

Communications & Networks Engineering

Applied Project

DR / AMIR ELSAFRAWY

Temperature-Based Cooling System

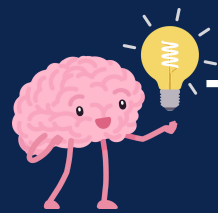
Presented by

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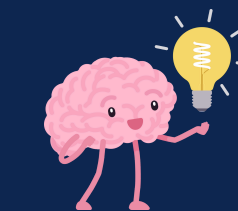
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Project introduction



This project builds a simple, low-cost cooling controller that keeps temperature in a safe range using two 12 V fans. A DS18B20 digital temperature sensor reads the environment. An ESP32 decides when to start/stop each fan using three thresholds (30 °C, 40 °C, 55 °C). At the highest threshold, the system raises an alert through the Blynk IoT mobile app and sends an email to Gmail. The design includes a 12 V→5 V regulator and an NPN transistor level-shifter that converts the ESP32's 3.3 V logic to 5 V where needed. The controller was built, tested on hardware, and verified in simulation



Platforms:-

ESP32 Microcontroller

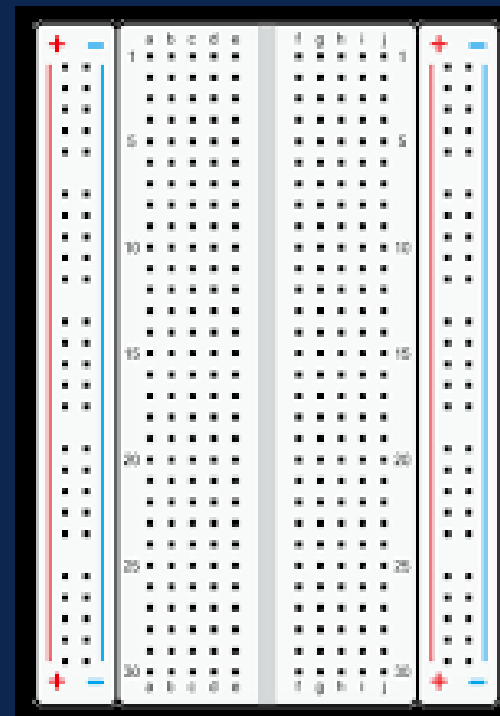
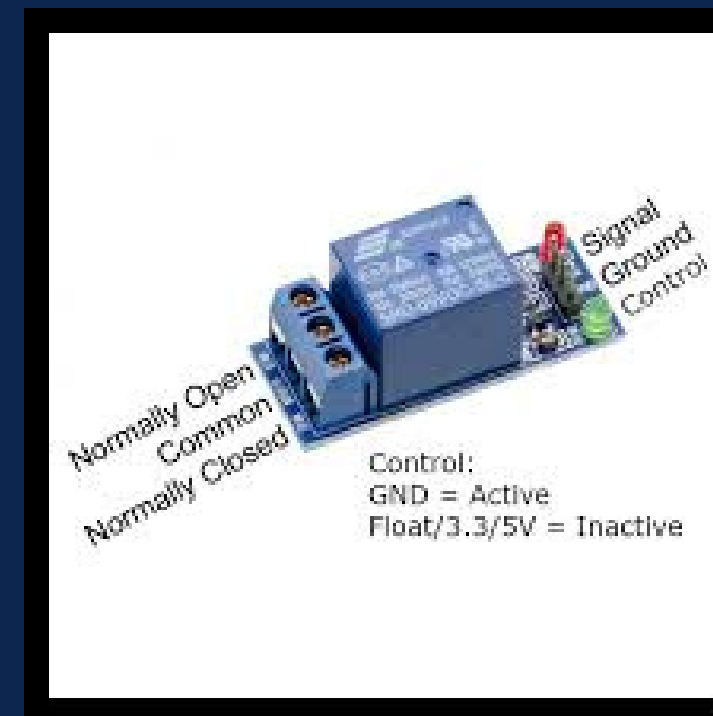
DS18B20 Sensor

