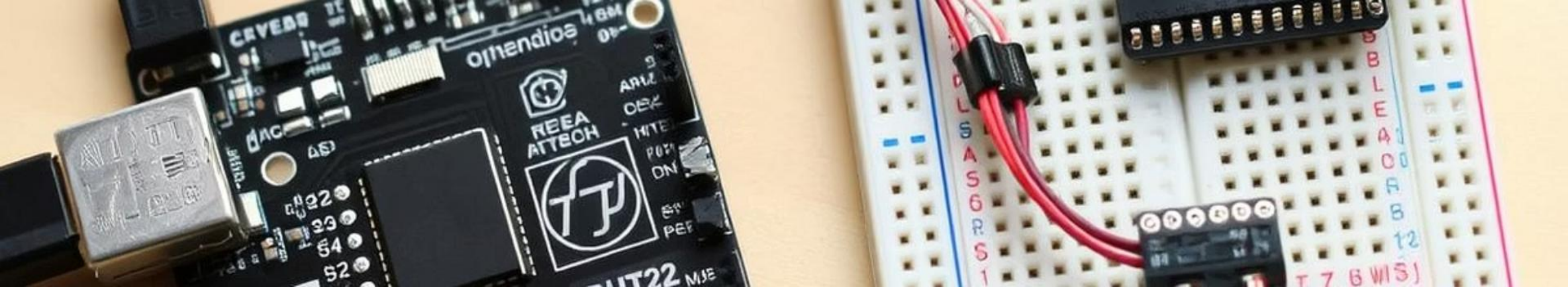


# Smart Environment Monitoring with ESP32 and ThingSpeak

This system measures temperature, humidity, and distance in real-time. It utilizes ESP32, DHT22, and ultrasonic sensors. Data uploads via Wi-Fi to ThingSpeak for instant access.

Ideal for smart bins, weather stations, and automation projects.



# Project Components: Hardware

## ESP32 Development Board

Low-cost, low-power microcontroller with built-in Wi-Fi.

## DHT22 Sensor

Measures temperature (0-50°C) and humidity (0-100%) accurately.

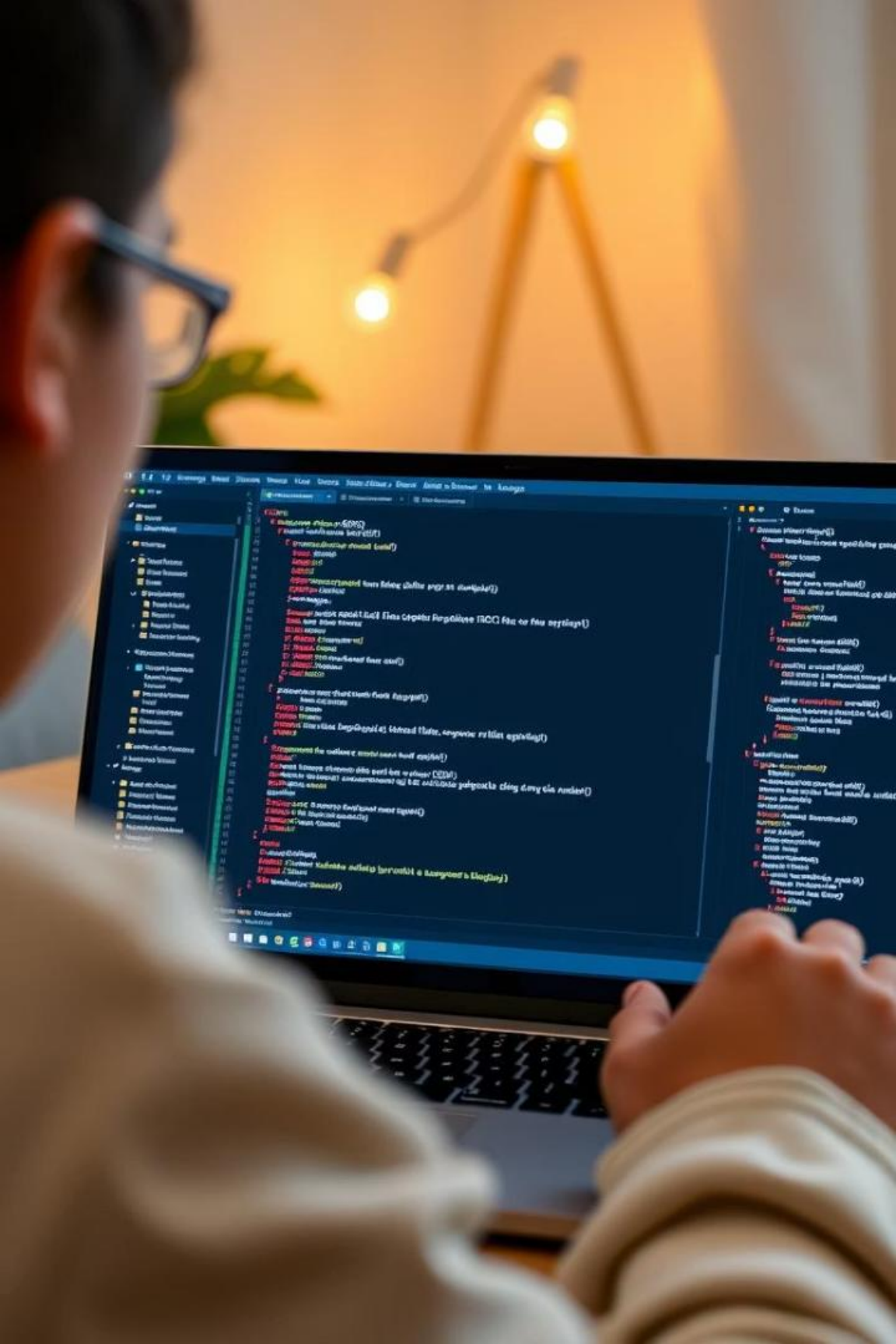
## Ultrasonic Sensor (HC-SR04)

