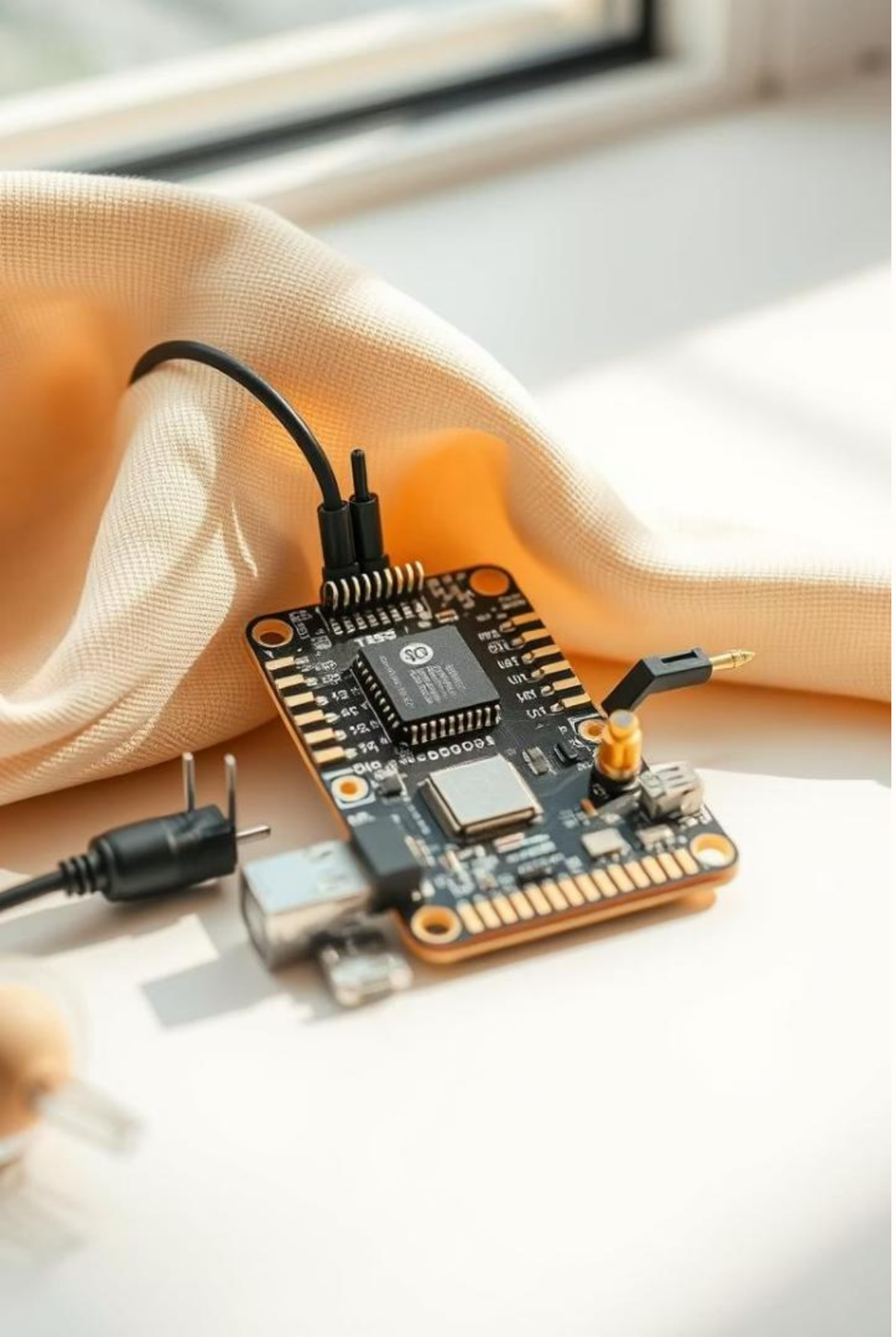
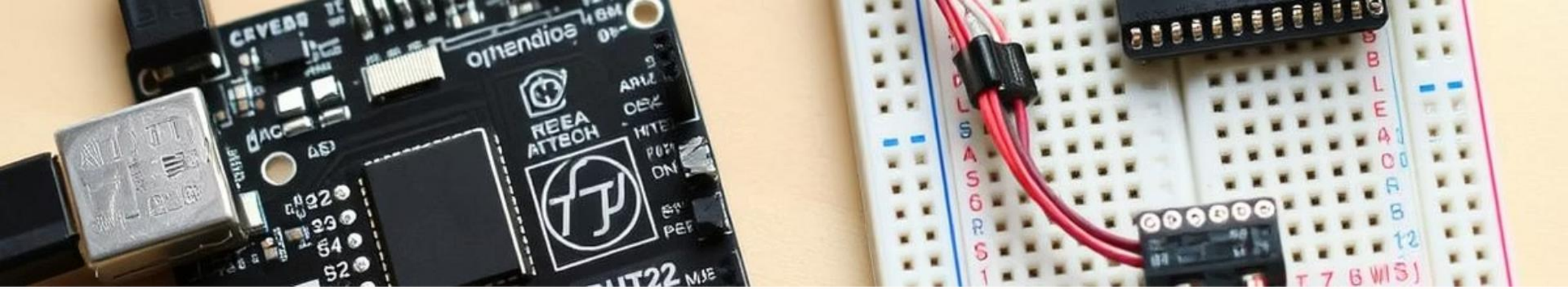


