

Communications & Networks Engineering

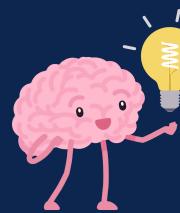
Applied Project

DR / AMIR ELSAFRAWY

Temperature-Based Cooling System

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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

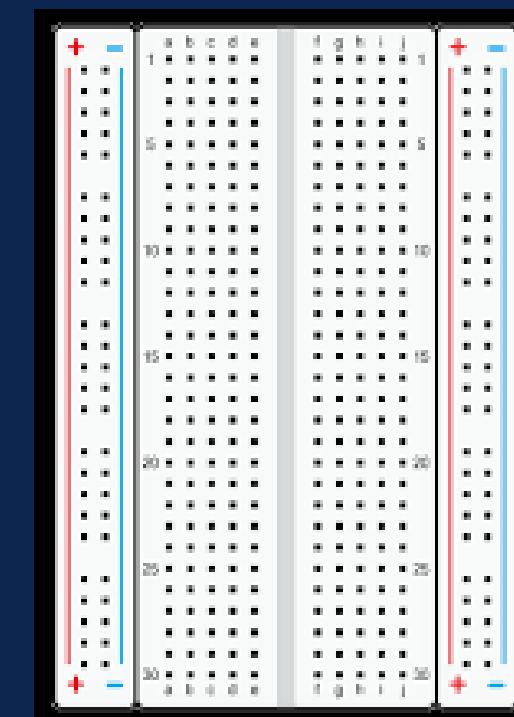
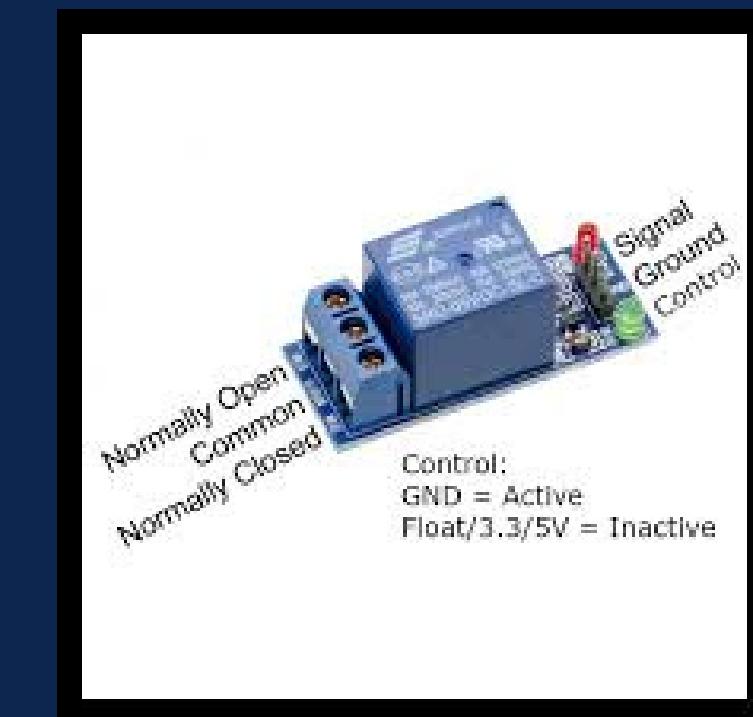
DS18B20 Sensor

Dual 12 V Fans

Two Single-Relay Modules

Hardware components

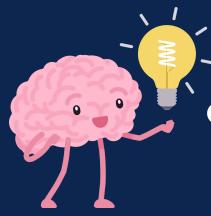
- ESP32 development board – main microcontroller, Wi-Fi and IoT connectivity.
- DS18B20 digital temperature sensor – 1-Wire interface; accurate and noise-resistant.
- Two 12 V brushless DC fans – main actuators for cooling.
- Two single-relay modules (5 V coils) – switch the 12 V fan power lines.
- 12 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 ($\pm 1^\circ\text{C}$) 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

B Blynk.Console My organization - 2630I | 🔍 Messages used: 19.2k of 200.0k | Ask AI 🔍

