Heater Control System (ESP32 + DHT22)

Wokwi Project Link: https://wokwi.com/projects/439006205751180289

Project Overview

This project implements a temperature-based heater controller on an ESP32 using a DHT22 sensor. It uses a state machine to manage heating behavior and includes bonus features for BLE advertising, LED feedback, and FreeRTOS-based periodic operations.

Features

- State Machine with: Idle, Heating, Stabilizing, Target Reached, Overheat
- Continuous temperature reading from DHT22 sensor
- Heater control via relay (GPIO 5)
- Serial logging of temperature and state
- BLE advertising of current heating state
- LED visual feedback (GPIO 2) – solid ON while heating, blinking in overheat
- FreeRTOS task for periodic temperature checks (1s interval)

Hardware / Wiring (Wokwi Simulation)

Components:
- ESP32 DevKit V1
- DHT22 Temperature Sensor
- Relay Module
- LED for visual feedback
- 10k pull-up resistor for DHT22

Component	ESP32 Pin
DHT22 VCC	3V3
DHT22 GND	GND
DHT22 DATA	GPIO 4
Relay VCC	3V3
Relay GND	GND
Relay IN	GPIO 5
LED Anode (+)	GPIO 2
LED Cathode (-)	GND

Libraries Required

- DHT sensor library (by Adafruit)
- Adafruit Unified Sensor
- BLE (built into ESP32 Arduino core)

How to Run (Wokwi)

- Open the Wokwi project link or import the provided sketch.ino and diagram.json into a new ESP32 project.

- Install the required libraries.
- Click Run.
- Open the Serial Monitor (baud: 115200) to view temperature readings and state transitions.
- Observe LED behavior: Solid ON = Heating, Blinking = Overheat, OFF = Idle / Target Reached / Stabilizing.

Configuration

Temperature thresholds can be adjusted in sketch.ino: targetTemp = 30.0 // target temperature (°C) overheatTemp = 40.0 // overheat cutoff (°C) stabilizingRange = 1.0 // ± range before target

Future Improvements

- Additional overheat sensor for hardware redundancy
- Multiple heating profiles selectable via BLE or physical buttons
- PID temperature control for smoother stability
- Cloud dashboard integration for logging

Repository Contents

- sketch.ino - Main ESP32 Arduino code
- diagram.json - Wokwi wiring configuration
- README.md - Project documentation
- Design_Document.pdf - Part-1 system design
- block_diagram.png - Clean block diagram image