Smart Environment Monitoring with ESP32 and ThingSpeak

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

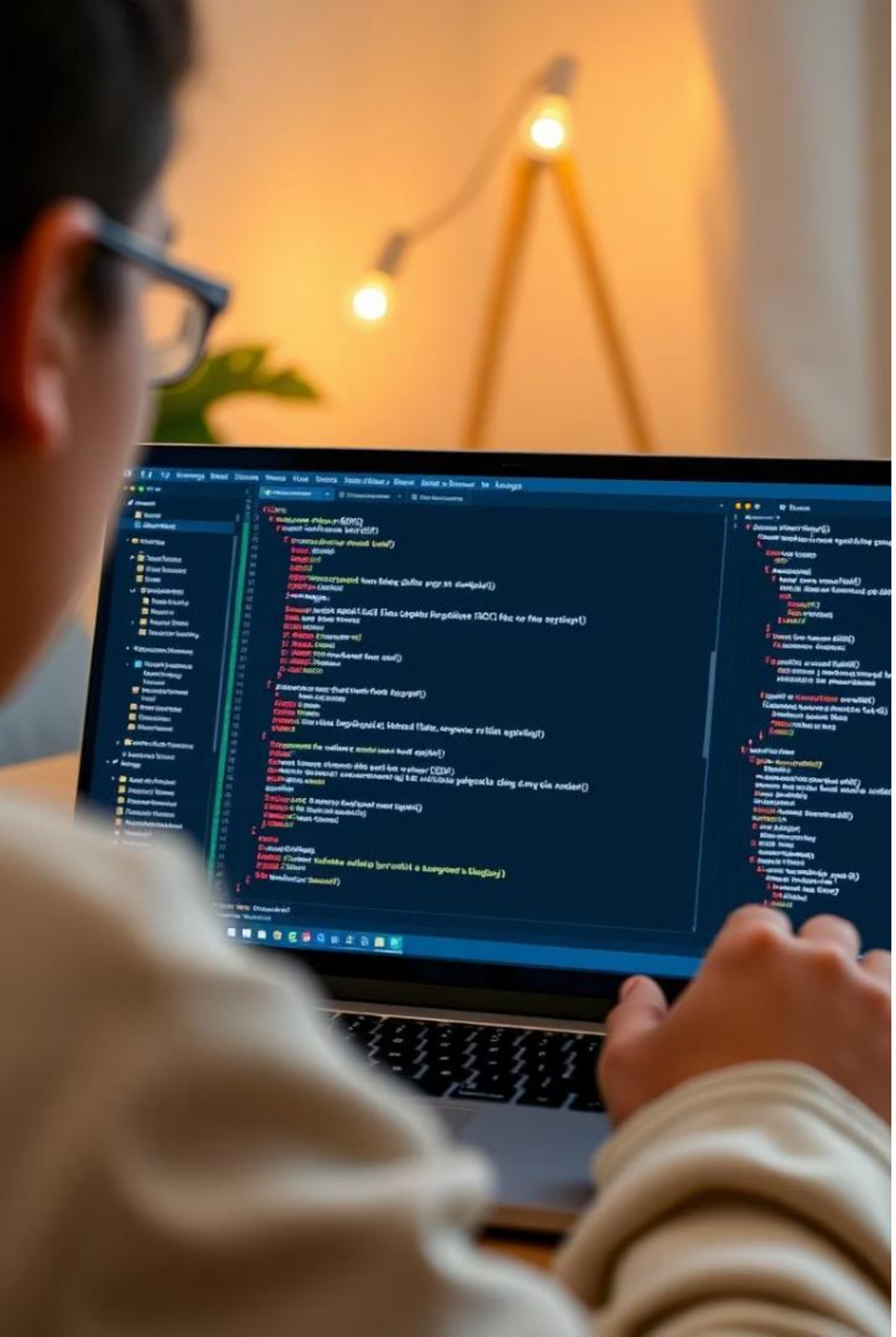
Measures temperature (0-50°C) and humidity (0-100%) accurately.

