JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY, NOIDA
B. TECH 7TH SEMESTER
SMART SYSTEM AND IOT
PROJECT BASED LEARNING

TITLE OF PROJECT:

Smart Dustbin System for Dynamic Waste Management

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1.Introduction

In today's world, rapid urbanization and population growth have led to increasing waste generation, creating a need for efficient and automated waste management systems. Traditional waste collection methods often result in overflowing bins, unhygienic conditions, and inefficient use of manpower.

This project aims to design and implement a Smart Dustbin using IoT (Internet of Things) technology that can automatically open its lid for contactless waste disposal and monitor the fill level of the bin in real-time. The system uses an ESP32 microcontroller, ultrasonic sensor, and infrared (IR) sensor, integrated with the Blynk IoT platform for remote monitoring and notification alerts when the bin is full.

The objective of the project is to make waste collection smarter, more hygienic, and efficient, reducing manual effort and supporting smart city initiatives.

2.Problem Statement

Traditional waste bins in public and private spaces present several challenges. They are often unhygienic, requiring physical contact to open, which can contribute to the spread of germs. Furthermore, their waste levels are not monitored, leading to two primary inefficiencies: **overflowing bins** that create unsanitary conditions and attract pests, or **unnecessary collection trips** to bins that are nearly empty, wasting fuel, labor, and time. Our project directly addresses these issues by creating a system that not only offers contactless operation but also provides real-time data on its status, enabling a more data-driven and efficient waste management strategy.

3.Methodology

The proposed smart dustbin system consists of three major functions:

1. Contactless Lid Operation

- The IR sensor detects user presence near the bin.

- The ESP32 triggers a servo motor to open the lid automatically, enabling touch-free waste disposal.

- After a short delay, the lid closes automatically.

2. Waste Level Monitoring

- An ultrasonic sensor (HC-SR04) mounted on the top of the bin measures the distance to the waste surface.

- The ESP32 calculates the percentage fill level of the bin.

3. IoT Connectivity and Alerts

- The ESP32 sends real-time data (distance and fill level) to the Blynk Cloud via Wi-Fi.

- When the bin reaches a predefined threshold (e.g., 90% full), the system triggers a notification alert to the Blynk mobile app.

- Users can view live fill-level updates on the Blynk dashboard.

This ensures efficient waste collection planning, preventing overflow and maintaining cleanliness.