Get Started Dashboards Custom Data Developer Zone >

Devices Automations Users Organizations Locations

Fleet Management > In-App Messaging

ds18b20 • Online Oday My organization - 2630I Edit

Live 1h 6h 1d 1w 1mo 3mo 6mo 1y 11m

temp celsius 34.75 °C

temp fahrenheit 94.55 °F

Chart

temp celsius

Nov 05 Nov 07 Nov 09 Nov 11 Nov 13 Nov 15

Chart

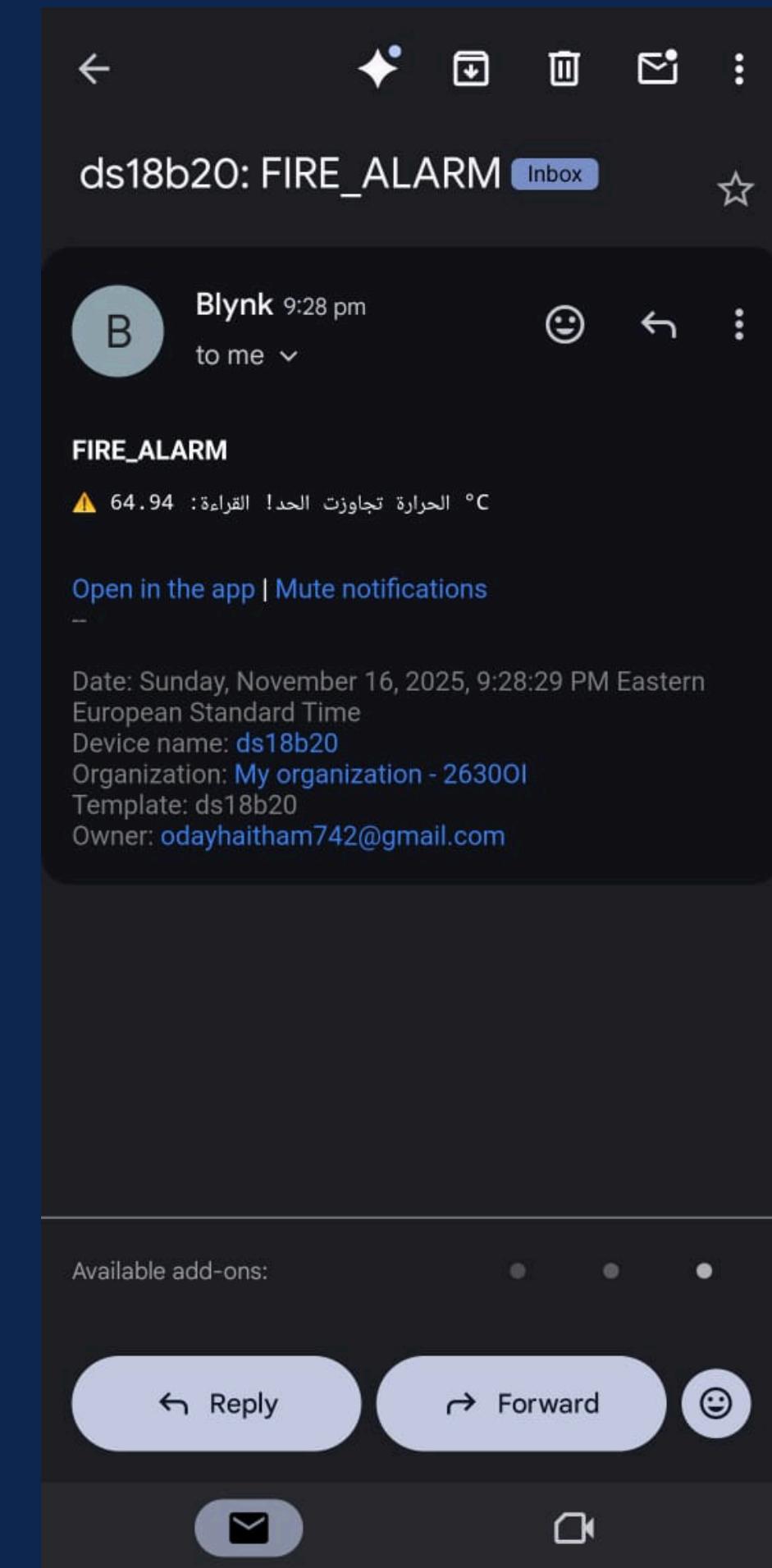
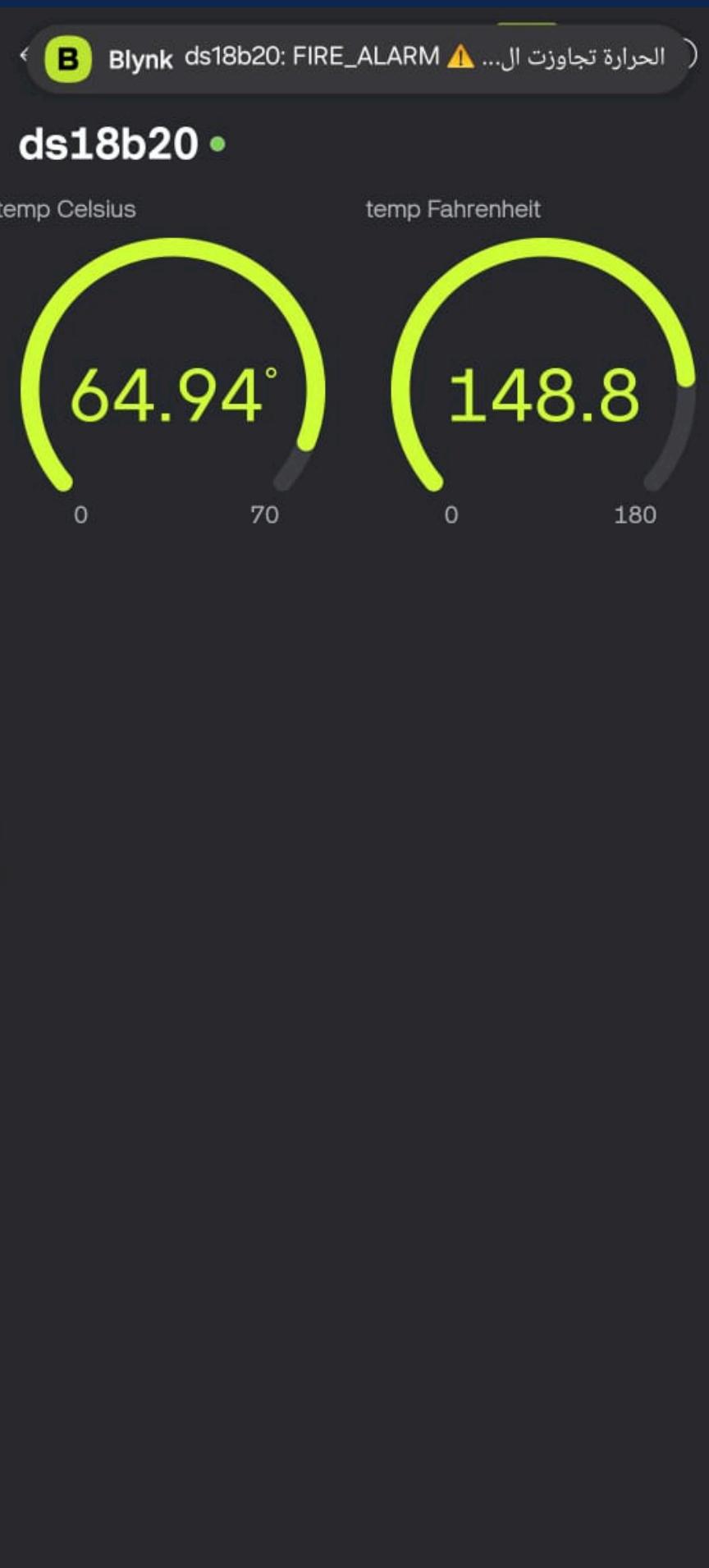
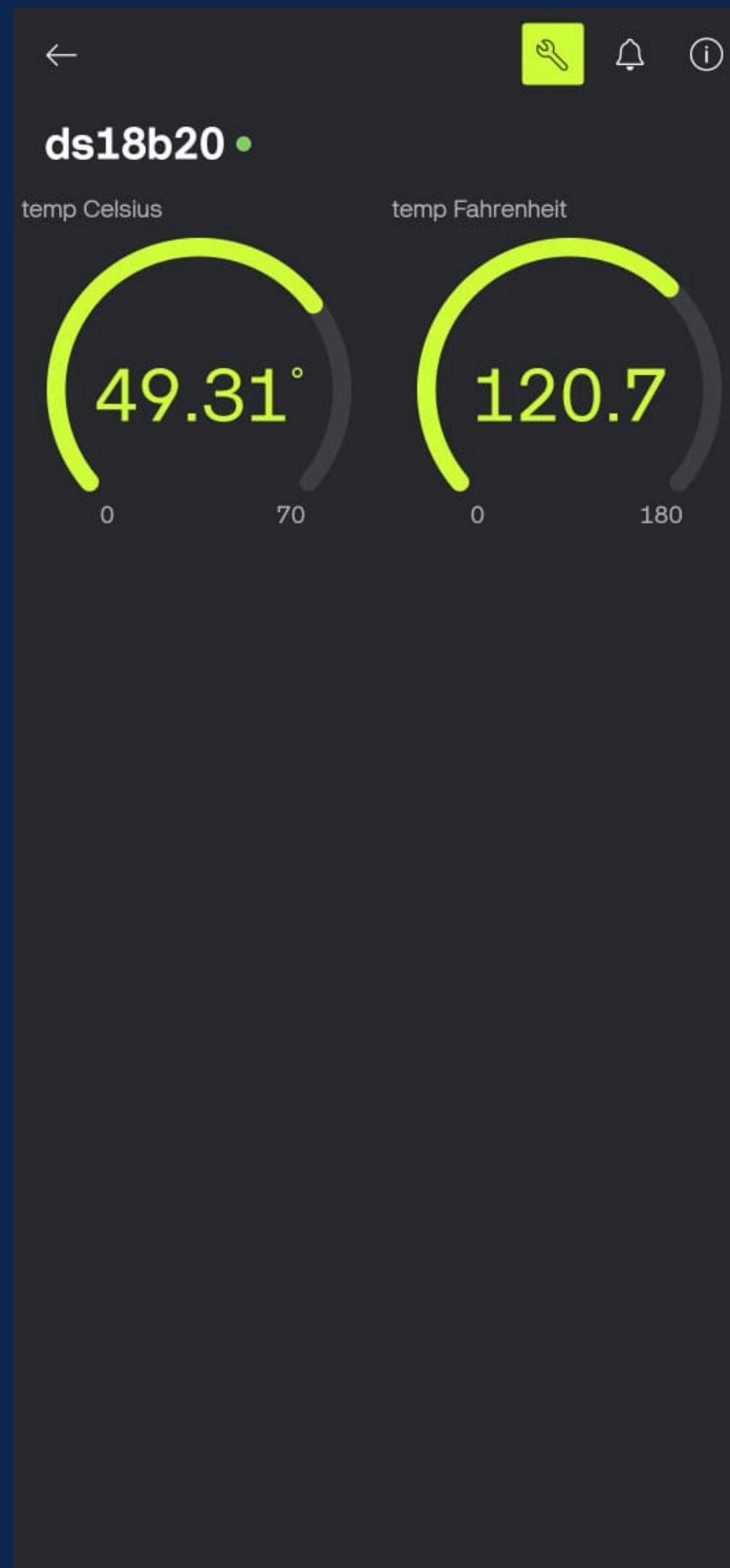
temp fahrenheit