Ultrasonic Sensor (HC-SR04)

Distance detection from 2cm to 400cm with ±3mm 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

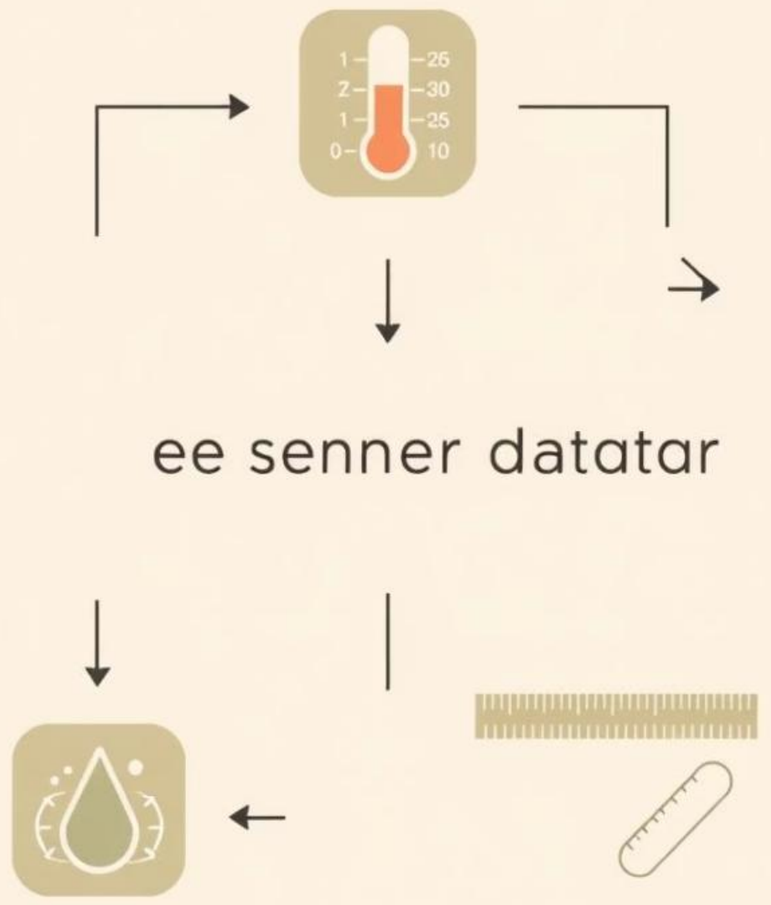
Ultrasonic Sensor

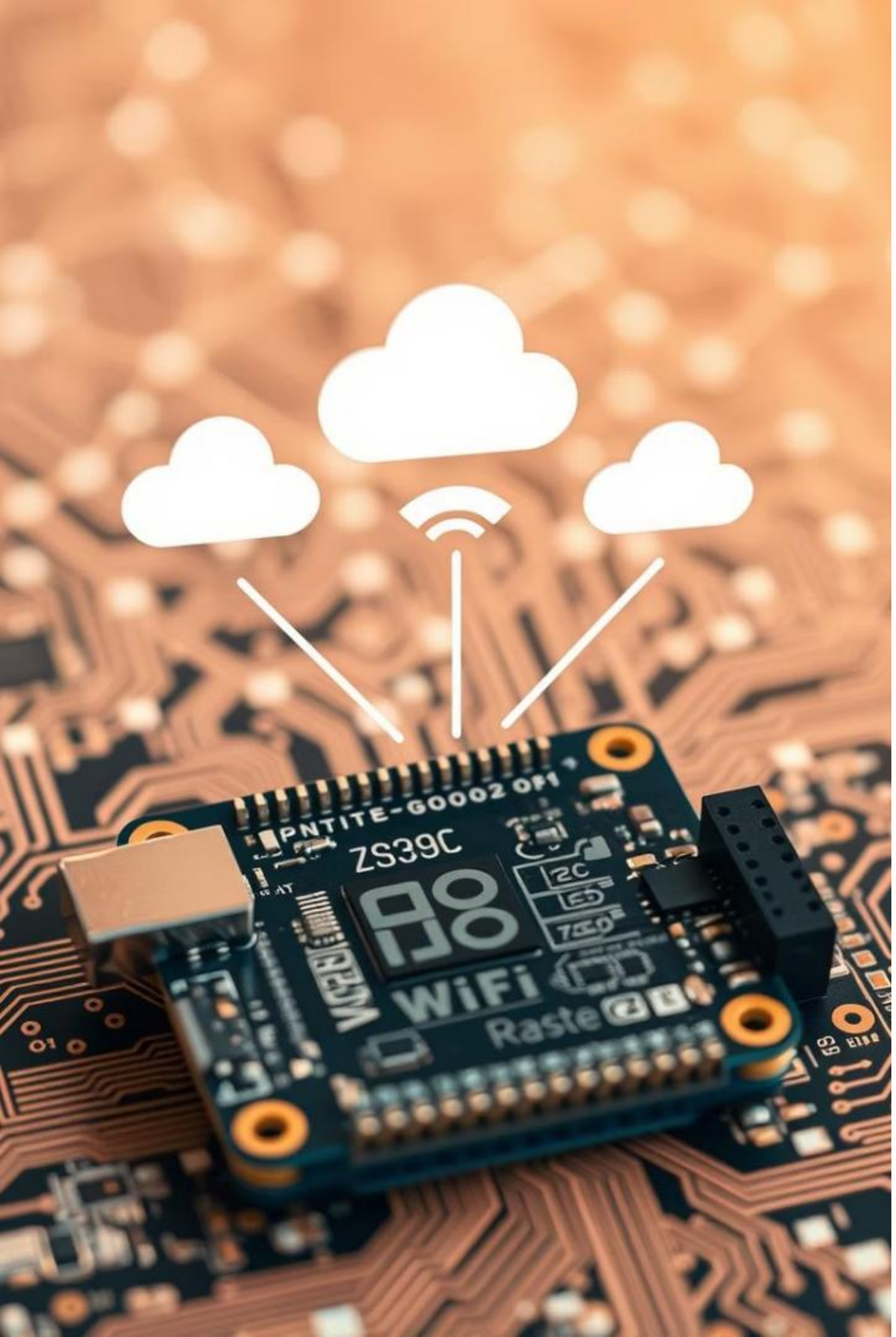
Measures distance every 5 seconds for accuracy.

