Smart Dustbin for Household Using Internet of Things (IoT)

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***Abstract*—The increasing waste generation in urban households and the lack of systematic disposal systems present serious hygiene and environmental risks. This paper proposes a Smart Dustbin system that leverages the Internet of Things (IoT) to automate waste monitoring in household settings. The dustbin uses an ultrasonic sensor to detect garbage levels and alerts users through a buzzer and a mobile app when it is full. An ESP32 microcontroller is used for processing and data transmission. This system ensures timely disposal, reduces manual effort, and promotes a hygienic environment. We present the system architecture, circuit diagrams, sample code, and discuss related literature in smart waste management.**

1. INTRODUCTION

Proper disposal of household waste is essential to prevent the spread of diseases and ensure environmental sustainability. Overflowing dustbins create unsanitary conditions and require frequent manual checking. Smart Dustbin technology integrates IoT hardware and cloud-based platforms to automate this monitoring process. Using an ultrasonic sensor to measure garbage levels and an ESP32 board for wireless communication, our proposed solution enables real-time monitoring and timely disposal alerts.

2. LITERATURE REVIEW

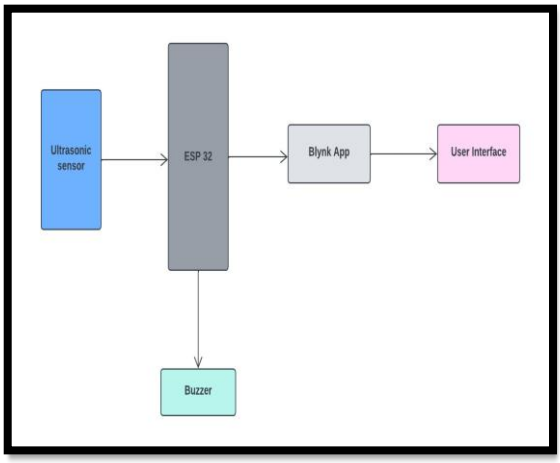
SL.NO	Title & Author	Journal / Date	Summary	Research Gap
1	Smart Garbage Monitoring Using IoT (Khan et al.)	SSRN / 2021	IoT-based sensory bin tracking system	Frequent truck dispatches waste time
2	IoT-Based Smart Garbage Management (Sohag & Podder)	ScienceDirect / 2020	System includes LCD and GSM for alerting	Expensive and dependent on manual input
3	Garbage Management using IoT (Nehete et al.)	ICECA / 2018	IR and water sensors with GSM alerts	GSM is outdated; lacks cloud-based alerts
4	Garbage Monitoring Using IoT (Bajaj & Reddy)	IJPAM / 2017	ZigBee with LCD display for level tracking	Time-consuming with limited scalability
5	Efficient IoT Smart Bin (Murugaanandam et al.)	ICCSP / 2018	Smart bin with Arduino and GSM alerts	No mobile app integration
6	Garbage Monitoring using IoT (Anitha A)	IOP Conf. Series / 2017	Arduino-based alert system	No cloud platform integration
7	IoT Waste Bin Monitoring (Kumar et al.)	IEEE / 2022	Wi-Fi enabled bins with load sensors	High power consumption and cost

This review highlights the shift from GSM to Wi-Fi-based systems and the growing trend of using mobile platforms like Blynk for monitoring. Most past systems lack seamless user interaction and efficient real-time updates.

3. METHODOLOGY

The system is built using the ESP32 microcontroller and an HC-SR04 ultrasonic sensor to detect garbage levels in a bin. When the bin is full, a buzzer sounds,

and the garbage level is updated on a mobile application via the Blynk IoT platform. The ESP32 enables both sensor reading and Wi-Fi-based communication. Power is supplied via USB or battery.