Dual 12 V Fans

Two Single-Relay Modules

Hardware components

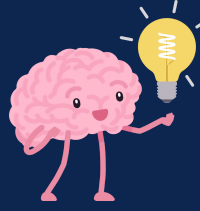
- ESP32 development board – main microcontroller, Wi-Fi and IoT connectivity.
- DS18B20 digital temperature sensor – 1-Wire interface; accurate and noise-resistant.
- Two 12 V brushless DC fans – main actuators for cooling.
- Two single-relay modules (5 V coils) – switch the 12 V fan power lines.
- 12 V→5 V regulator module – powers relays and logic (as needed).
- NPN transistor level shifter – converts 3.3 V GPIO to 5 V signal for relay modules that expect 5 V logic. Include base resistor and flyback protection is handled on the relay board.
- Wires, breadboard, connectors, and a 12 V DC power source with adequate current.



System overview

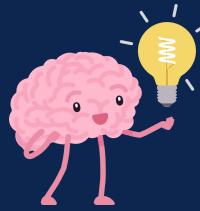
Action	Temperature (°C)
All fans OFF	< 30
Fan-1 ON	≥ 30 and < 40
Fan-1 ON + Fan-2 ON	≥ 40 and < 55
Both fans OFF + Fire/Over-temperature alarm via Blynk + Gmail	≥ 55

Wiring summary



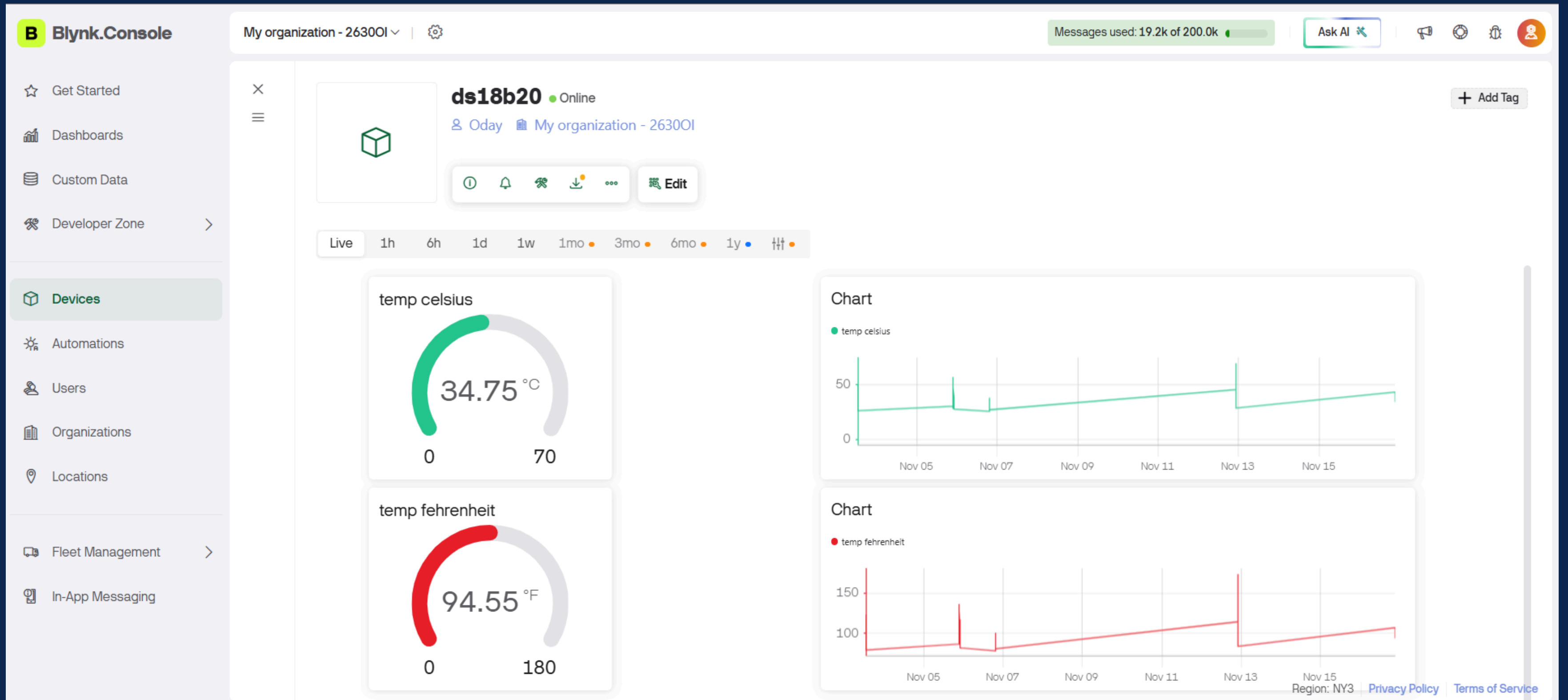
- DS18B20: VDD→3.3 V (or 5 V if using parasite power per datasheet), GND→GND, DQ→ESP32 GPIO (with a 4.7 kΩ pull-up to 3.3 V).
- Relays: VCC→5 V, GND→GND, IN1/IN2 driven by ESP32 GPIO via NPN level shift (GPIO→1 kΩ→base; emitter→GND; collector→relay IN; 10 kΩ pull-down on base recommended).
- Fans: +12 V to fan +; fan – to the COM/NO contacts of each relay so the relay switches the ground (or the positive line—pick one scheme and keep it consistent). Add inline fuses if possible.
- GND: Tie ESP32 GND, 5 V GND, and 12 V GND together.

