- Cost-effective
- Easy to install and use

Applications

- Homes
- Offices
- Hospitals
- Public places
- Smart cities

Future Enhancements

Future improvements may include:

- Waste segregation (dry/wet)
- Integration with IoT cloud platforms
- GPS tracking of bins
- Methane and odor detection sensors
- Automated waste collection systems

X. CONCLUSION

The smart dustbin system presents an efficient solution for modern waste management challenges. By integrating automation and communication technologies, it ensures cleanliness, reduces human effort, and promotes environmental sustainability. The system is scalable, affordable, and suitable for real-world applications.

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