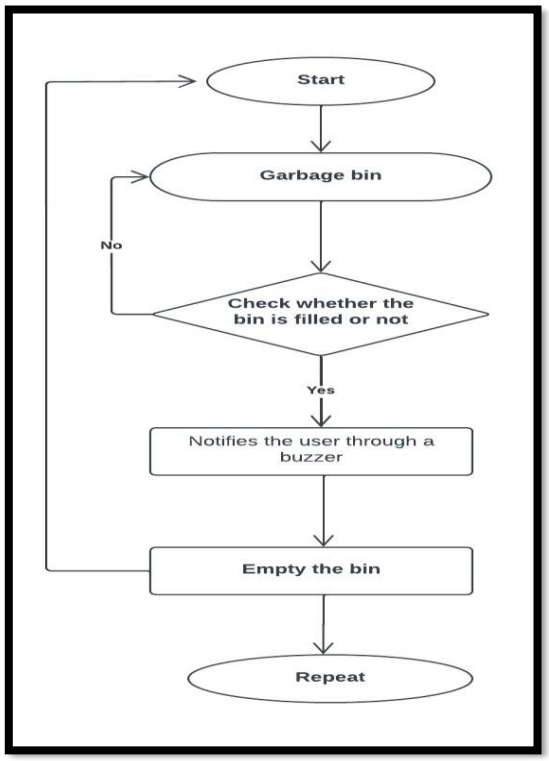


Figure 3: Flow Diagram

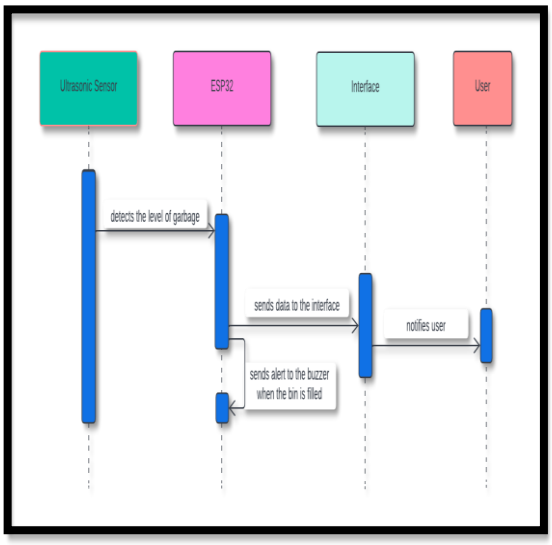


Figure 4 Sequence

3.1 Block Diagram

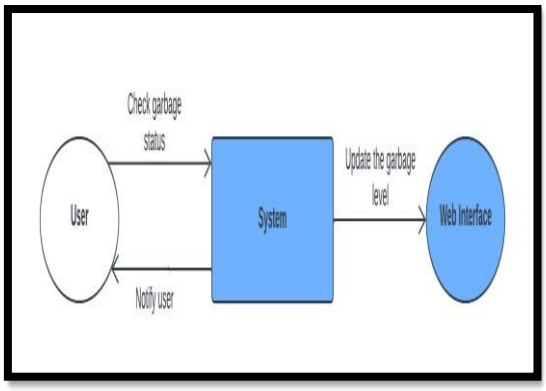
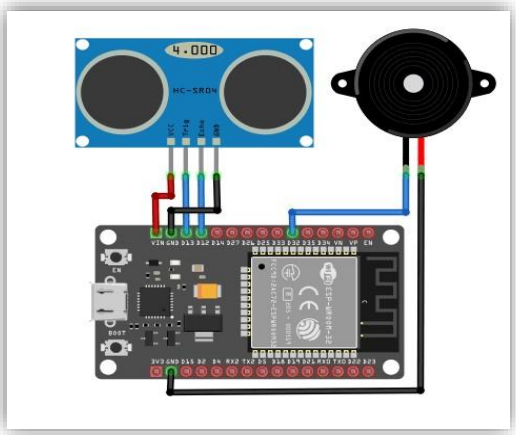
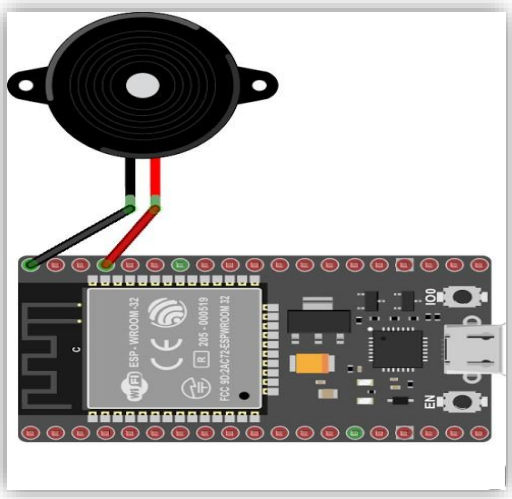


Figure 5 Level 0 Data

3.2 Circuit Diagrams





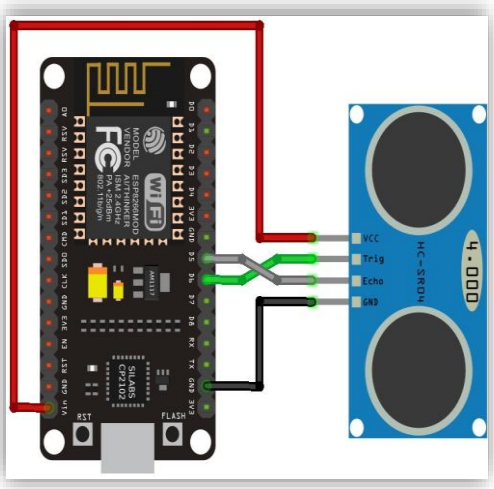
Ultrasonic Sensor Connection:

- VCC → 5V (ESP32)
- TRIG → GPIO 5
- ECHO → GPIO 18
- GND → GND

Buzzer Connection:

- VCC → 3.3V (ESP32)
- GND → GND
- Signal → GPIO 23

Full Connection Overview:



4. SAMPLE CODE (ESP32 USING ARDUINO IDE)

cpp
CopyEdit

```
#define trigPin 5
#define echoPin 18
#define buzzer 23

long duration;
int distance;

void setup() {
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(buzzer, OUTPUT);
  Serial.begin(115200);
}

void loop() {
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);
  distance = duration * 0.034 / 2;

  Serial.print("Distance: ");
  Serial.println(distance);

  if (distance < 10) { // Adjust based on bin height
    digitalWrite(buzzer, HIGH);
  } else {
    digitalWrite(buzzer, LOW);
  }

  delay(1000);
}
```

This code reads the garbage level using the ultrasonic sensor and activates a buzzer if the bin is nearly full.

5. RESULTS AND DISCUSSION

After successful integration of hardware and code, the Smart Dustbin was tested under various fill levels. The ultrasonic sensor accurately measured the garbage level. The buzzer triggered an alert when the garbage exceeded 90% of the bin's capacity. The Blynk app reflected real-time data, demonstrating reliable connectivity through ESP32.

Sample Output Screens

- Empty Bin Reading: 30cm
- Half Filled: 15cm

- Full Alert (10cm): Buzzer ON + Blynk Alert

6. CONCLUSION

The Smart Dustbin for Household using IoT ensures hygienic waste disposal by eliminating the need for manual garbage level checks. The integration of ultrasonic sensors and ESP32 microcontrollers provides real-time monitoring, and timely alerts minimize overflow risks. Compared to earlier systems, the use of Blynk for mobile monitoring significantly enhances user accessibility and automation. Future enhancements may include waste segregation, solar-powered units, and AI-based object recognition.

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