Sensor-Actuated Smart Dustbin System for Efficient Waste Management

SENSORS AND ACTUATORS

GROUP-13

TEAM MEMBERS

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INTRODUCTION

- The Smart Dustbin System is an **automated waste management solution** designed to maintain hygiene and prevent overflow.
- It integrates **sensors and actuators** to monitor the dustbin's fill level and operate the lid automatically.
- The system reduces **manual effort** and ensures timely waste disposal while maintaining **clean and sanitary surroundings**.
- This project employs **IR sensor, Ultrasonic sensor, Servo motor**, and **Arduino Mega 2560** for automation.

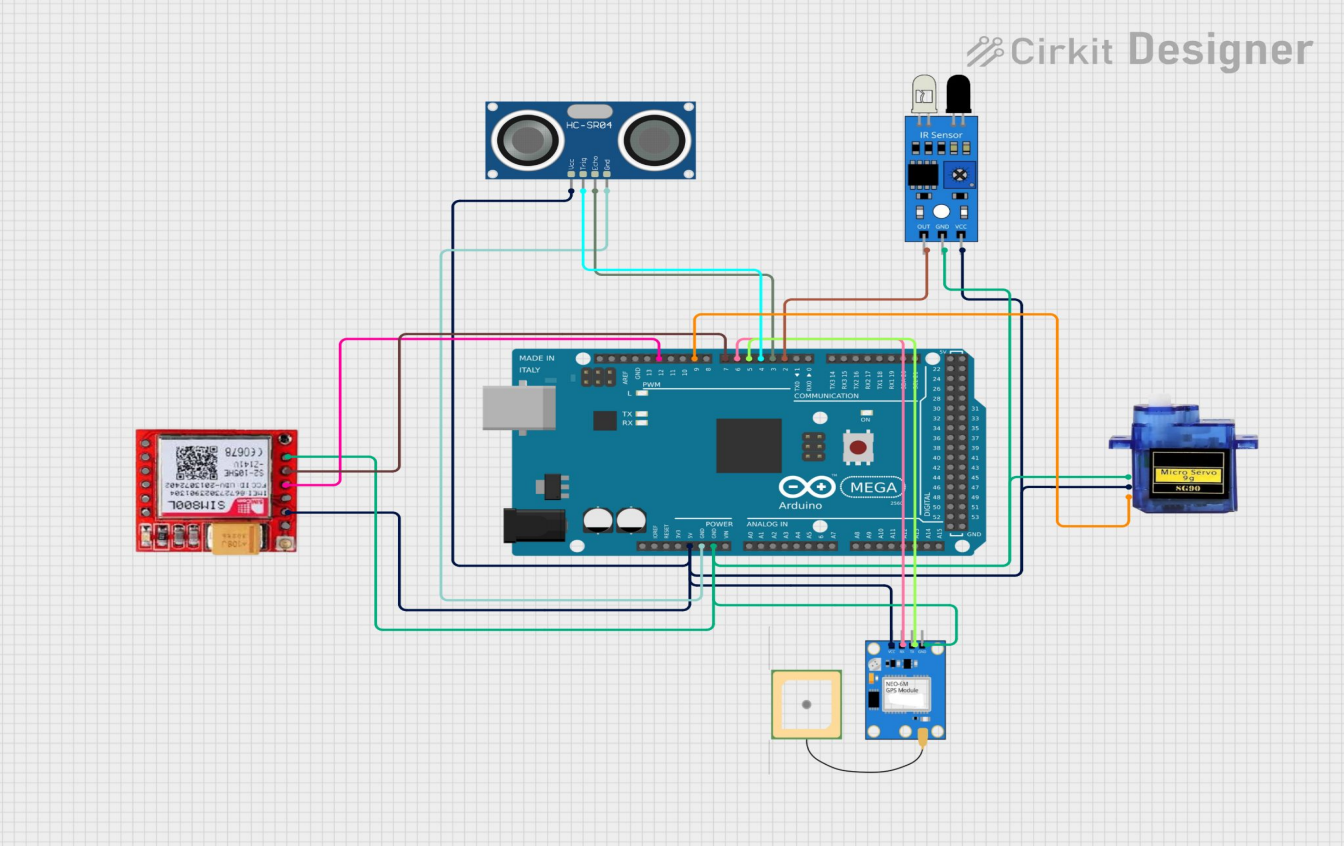
PROBLEM STATEMENT

- Traditional dustbins require **manual operation**, which is inefficient and unhygienic.
- Overfilled bins cause **spillage, odor, and unsanitary conditions**, posing health risks.
- Waste collection teams face difficulty in **monitoring multiple bins** efficiently.
- Manual supervision lacks **real-time feedback**, leading to delayed action and wasted manpower.
- There is a need for a **sensor-actuated smart dustbin system** that automates lid operation and provides **real-time alerts**.