3

Data Formatting

Prepares sensor data for ThingSpeak upload.





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.

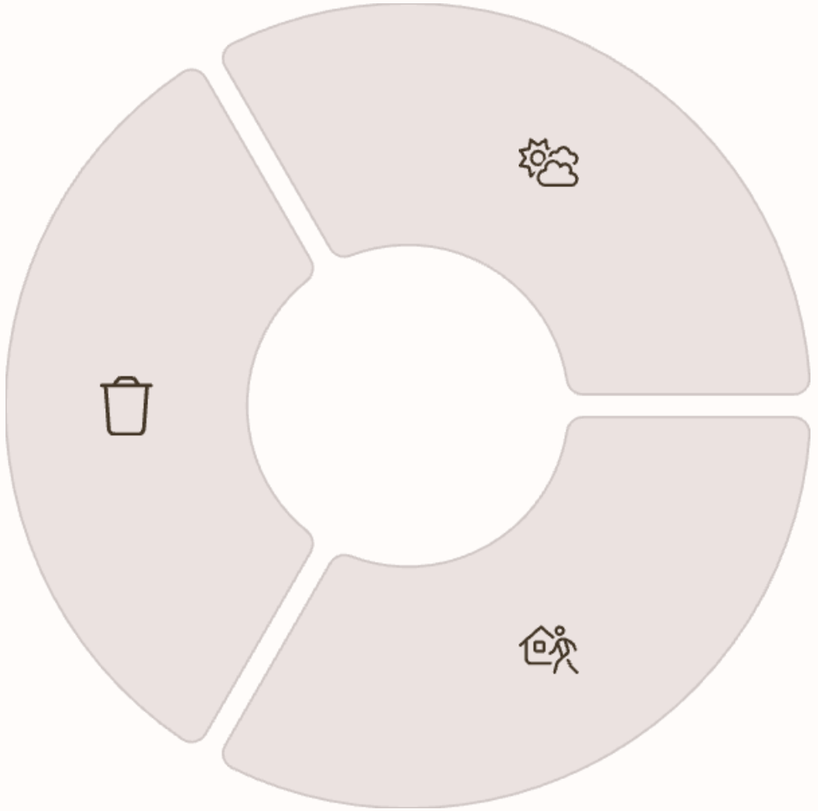
Mobile Access

View data remotely through the ThingSpeak mobile app.