Distance detection from 2cm to 400cm with  $\pm 3\text{mm}$  precision.

## Prototyping Tools

Includes jumper wires and breadboard for connections.





# Software Setup and Libraries

## Arduino IDE

Code development and uploading to ESP32.

## ESP32 Board Package

Enables ESP32 programming support in the IDE.

## DHT Sensor Library

Simplifies interaction with the DHT22 sensor.

## NewPing Library

Facilitates ultrasonic sensor readings efficiently.

# Code Structure: Data Acquisition

1

## DHT22 Sensor

Reads temperature and humidity every 5 seconds.

2

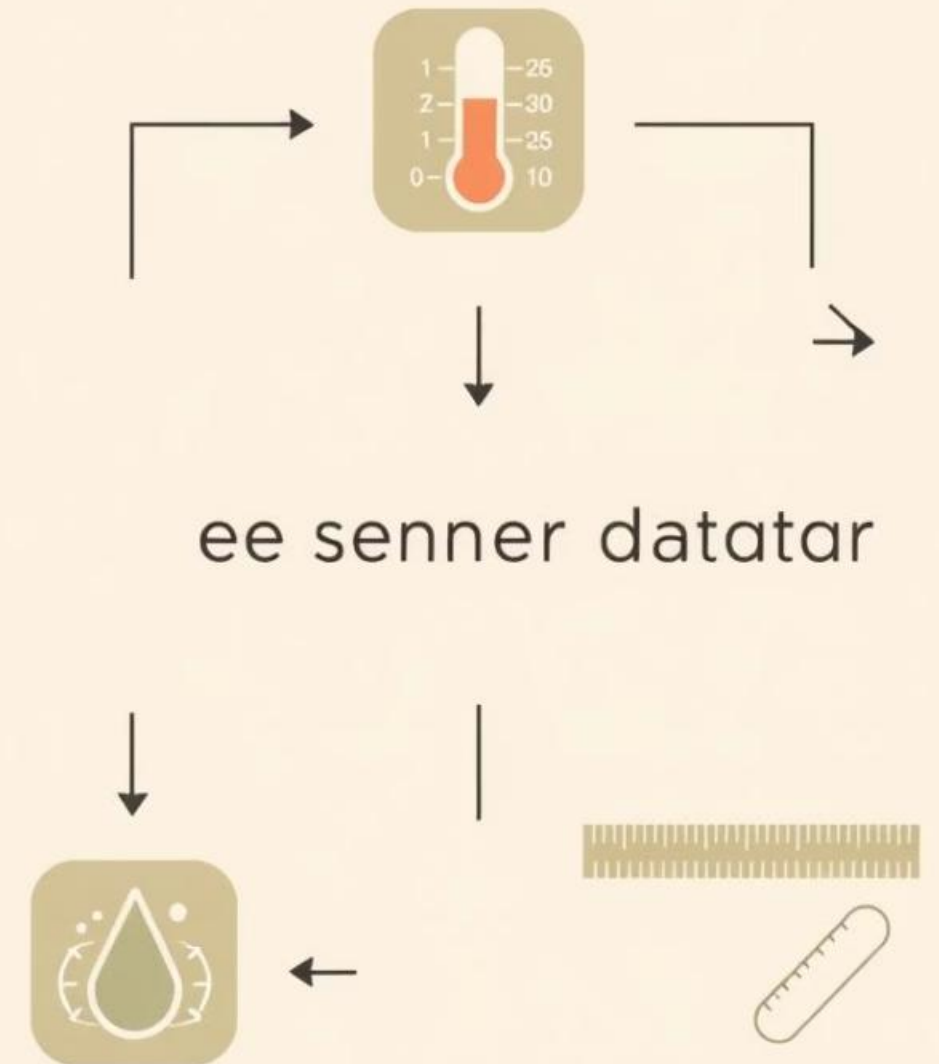
## Ultrasonic Sensor

Measures distance every 5 seconds for accuracy.

3

## Data Formatting

Prepares sensor data for ThingSpeak upload.