OBJECTIVES

- Develop a **contactless automatic dustbin lid** using IR sensor and servo motor.
- Monitor **waste level** in the bin using an **ultrasonic sensor**.
- Send **real-time SMS alerts** when the dustbin is full using GSM module.
- Provide **GPS coordinates** in the SMS for precise location tracking.
- Create a **hygienic, efficient, and automated waste management solution** suitable for homes, offices, and public places.

SYSTEM DESIGN AND ARCHITECTURE



METHODOLOGY

HARDWARE AND SOFTWARE REQUIREMENT

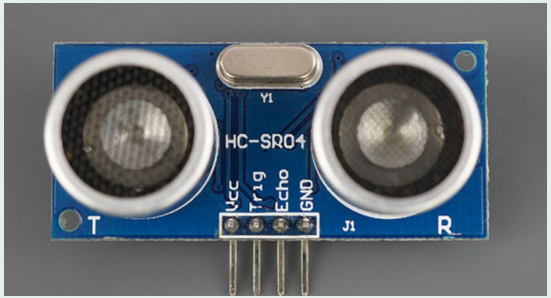
Hardware Components:

- Arduino Mega 2560
- IR Sensor
- Ultrasonic Sensor (HC-SR04)
- Servo Motor (SG90)
- GPS Module (NEO-6M)
- GSM Module (SIM800L)
- Wires
- Dustbin with Lid Mechanism

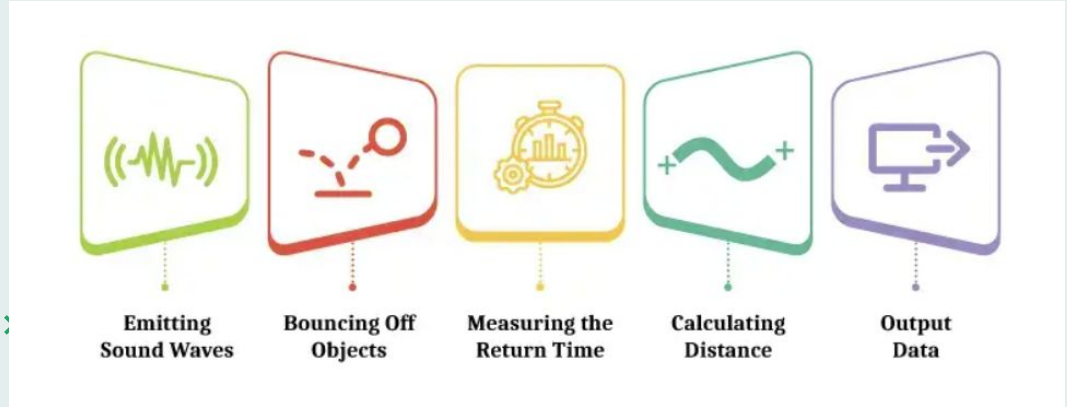
Software Requirements:

- Arduino IDE
- Windows 7/10/11

ULTRASONIC SENSOR (HC-SR04)