Logic flow

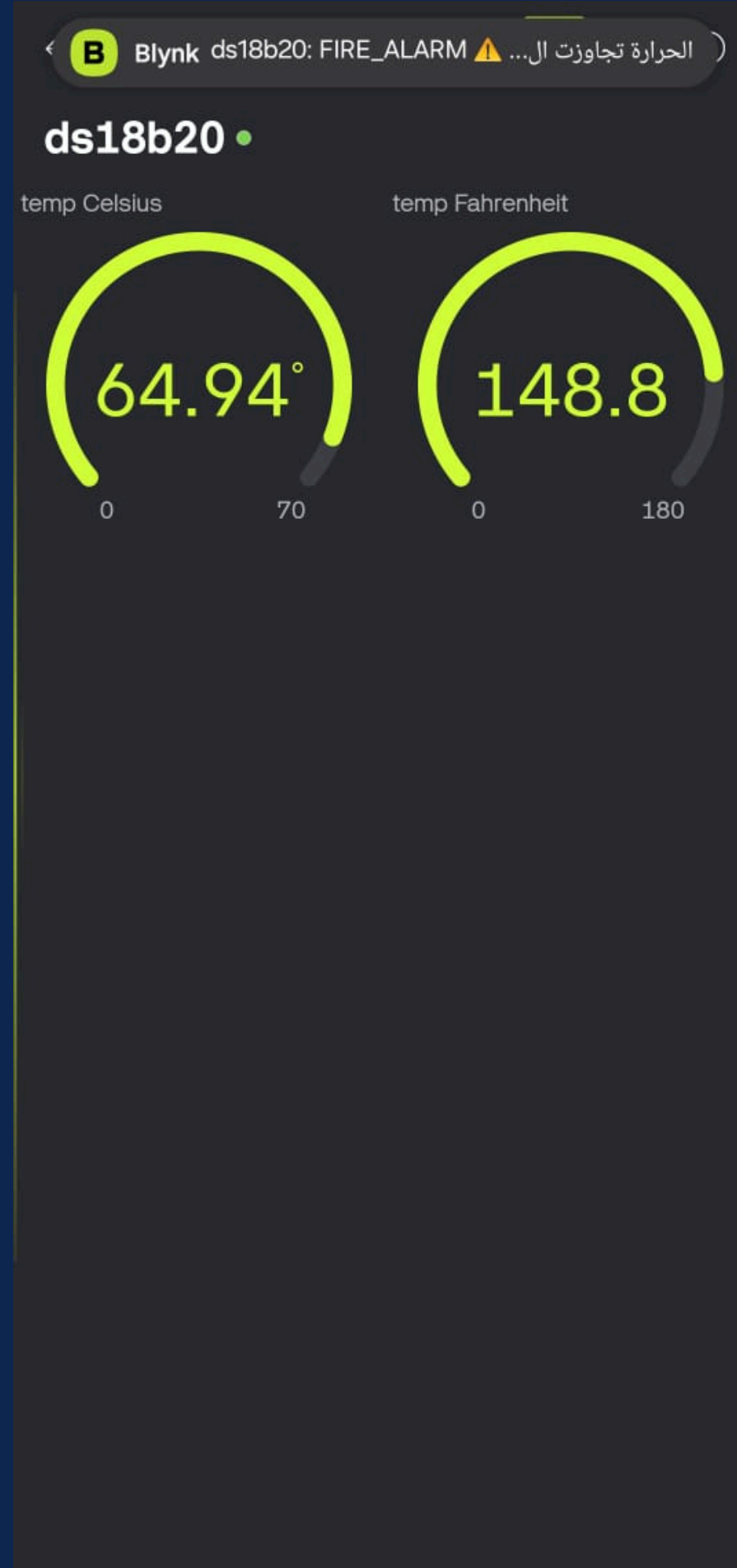