A close-up photograph of an ESP32 microcontroller module mounted on a copper-colored printed circuit board (PCB). The module is a small, dark blue chip with various components like a USB Type-C port, a micro-SD card slot, and several pins. Above the module, there is a white graphic of three clouds with a Wi-Fi signal icon (three concentric arcs) in the center. Three white lines connect the signal icon to the module, suggesting a wireless connection. The background is a blurred view of the PCB's intricate circuitry.

# Code Structure: Wi-Fi and ThingSpeak

## Wi-Fi Connection

Connects ESP32 to a 2.4 GHz wireless network.

## ThingSpeak API

Uploads sensor data using ThingSpeak's REST API.

## Data Transmission

Sends updates every 20 seconds respecting API limits.

## API Key

Secures and identifies the ThingSpeak channel.

# Data Visualization on ThingSpeak

## Live Graphs

Monitor temperature, humidity, and distance instantly.

## Data Logging

Records historical sensor data for trend analysis.

## Privacy Options

Channels can be public or private as needed.

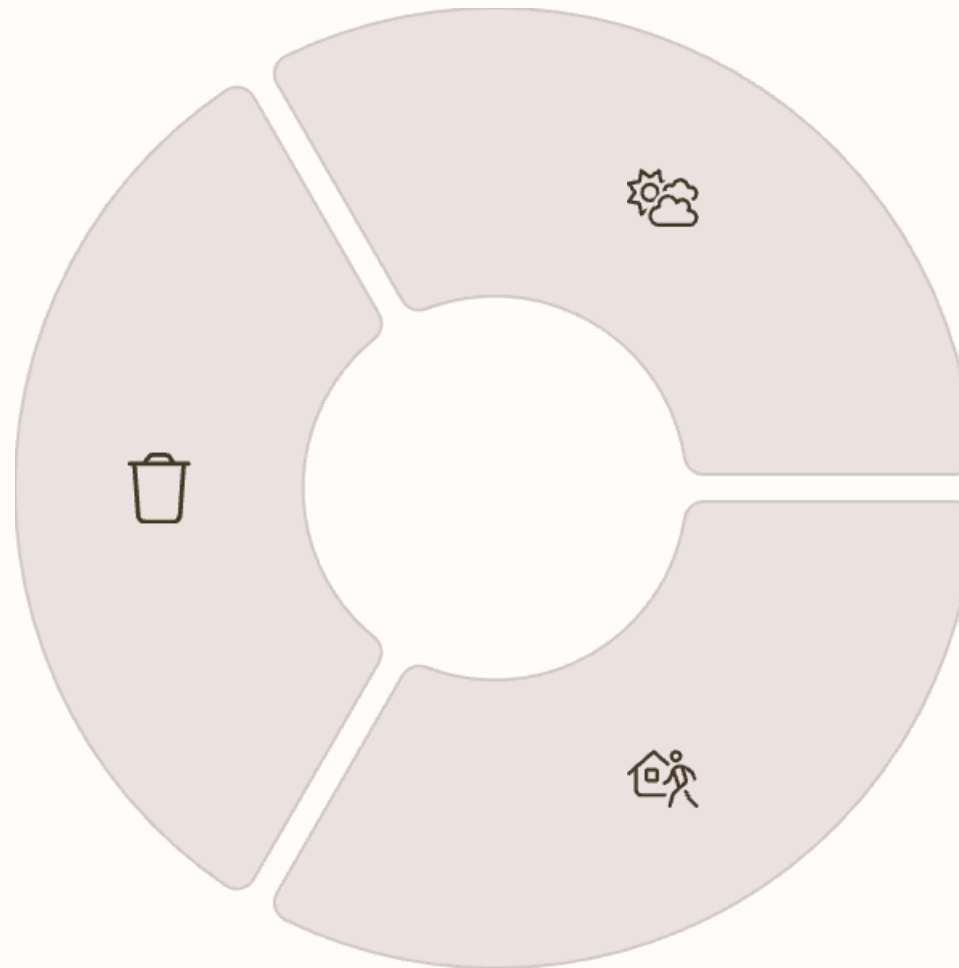
## Mobile Access

View data remotely through the ThingSpeak mobile app.

# Applications and Use Cases

## Smart Bin Monitoring

Track fill levels and environment for efficient waste management.



## Remote Weather Station

Gather microclimate data for agriculture or research.

## Home Automation

Control HVAC and devices based on real-time sensor data.



# Smart sweetr sation

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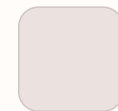
© Sorty AShedra

## Future Enhancements and Possibilities



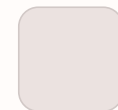
### Solar Power Integration

Enable remote, autonomous sensor deployments without AC power.



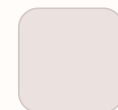
### Predictive Maintenance

Use data trends to anticipate system faults or replacements.



### IFTTT Automation

Trigger actions like alerts or device control from sensor events.



### Additional Sensors

Add air quality and light sensors for comprehensive monitoring.