Heater Control System – Design Document

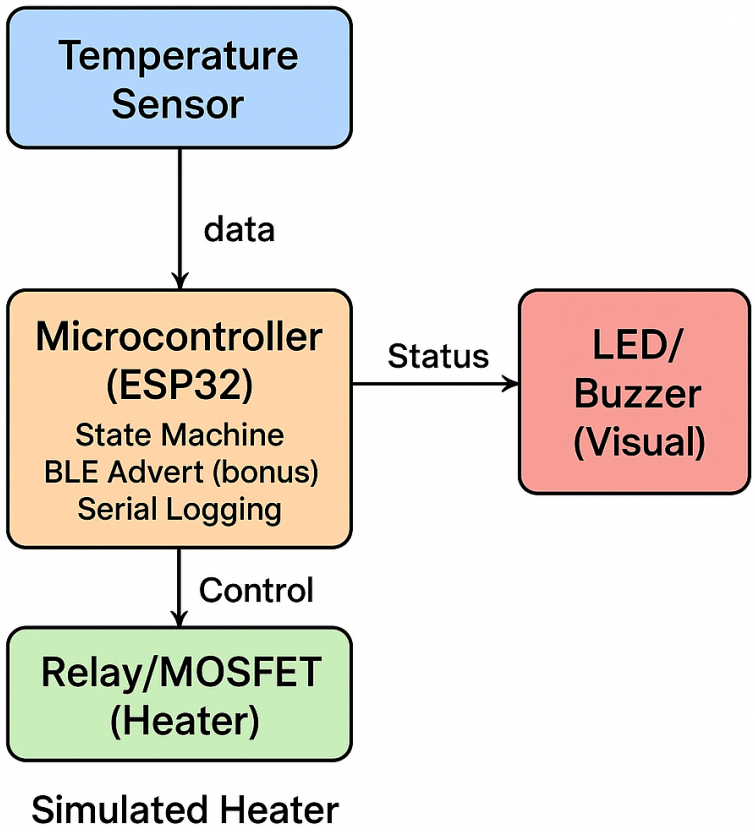
1. Minimum Sensors Required

The system requires at least one temperature sensor to measure the ambient or heater temperature. For this prototype, the DHT22 digital temperature and humidity sensor is chosen due to its accuracy, library support, and ease of interfacing. Optional sensors include a second temperature sensor for overheat detection and a current sensor for verifying heater operation.

2. Recommended Communication Protocol

For the current single-sensor system, the DHT22's proprietary single-wire digital protocol is used. This protocol reduces wiring complexity and ensures stable readings with minimal hardware. If more sensors or peripherals are added in future, I²C is recommended for its multi-device support, simple wiring (SDA/SCL), and robust ecosystem. For analog thermistors, ADC input can be used.

3. Block Diagram



4. Future Roadmap

- Add overheating protection via a secondary sensor and a latched fault mechanism.
- Support multiple heating profiles (Low, Medium, High) selectable via BLE or physical buttons.
- Implement PID control or hysteresis for stable temperature maintenance.

- Integrate watchdog timer for reliability.
- Store last-used profile in non-volatile memory.
- Add BLE connectivity for real-time monitoring and optional cloud logging.
- Use safety-rated components (SSR/relay, fuses, isolation) for real-world deployment.