IoT Based Waste Management System

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PROBLEM STATEMENT

- In contemporary urban settings, it is increasingly evident that waste bins are consistently overflowing with garbage. Regrettably, municipal authorities seem to be neglecting this issue, leading to a cascade of problems. When bins are full, people resort to disposing of their trash outside the bins, resulting in not only an unsightly mess but also emanating a foul odor, pervading the surrounding environment.

IDEA

- Consider a smart container equipped with technology that allows it to track and record the amount of waste it holds. This data can be efficiently transmitted back to a central system for analysis.
- Importantly, when the container reaches its full capacity, automated notifications are sent via email to the waste management department, ensuring timely and proactive response to maintain cleanliness in the area.

SOLUTION

- In the proposed smart dustbin system, two of the ultrasonic sensors are dedicated to monitoring the bin's fill level. When the bin nears its capacity, these sensors promptly inform the waste management department via email, ensuring timely attention. Simultaneously, they trigger the servo motor to close the bin's door securely and display a clear "FULL" message on the integrated LCD screen. This real-time feedback mechanism not only streamlines waste collection processes but also maintains cleanliness in public spaces.
- Additionally, the third ultrasonic sensor serves an external function by measuring the distance from the bin. If an object is detected within its range, the door opens automatically to facilitate convenient disposal. However, in situations where the bin has reached its maximum capacity, the door remains closed, preventing overflow and discouraging littering. This innovative design promotes responsible waste management practices, enhancing both efficiency and cleanliness in urban environments.

HARDWARE REQUIRED

- Arduino uno
- Ultra Sonic Sensors (HC-SR04)
- Servo Motor
- LED

Required Online Software's:

- Arduino IDE
- Python

Required Libraries:

- SMTP lib
- <Servo.h>

Arduino UNO

- **Microcontroller:** ATmega328P running at 16 MHz.
- **Digital I/O Pins:** 14, including 6 PWM pins.
- **Analog Inputs:** 6 analog inputs for reading analog signals.
- **Memory:** 32KB Flash memory for program storage.
- **RAM:** 2KB of SRAM for temporary data storage.
- **EEPROM:** 1KB EEPROM for data preservation between reboots.
- **Voltage Regulator:** Integrated voltage regulator for stable power supply.
- **USB Connectivity:** Can be connected to a computer via USB for programming and power.
- **Open Source:** Based on open-source hardware and software.
- **Expandability:** Compatible with various sensors, actuators, and shields.
- **User-Friendly:** Easy to program using the Arduino IDE.
- **Versatility:** Suitable for a wide range of electronic projects and prototypes.

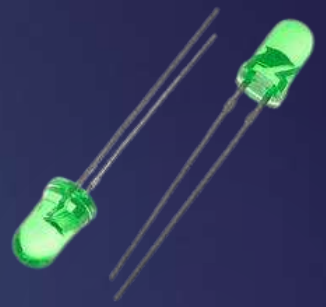
Ultra Sonic Sensor

- **Distance Measurement:** HC-SR04 is an ultrasonic ranging module that uses ultrasonic waves to measure distance without making physical contact.
- **Working Principle:** It works on the principle of sending a pulse of ultrasonic sound and measuring the time it takes for the sound waves to bounce back after hitting an object.
- **Accuracy:** Provides accurate distance measurements with high precision, usually within a few millimeters.
- **Range:** Typically has a range from 2 cm to 400 cm (1 inch to 13 feet), making it suitable for various applications where proximity or distance sensing is required.
- **Components:** Consists of two main components - a transmitter (ultrasonic sensor) and a receiver (ultrasonic transceiver).
- **Trigger and Echo Pins:** Requires two pins for operation - a trigger pin to send ultrasonic pulses and an echo pin to receive the reflected signals.
- **Low Cost:** HC-SR04 sensors are relatively inexpensive, making them popular among hobbyists and students for prototyping and experimenting with distance sensing applications.
- **Versatility:** Can be used both indoors and outdoors, making it versatile for a wide range of applications in different environments.