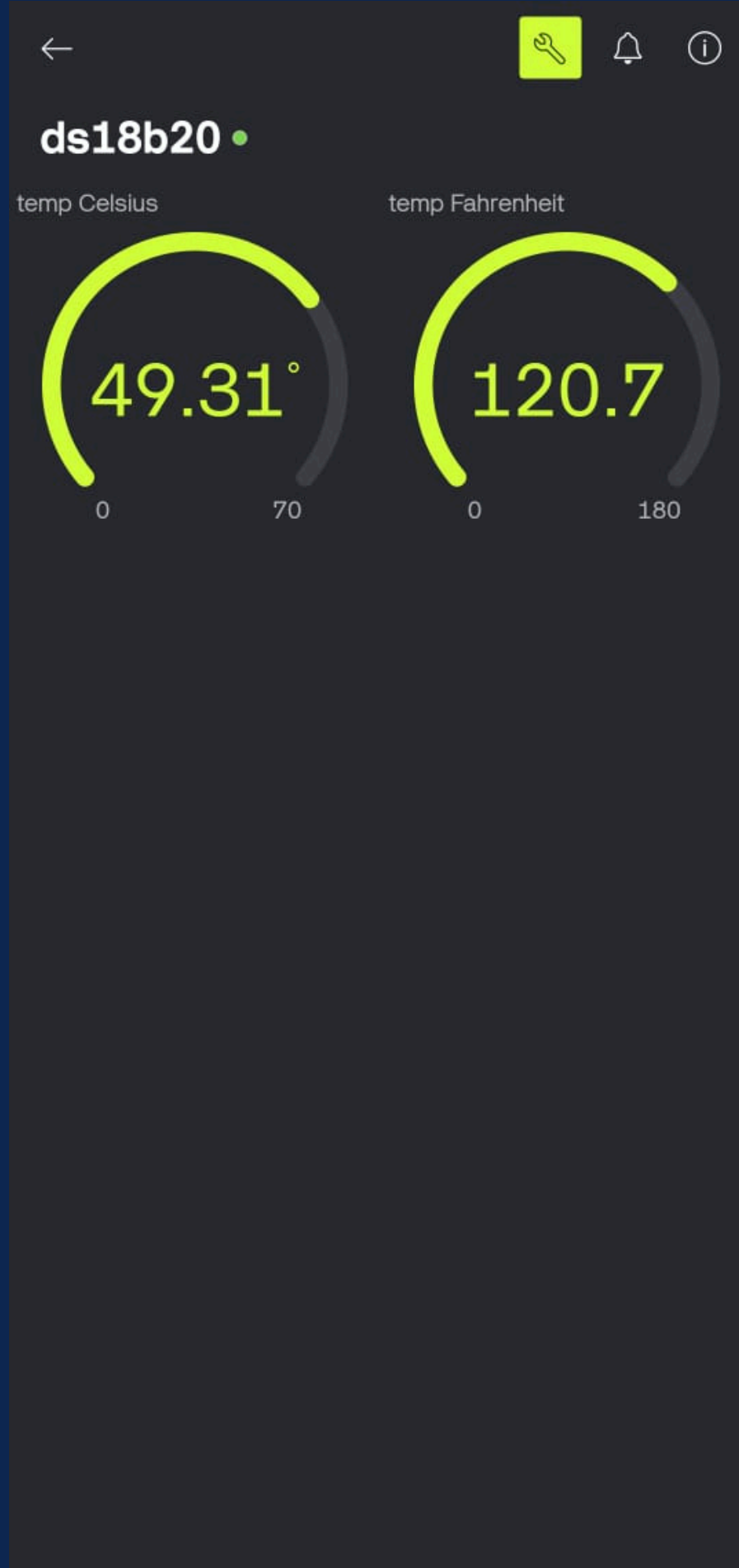