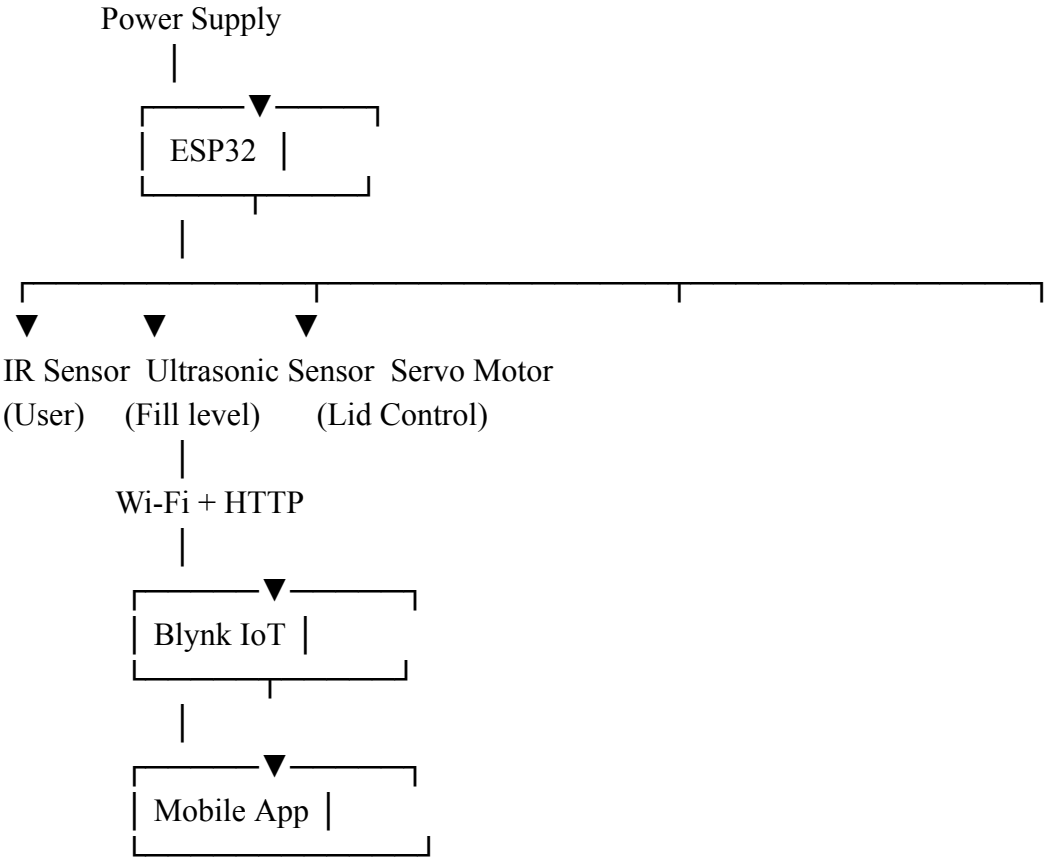
4.Components Used

Component	Description	Function
ESP32 Microcontroller	Dual-core Wi-Fi + Bluetooth microcontroller	Central unit that processes sensor data and connects to Blynk Cloud
Ultrasonic Sensor (HC-SR04)	Distance measurement using sound waves	Measures waste level inside the bin
IR Sensor (LM393 module)	Detects user proximity	Triggers the lid to open automatically
Servo Motor (SG90)	Rotational actuator	Opens and closes the lid
Blynk IoT Platform	Cloud platform for IoT devices	Displays fill level and sends notifications
Power Supply (5V)	USB / Power bank	Provides power to ESP32 and connected sensors

5.Flow of Control

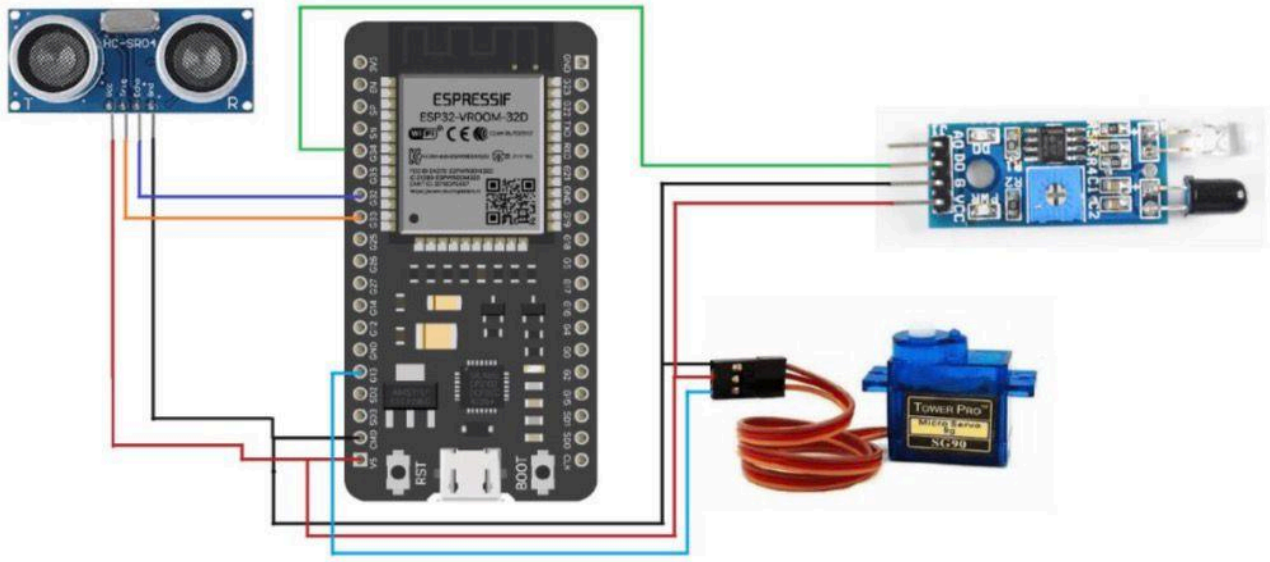
Step-by-Step Operation:
1. System powers up and connects to Wi-Fi and the Blynk Cloud.
2. IR sensor continuously monitors for human presence.
3. When a user approaches, IR sensor signals ESP32.
4. ESP32 commands the servo motor to open the lid.
5. After a few seconds, the lid closes automatically.
6. The ultrasonic sensor measures the waste level inside the bin.
7. ESP32 calculates the percentage of the bin filled.
8. Data is sent to the Blynk dashboard (V0 – distance, V1 – fill %, V2 – servo angle).
9. If fill level ≥ 90%, ESP32 sends a "Bin Full" notification through Blynk.