Servo Motor

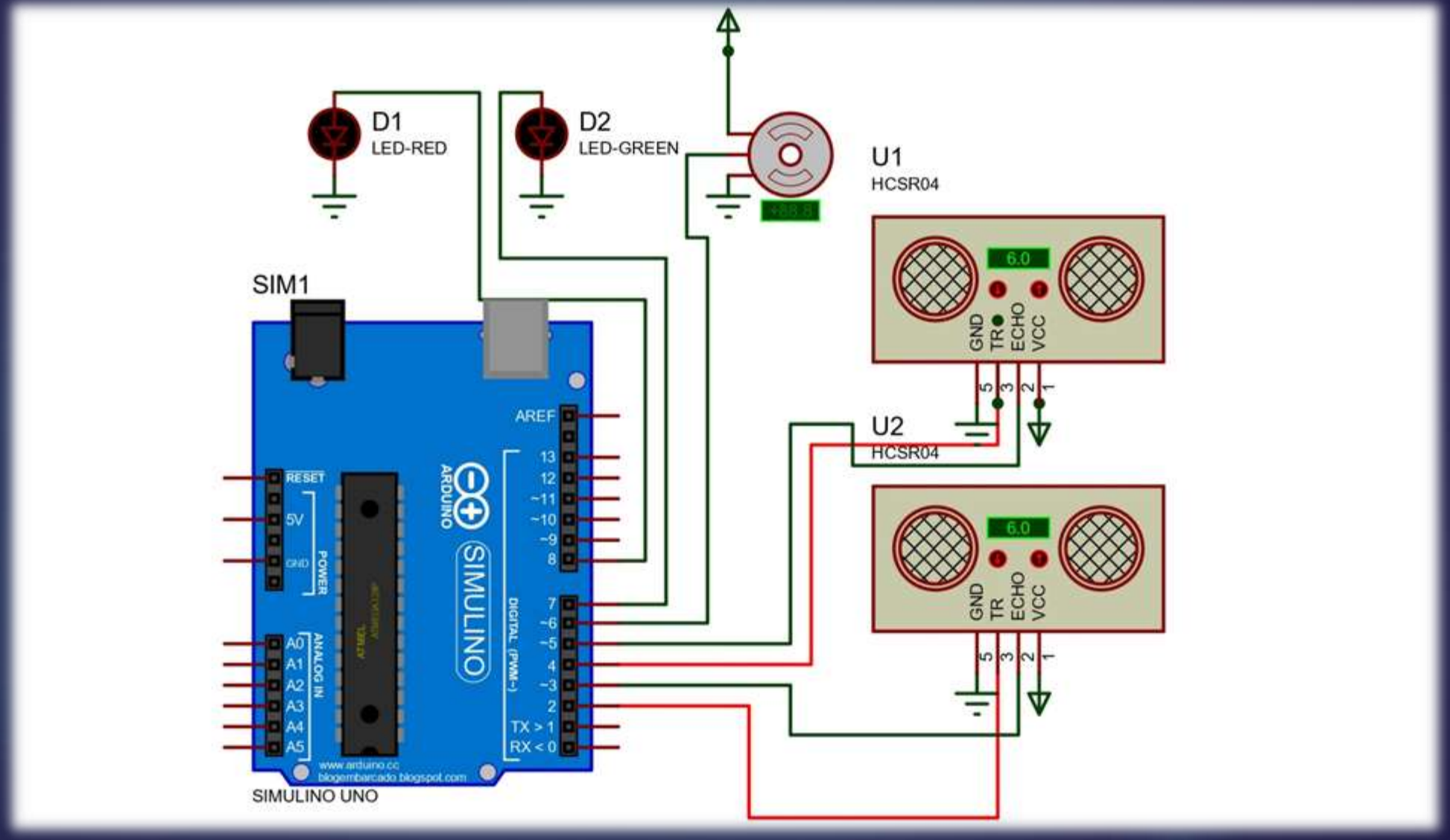
- **Controlled Movement:** Servo motors are precise motors that allow for controlled angular movement, making them ideal for robotics and other applications where specific angles are required.
- **Angle Precision:** Can rotate to a specific angle between 0 and 180 degrees, providing accurate positioning control.
- **Three Wires:** Servo motors have three wires: power (VCC), ground (GND), and control signal. Arduino can generate the control signal to adjust the motor's position.
- **Position Feedback:** Some advanced servos provide position feedback, enabling precise control and feedback to the microcontroller about the motor's position.
- **Arduino Compatibility:** Arduino boards can generate PWM signals necessary to control servo motors, allowing for easy integration into Arduino projects.
- **Easy to Program:** Arduino libraries simplify the programming of servo motors, making it straightforward for beginners and experts to implement servo control in their projects.
- **Stability:** Servo motors are stable and can hold their position even under external force, ensuring reliable performance in various applications.