- Read DS18B20 temperature every 500–1000 ms and apply a small moving average or hysteresis (± 1 °C) to reduce relay chatter.
- Compare to thresholds: 30 °C, 40 °C, 55 °C.
- Set relays:
 - $T < 30 \rightarrow \text{Relay1=OFF, Relay2=OFF.}$
 - $30 \leq T < 40 \rightarrow \text{Relay1=ON, Relay2=OFF.}$
 - $40 \leq T < 55 \rightarrow \text{Relay1=ON, Relay2=ON.}$
 - $T \geq 55 \rightarrow \text{Relay1=OFF, Relay2=OFF; raise alarm.}$
- On alarm: push notification through Blynk IoT app and send Gmail email.
- Log the last temperature and the current state for diagnostics.

web console page

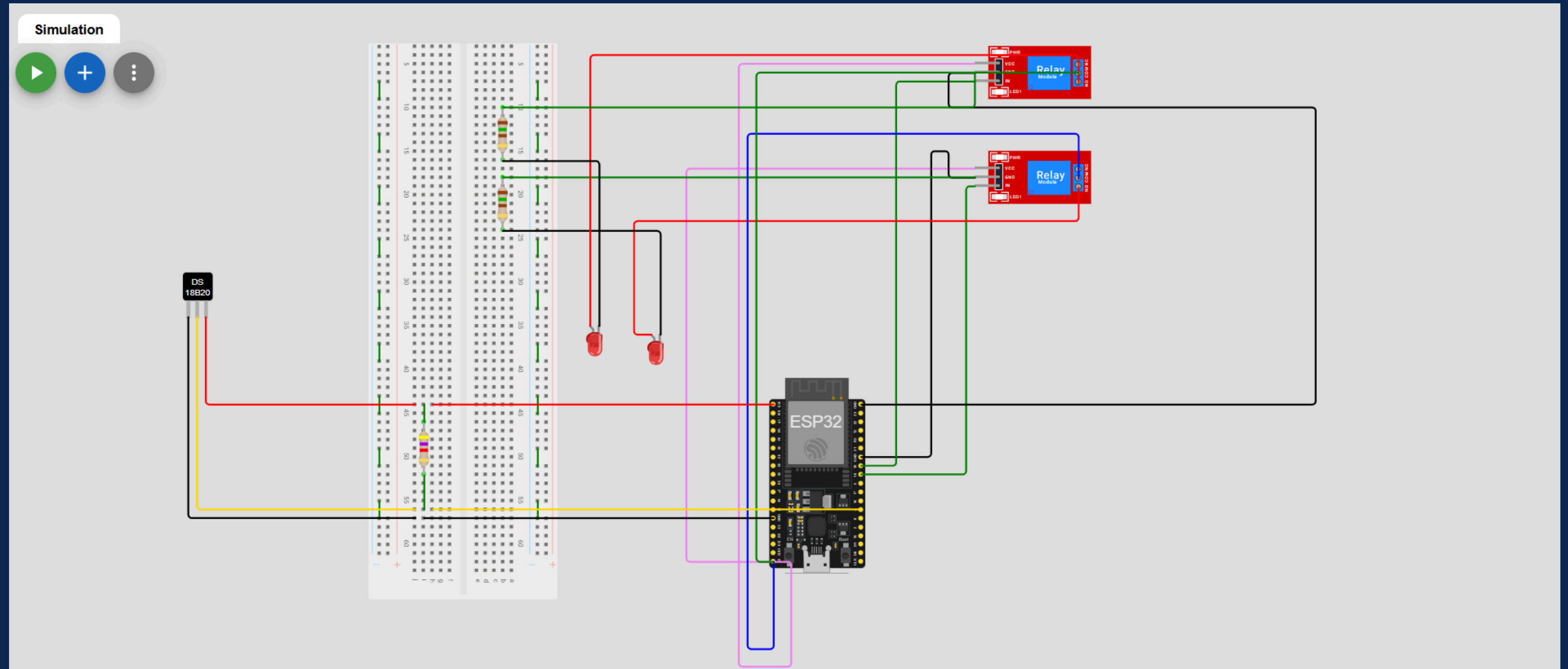


Mobile app and feedbacks



Email notification interface for ds18b20: FIRE_ALARM. The notification includes a back arrow, a star icon, a download icon, a trash icon, an envelope icon, and a menu icon. The sensor name is ds18b20: FIRE_ALARM. The notification is from Blynk, dated 9:28 pm, to me. The notification title is FIRE_ALARM. The notification content is: ⚠️ 64.94 °C الحرارة تجاوزت الحد! القراءة: 64.94. The notification includes links: Open in the app | Mute notifications. The notification includes metadata: Date: Sunday, November 16, 2025, 9:28:29 PM Eastern European Standard Time; Device name: ds18b20; Organization: My organization - 26300I; Template: ds18b20; Owner: odayhaitham742@gmail.com. The notification includes a section for Available add-ons. The notification includes buttons: Reply, Forward, and a smiley face icon.