Nov 05 Nov 07 Nov 09 Nov 11 Nov 13 Nov 15

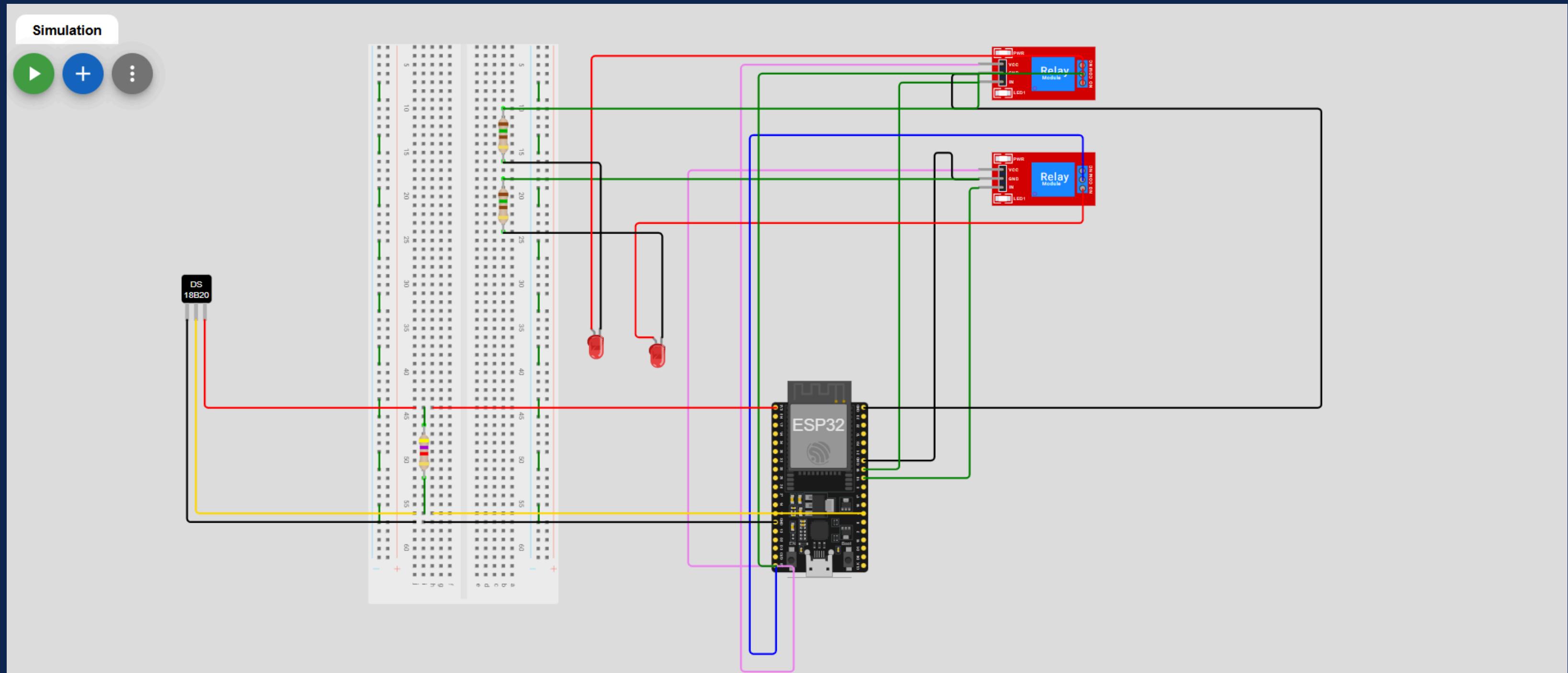
Region: NY3 | Privacy Policy | Terms of Service

The screenshot shows the Blynk web console interface. The left sidebar includes links for Get Started, Dashboards, Custom Data, Developer Zone, Devices (selected), Automations, Users, Organizations, Locations, Fleet Management, and In-App Messaging. The main area displays a device card for 'ds18b20' (Online) connected to 'Oday' in 'My organization - 2630I'. Below the device card is a timeline selector with options: Live, 1h, 6h, 1d, 1w, 1mo (orange dot), 3mo (orange dot), 6mo (orange dot), 1y (blue dot), and 11m (orange dot). Two circular gauges are shown: 'temp celsius' at 34.75 °C and 'temp fahrenheit' at 94.55 °F. To the right are two line charts for 'temp celsius' and 'temp fahrenheit' from November 5 to November 15. The 'temp celsius' chart shows values around 35°C with a jump to ~50°C on Nov 13. The 'temp fahrenheit' chart shows values around 100°F with a jump to ~150°F on Nov 13. The bottom right corner indicates the region is 'NY3'.