LED



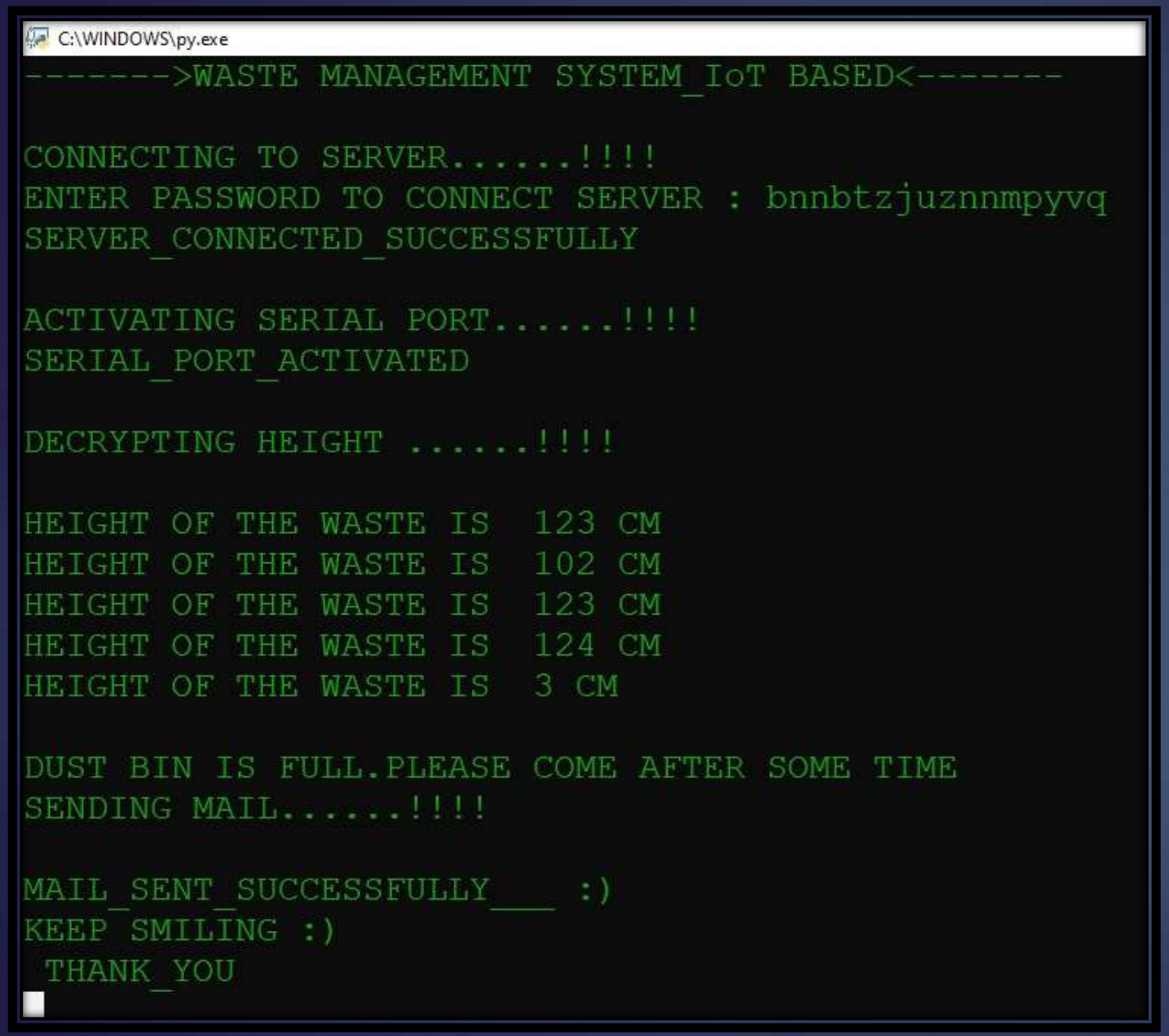
- **Light Emission:** LEDs are semiconductor devices that emit light when an electric
  current passes through them.
- **Low Power Consumption:** LEDs are energy-efficient and consume significantly less
  power compared to traditional incandescent bulbs.
- **Variety of Colors:** LEDs are available in various colors, including red, green, blue, yellow, and white, allowing for creative and colorful lighting effects in projects.
- **Long Lifespan:** LEDs have a long operational life, often lasting tens of thousands of
  hours, making them durable and reliable for various applications.
- **Digital Output:** LEDs can be controlled using digital pins on Arduino. By applying a voltage across the LED in the
  correct polarity, it can be turned on or off using Arduino code.
- **Blinking and Fading:** LEDs are often used for basic tasks such as blinking to indicate a status or more complex tasks like fading in and out to create gradual lighting effects.
- **Visual Feedback:** LEDs are widely used to provide visual feedback in projects. For example, they can indicate the
  success of an operation, the status of a device, or serve as indicators for user interaction.
- **Prototyping:** LEDs are commonly used in prototyping and breadboarding scenarios to quickly test circuits and
  visualize output, making them an essential component in Arduino-based experiments and projects.

