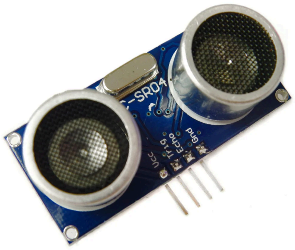
This Arduino code demonstrates the integration of an ESP32 microcontroller to create a smart trashcan system that measures trash levels, controls a servo-operated lid, activates a buzzer, and communicates data to a server. Below is a detailed explanation of the functionality:

Components and Connections:

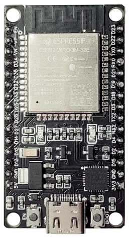
1. **Servo Motor**

    - Red (Power): Connect to 5V on ESP32.
    - Orange (Signal): Connect to **D13** on ESP32.
    - Brown (Ground): Connect to GND on ESP32.
2. **Buzzer**

    - Red (Power): Connect to **D15** on ESP32.
    - Black (Ground): Connect to GND on ESP32.
3. **HC-SR04 Ultrasonic Sensor (Buzzer-related HC)**
    - VCC: Connect to 5V on ESP32.
    - Trig: Connect to **D14** on ESP32.
    - Echo: Connect to **D27** on ESP32.
    - GND: Connect to GND on ESP32.
4. **HC-SR04 Ultrasonic Sensor (Lid-related HC)**
    - VCC: Connect to 5V on ESP32.
    - Trig: Connect to **D26** on ESP32.
    - Echo: Connect to **D25** on ESP32.
    - GND: Connect to GND on ESP32.



5. **ESP32**



Power Supply:

- Use a regulated 5V power supply for both sensors, the servo motor, and the ESP32.
- Ensure all GND connections (servo, sensors, and ESP32) are tied together for a common ground.

Wiring Notes:

- Use **male-to-female jumper wires** for secure connections.
- Add a **220-ohm resistor** in series with the buzzer if needed for current limiting.
- Consider a **level shifter** for the HC-SR04 Echo pin, as the ESP32 operates at 3.3V logic.

Features:

1. **Wi-Fi Connectivity**:
   - The ESP32 connects to a Wi-Fi network using provided SSID and password credentials.
   - Data is sent to a server endpoint (`/smart-trashcan`) via HTTP POST requests.
2. **Ultrasonic Sensors**:

   - Two ultrasonic sensors measure distances:
      - **Sensor 1**: Determines the trash level inside the trashcan.
      - **Sensor 2**: Controls the servo lid based on proximity.
3. **Trash Level Monitoring**:
   - The trash level is calculated as a percentage based on the distance measured by Sensor 1.
   - If the trash level exceeds 90%, the buzzer is activated to indicate that the trashcan is full.
4. **Servo-Controlled Lid**:
   - Sensor 2 detects objects near the lid.
   - If an object is detected within the threshold distance, the lid opens (servo at 90°). Otherwise, the lid remains closed (servo at 0°).
5. **Buzzer Activation**:
   - A buzzer is triggered when the trash level reaches 90% or higher, signaling that the trashcan needs to be emptied.
   - To preserve power, the servo motor is detached when the buzzer is active.
6. **Server Communication**:
   - The ESP32 sends `trashLevel`, `buzzerStatus`, and `lidStatus` to the server as URL-encoded POST data.
   - The server processes and stores this data for further use.
7. **Serial Monitoring**:
   - Debugging information, including trash level, buzzer status, and lid status, is displayed on the Serial Monitor.

Workflow:

1. **Setup**:
   - Initializes pins for ultrasonic sensors, buzzer, and servo motor.
   - Connects to the Wi-Fi network.
   - Positions the lid in the initial closed state.
2. **Loop**:
   - Measures distances using the ultrasonic sensors.
   - Calculates the trash level and determines whether the buzzer should be activated.
   - Controls the servo motor to open or close the lid based on proximity detection.
   - Sends the collected data (`trashLevel`, `buzzerStatus`, `lidStatus`) to the server for real-time monitoring.

3. **Utility Functions**:

    - `getDistance()`: Measures the distance using the ultrasonic sensor.
    - `sendDataToServer()`: Sends HTTP POST requests to the server with trashcan data.
    - `connectToWiFi()`: Handles Wi-Fi connection setup and reconnection logic.

Applications:

- **Smart Waste Management**: Helps monitor and manage waste levels remotely.
- **IoT Integration**: Combines hardware and cloud-based systems for real-time data transmission.
- **Energy Efficiency**: Optimizes servo motor usage by detaching it when the buzzer is active.

This code serves as an efficient IoT solution for automating waste management and can be extended with additional features like mobile app integration or AI-based waste sorting.