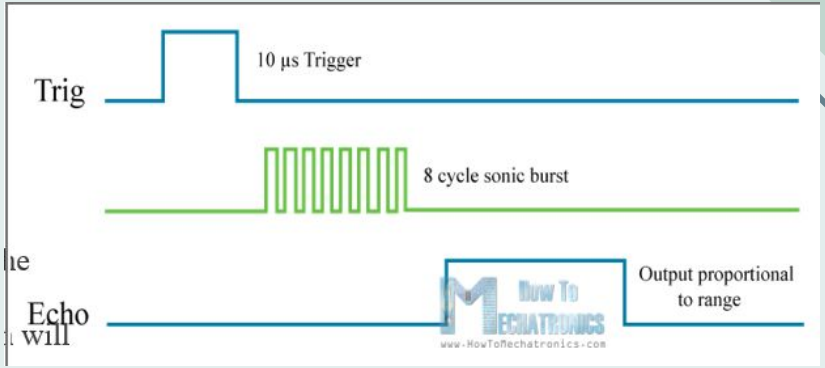


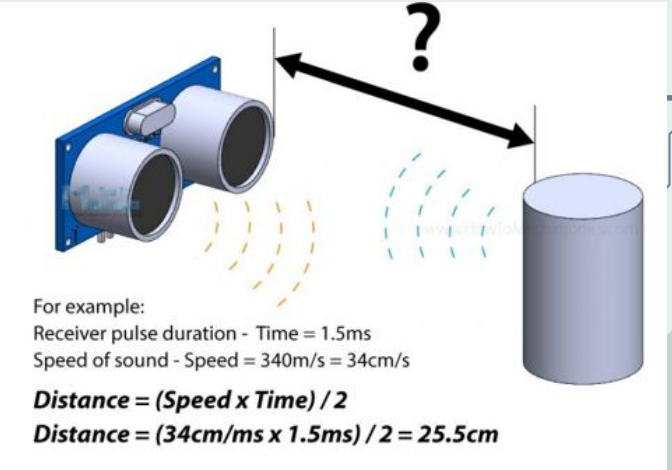
Type: Distance Sensor / Input Device
Function: Measures the distance between the sensor and waste surface inside the bin.
Role: Arduino calculates **dustbin fill level** (%) based on measured distance.
Benefit: Helps determine when the dustbin is full and needs collection.



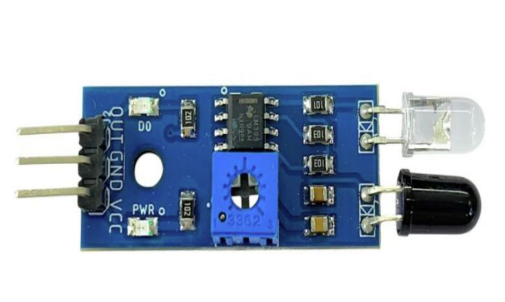
ULTRASONIC SENSOR (HC-SR04) - WORKING

- The **TRIG pin** is made **HIGH for 10 microseconds**.
- This sends a **burst of 8 ultrasonic sound waves** into the air.
- The **ECHO pin** then turns **HIGH** and waits for the sound to return.
- When the sound hits an object (like trash) and comes back, **ECHO turns LOW**.
- If no sound returns, the sensor waits **38 milliseconds** and then turns **LOW** (timeout).
- Arduino measures **how long ECHO stayed HIGH** to find the **distance**.
- **More time = object far, less time = object close**.





IR SENSOR

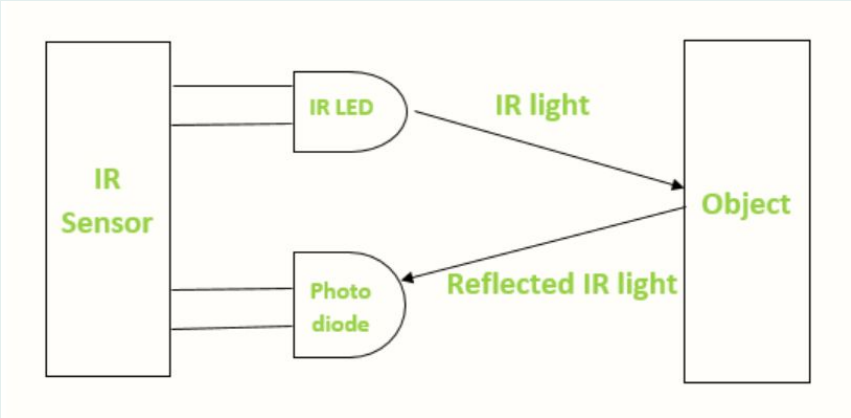


Type: Proximity Sensor / Input Device

Function in Project: Detects **human hand or object** near the dustbin lid.

Role: Sends a HIGH signal to Arduino when someone approaches → triggers the **servo motor** to open the lid automatically.

Benefit: Enables **contactless lid opening** for hygiene.



SERVO MOTOR (SG90) & GPS Module (NEO-6M)

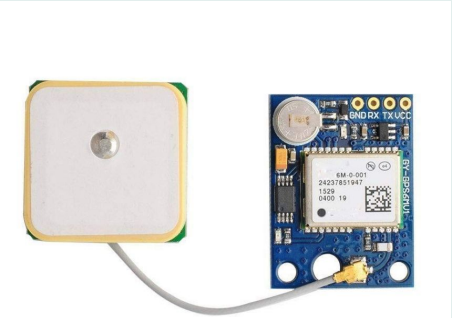
Type: Actuator / Output Device

Function: Rotates the dustbin lid to open or close based on Arduino signals.

Role:

- 0° → Lid closed
- 90° → Lid open

Benefit: Automates lid movement based on IR detection → hygienic and convenient.



Type: Sensor / Communication Module

Function : Provides **real-time latitude and longitude** of the dustbin.

Role: Sends location data with SMS alert when bin is full.

Benefit: Helps **waste collection team locate the bin** easily.

GSM Module (SIM800L)

Type: Communication Module / Actuator

Function in Project: Sends SMS notifications to the waste management team when the dustbin is full.