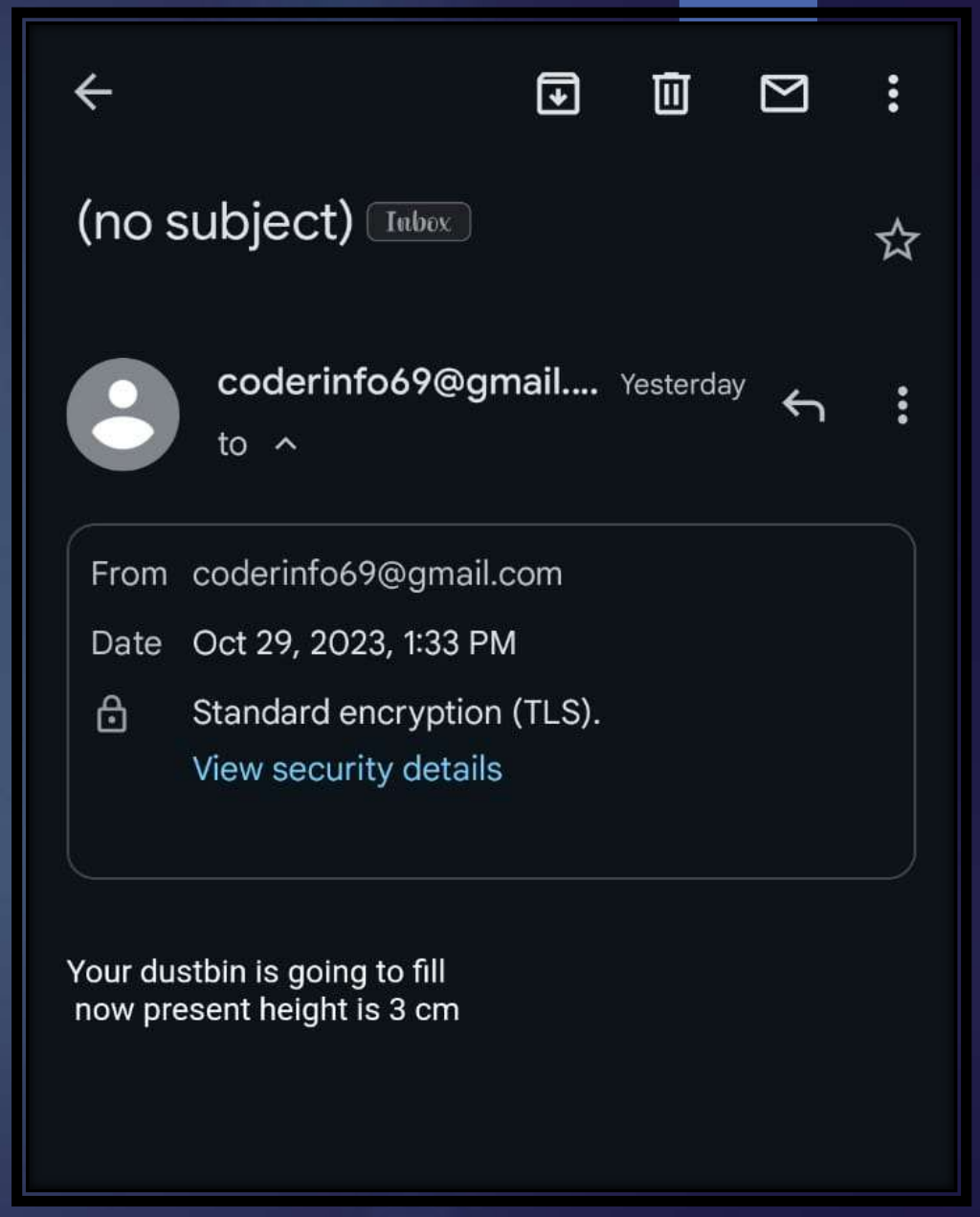
CIRCUIT DIAGRAM



OUTPUT

- At the project's culmination, the system displays the current waste level inside the dustbin. If the bin reaches its full capacity, an automated email notification is sent to the waste management department, signaling the need for collection.
- Additionally, the system incorporates a feature to automatically close the bin lid when it's full, ensuring containment. To enhance user convenience, the system employs sensors to detect a person's arrival, promptly opening the bin door for efficient waste disposal.
- This integrated solution not only provides real-time waste status updates but also offers seamless and user-friendly interactions, promoting responsible waste management practices.


C:\WINDOWS\py.exe
-------->WASTE MANAGEMENT SYSTEM_IoT BASED<-------
CONNECTING TO SERVER.....!!!!
ENTER PASSWORD TO CONNECT SERVER : bnnbtzjuznnmpyvq
SERVER_CONNECTED_SUCCESSFULLY
ACTIVATING SERIAL PORT.....!!!!
SERIAL_PORT_ACTIVATED
DECRYPTING HEIGHT .....!!!!
HEIGHT OF THE WASTE IS 123 CM
HEIGHT OF THE WASTE IS 102 CM
HEIGHT OF THE WASTE IS 123 CM
HEIGHT OF THE WASTE IS 124 CM
HEIGHT OF THE WASTE IS 3 CM
DUST BIN IS FULL.PLEASE COME AFTER SOME TIME
SENDING MAIL.....!!!!
MAIL_SENT_SUCCESSFULLY___ :)
KEEP SMILING :)
THANK_YOU


(no subject)
Inbox
coderinfo69@gmail....
Yesterday
to
From coderinfo69@gmail.com
Date Oct 29, 2023, 1:33 PM
Standard encryption (TLS).
View security details
Your dustbin is going to fill
now present height is 3 cm

Advantages