Applications and Use Cases

Smart Bin Monitoring

Track fill levels and environment for efficient waste management.

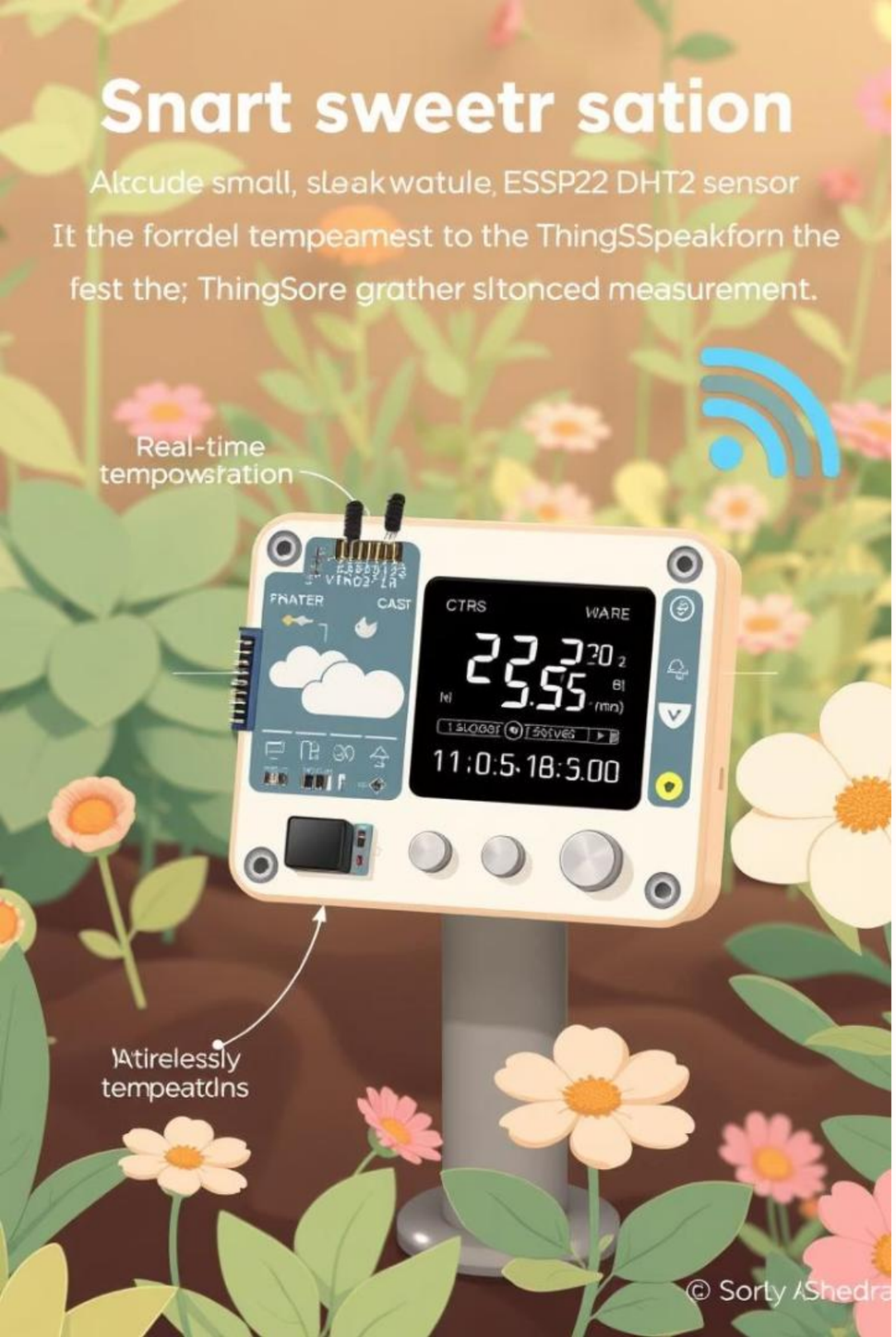


Remote Weather Station

Gather microclimate data for agriculture or research.

Home Automation

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



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.