6.Block Diagram / System Diagram



7. Appendices:

Connections



8.Conclusion

The IoT-based Smart Dustbin is an effective and economical solution for modern waste management systems.
By integrating ESP32 with IoT technology, it enables:
- Hygienic waste disposal (contactless lid operation)
- Efficient monitoring (real-time data via Blynk)
- Timely collection alerts (full-bin notifications)

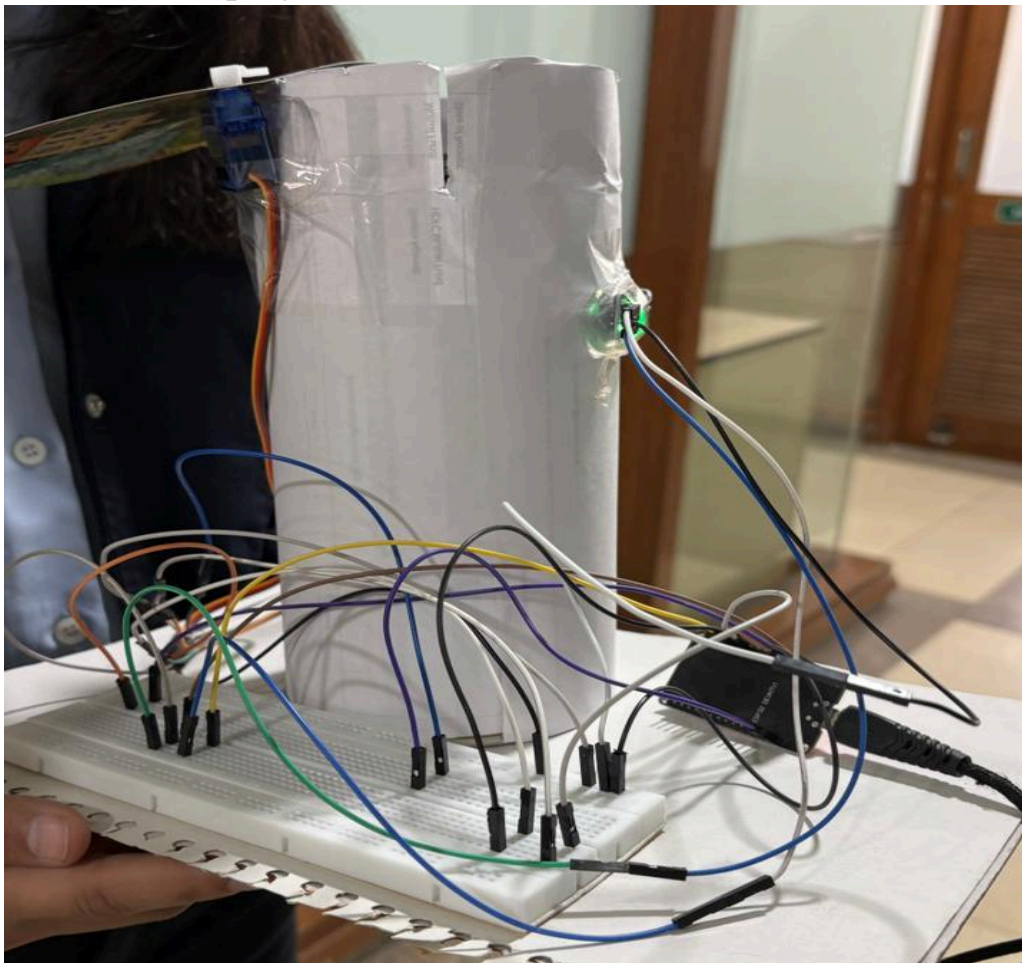
This project demonstrates how IoT can be leveraged to improve urban cleanliness and optimize waste management in smart cities.

9.Future Scope

- Solar-Powered Operation: Add solar panels for self-sustainable power.
- Multiple Bin Network: Implement multiple bins communicating to a central server for smart route optimization.
- Waste Classification: Integrate object detection (AI camera) for automatic segregation of biodegradable and non-biodegradable waste.

- MQTT Protocol Integration: Replace HTTP/Blynk with MQTT for faster, low-power data transmission.
- Data Analytics: Use historical data for predicting waste generation trends and optimizing collection frequency.

10.Pictures of project



11.References

1. HC-SR04 Ultrasonic Sensor Datasheet.
2. Tower Pro SG-90 Micro Servo Datasheet.
3. Banzi, M., & Shiloh, M. (2014). *Getting Started with Arduino: The Open Source Electronics Prototyping Platform*. Maker Media, Inc.
4. Al-Masri, E. (2018). "A Survey of IoT-based Smart Waste Management Systems." *Journal of Information and Communication Technology*.