Project: Basic Heater Control System

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1. Minimum Sensors Required

DS18B20 Digital Temperature Sensor: Precise, single-sensor temperature feedback is all that is needed for effective heating detection and control. The chosen sensor is the DS18B20. This is a digital sensor known for its accuracy and its use of the 1-Wire communication protocol, which simplifies wiring.

2. Recommended Communication Protocol

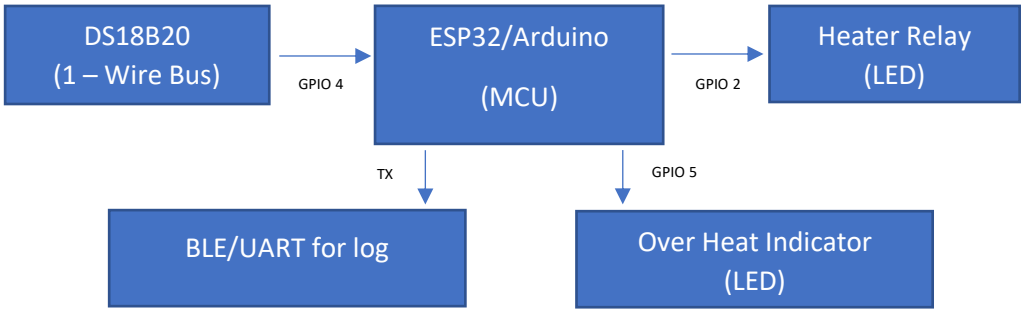
1-Wire Protocol

Minimalist Wiring: The 1-Wire protocol, used by the DS18B20 sensor, requires only one data line (plus ground) for communication, which simplifies the physical circuit design.

Unique Device Addressing: Each 1-Wire device has a unique, hard-coded 64-bit address, allowing multiple sensors to be connected on the same bus without address conflicts.

3. System Block Diagram

The following diagram illustrates the key modules and their connections as implemented in the code.



4. Future Roadmap

Enhanced Overheating Protection: The current OVERHEAT state recovers automatically once the temperature cools down. For enhanced safety, this could be converted to a latching fault state. In this mode, once OVERHEAT is triggered, the system would permanently disable the heater and require a manual power-cycle or reset to resume operation. This prevents the system from cycling in a potentially hazardous state. A hardware safety cutoff (thermal fuse) and additional sensor can be added for redundancy.

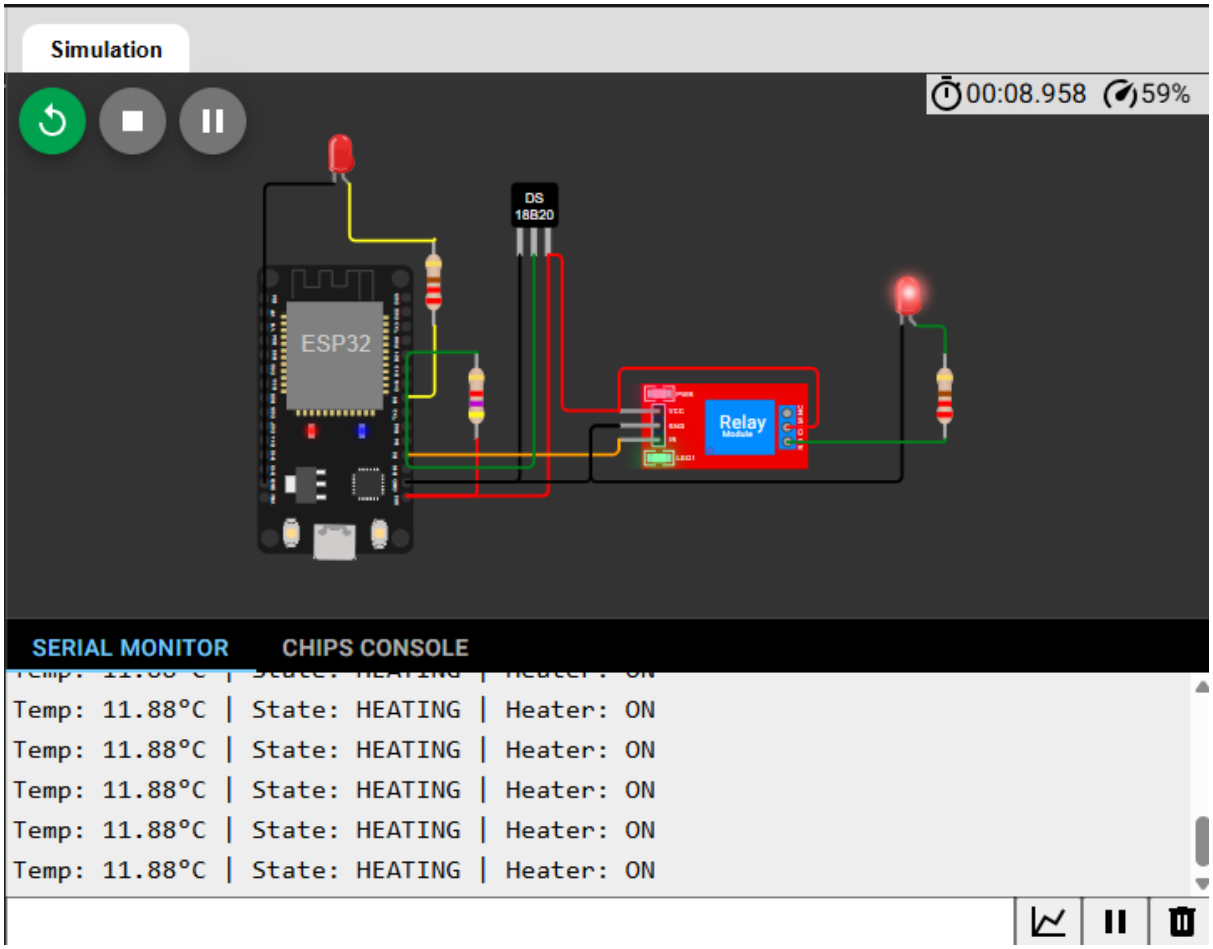
Support for Multiple Heating Profiles: The system can be evolved to support complex cooking or heating sequences.

Profile Storage: Use a struct or array in the code to define multiple heating profiles, where each profile consists of sequential steps (e.g., [{temp: 60, duration: 300s}, {temp: 85, duration: 600s}]).

User Interface: Add buttons or a simple command-line interface over Serial to allow a user to select a desired profile before starting the process.

Advanced State Machine: The state machine would be updated to not only track temperature but also the elapsed time for the current step in the profile, transitioning to the next step automatically.

5. Simulation:



6. Links:

GitHub: https://github.com/dyaswanthk/Basic-Heater-Control-System

Wokwi: https://wokwi.com/projects/438368800025482241

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