Mobile app and feedbacks



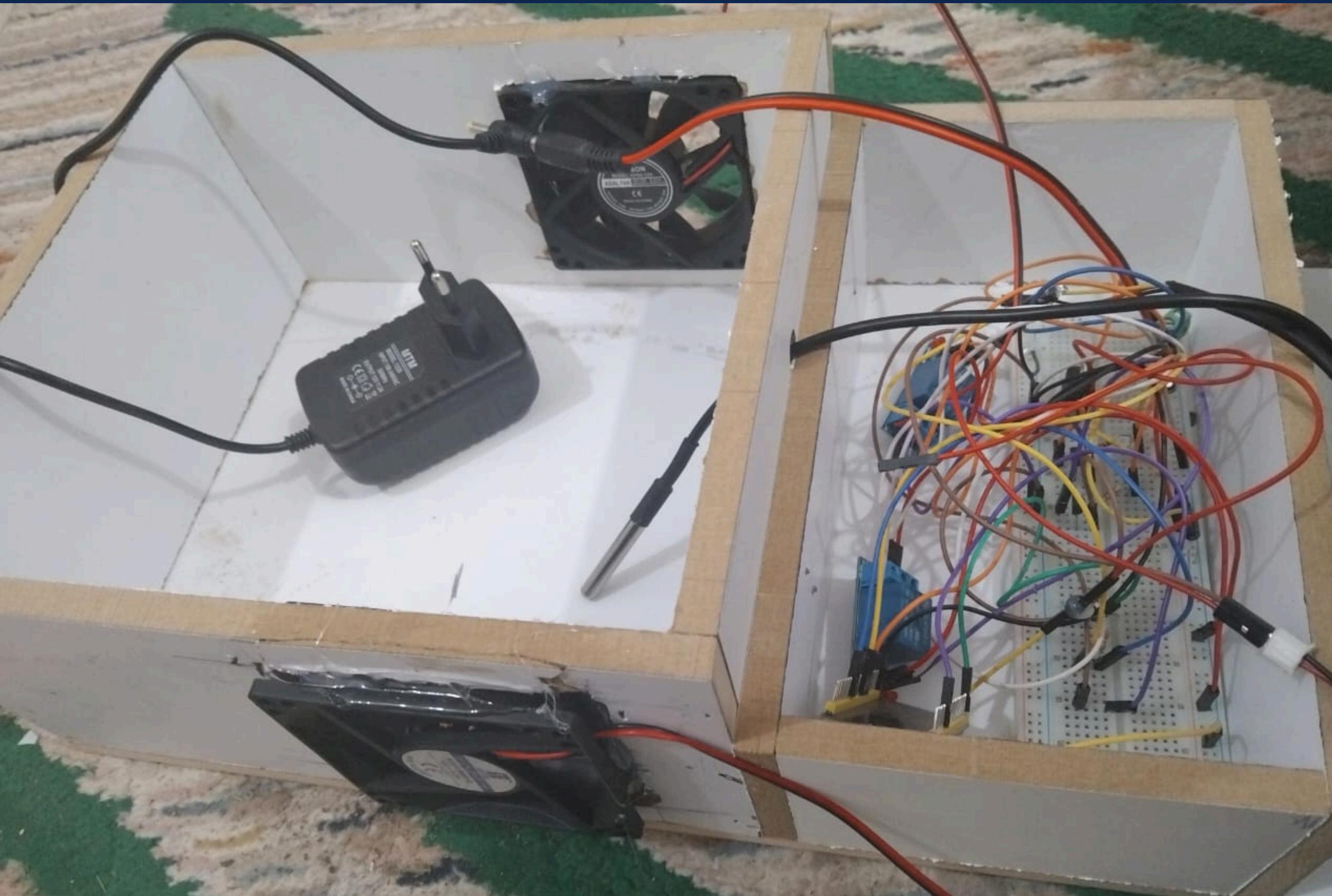
Wiring summary



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