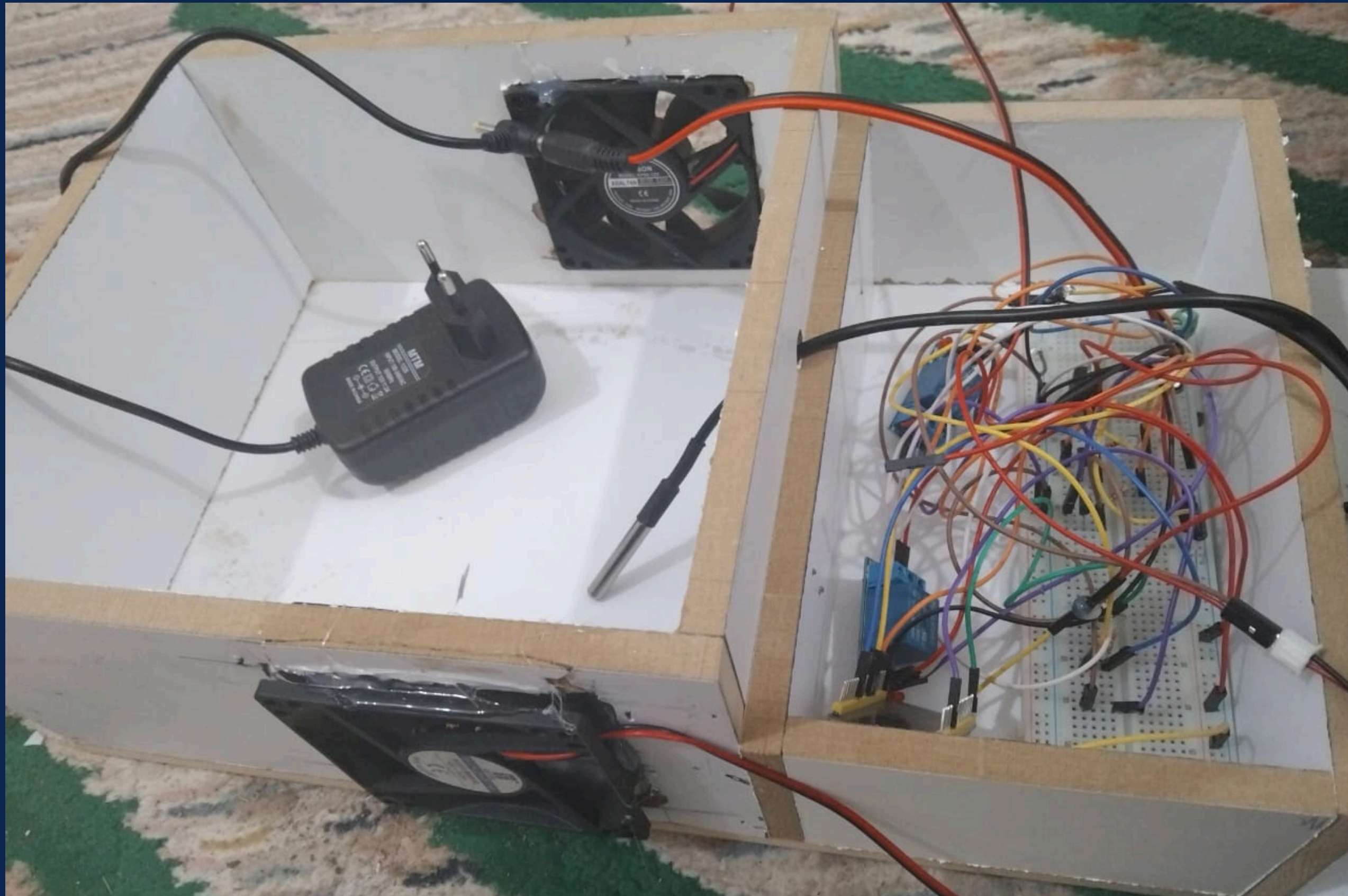
Wiring summary



● Possible Improvement

- PWM fan speed control using MOSFETs or 4-wire PWM fans to vary speed smoothly (quieter, saves power).
- PID or two-point with hysteresis: hold a target temperature (e.g., 35 °C) and adjust duty cycle automatically.
- Configurable threshold profiles from the Blynk app (edit 30/40/55 °C without reflashing).
- Data logging: store temperature and fan states to microSD or Blynk cloud; show trends/graphs.
- Multiple sensors & averaging: add extra DS18B20s at different locations; detect sensor fault (disconnected = 85 °C reading) and fail-safe.
- Enclosure & airflow design: ducts, dust filters, and mounting grill to improve cooling efficiency and safety.
- Hardware drivers: replace relays with logic-level N-MOSFETs (with flyback diodes) for higher reliability and silent switching.
- Power protection: TVS diode on 12 V line, reverse polarity diode, and over-current protection.
- OTA updates: enable OTA (Over-the-Air) firmware updates through Wi-Fi.
- Battery or solar option with power-save modes; ESP32 deep sleep when stable.
- Local UI: small OLED display and push-buttons for manual mode and threshold setting.
- Smart alarms: escalating alerts (app → email → buzzer) and auto-retry logic; include GPS/time stamps in messages.

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Thank you