1. **Efficient Waste Management:** The smart dustbin system optimizes waste management by providing real-time monitoring of the bin's fill level. This ensures timely collection and prevents overflow, maintaining cleanliness in public spaces.
2. **Timely Notifications:** The system automatically sends email notifications to the waste management department when the bin is full. This proactive approach enables swift response and organized waste collection scheduling.
3. **User Convenience:** By incorporating sensors to detect a person's arrival, the system opens the bin door automatically. This user-friendly feature enhances convenience and encourages responsible disposal practices among the public.
4. **Environmentally Friendly:** Preventing overflow and littering through automated lid closure promotes a cleaner environment. It reduces the chances of waste spreading, contributing to a healthier and more aesthetically pleasing community.

Disadvantages

1. **Maintenance Challenges:** The system's electronic components require regular maintenance to ensure accurate sensor readings and reliable performance. Technical issues or malfunctions might occur, necessitating timely repairs or replacements.
2. **Dependency on Technology:** Relying solely on technology for waste management might lead to issues if there are power outages or technical failures. Traditional waste management methods should serve as a backup to prevent service disruptions.
3. **Cost Considerations:** Implementing a sophisticated smart dustbin system involves costs related to sensors, communication modules, and maintenance. Balancing the benefits against the expenses is crucial for project feasibility, especially for budget-constrained communities or organizations.

THANK YOU