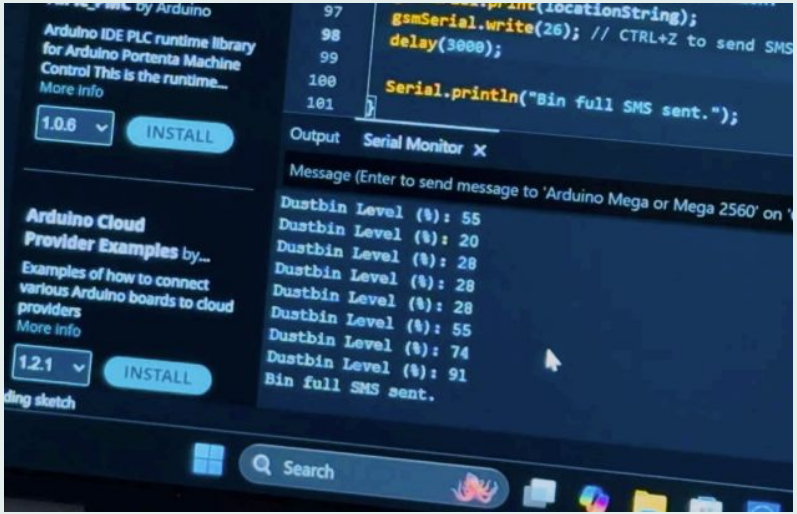
Role: Arduino triggers the SIM800L module to send an SMS automatically when the ultrasonic sensor detects the dustbin is ≥80% full.

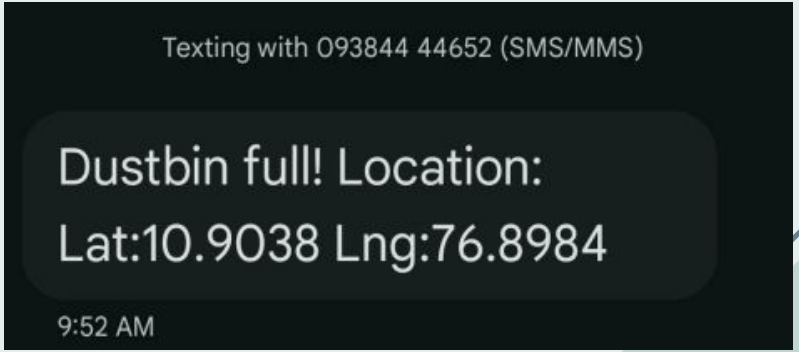
Benefit: Provides **real-time alerts** to waste management personnel **without needing an internet connection**, making it reliable for remote locations.

Component / Module	Pin on Module	Connect To (Arduino Mega Pin)	Function / Description
IR Sensor	VCC	5V	Power supply for IR sensor
	GND	GND	Common ground
	OUT	Pin **2** (`IR_PIN`)	Sends HIGH when object detected (hand near bin)
Servo Motor	Signal (Orange/Yellow)	Pin **9** (`SERVO_PIN`)	Controlled using PWM signal to open/close lid
	VCC (Red)	5V	Power supply
	GND (Brown/Black)	GND	Common ground
Ultrasonic Sensor (HC-SR04)	VCC	5V	Power supply
	GND	GND	Common ground
	TRIG	Pin **3** (`TRIG_PIN`)	Sends ultrasonic pulse
	ECHO	Pin **4** (`ECHO_PIN`)	Receives echo to measure distance

GPS Module (NEO-6M)	VCC	5V	Power supply for GPS receiver
	GND	GND	Common ground
	TX	Pin **5** (`GPS_RX`)	Sends GPS data to Arduino
	RX	Pin **6** (`GPS_TX`)	Receives data from Arduino
GSM Module (SIM800L)	VCC	5V	Power supply
	GND	GND	Common ground
	TX	Pin **7** (`GSM_RX`)	Sends data to Arduino
	RX	Pin **12** (`GSM_TX`)	Receives data from Arduino

HARDWARE SETUP AND RESULTS





CONCLUSION

- Developed a Smart Dustbin System that automates waste detection and lid operation.
- Real-time alerts via SMS ensure timely waste collection.
- Enhances hygiene and efficiency in public and private waste management.
- Demonstrated integration of sensors, actuators, and communication modules effectively.

WORK DISTRIBUTION

VASISTA CB.EN.U4AIE22134	Test IR sensor detection angle, handle active LOW logic.
DHARMA THEJA CB.EN.U4AIE22137	Test SMS delivery, add debug prints, ensure single SMS per threshold.
NANDANA GIREESH CB.EN.U4AIE22138	Test location validity, update interval, and error handling.
SNEGA SRI CB.EN.U4AIE22163	Map ultrasonic distance to percentage, constrain values, debug output.

THANKS!

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