**7-1 Final Project: Thermostat Lab**

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The smart thermostat prototype developed for SysTec demonstrates the integration of multiple embedded peripherals to create an efficient, low-level control system. The project goal was to implement a thermostat that can read ambient temperature, compare it to a set point, and activate heating or cooling indicators based on that comparison. The prototype also simulates cloud connectivity by transmitting system data through a serial interface.

The system uses an AHT20 sensor connected via the I²C bus to read temperature and humidity. Two PWM-controlled LEDs indicate the current system mode: the red LED represents heating, and the blue LED represents cooling. Each LED fades in and out when active and remains solid when the target temperature is reached. Three buttons handle user input. The first button cycles between Off, Heat, and Cool modes, while the other two increment or decrement the temperature set point. The LCD display shows the current date and time on the first line and alternates between temperature and system state on the second line. Every 30 seconds, a UART interface transmits the thermostat’s state, current temperature, and set point to simulate cloud communication.

To prepare for future production, three hardware architectures were analyzed—Raspberry Pi, Microchip, and Freescale. The Raspberry Pi 4B offers integrated Wi-Fi, extensive GPIO support, and a full Linux OS, making it ideal for rapid prototyping and cloud integration. The Microchip PIC32 series provides low power consumption and strong real-time performance but lacks built-in Wi-Fi on most models, requiring additional modules. Freescale (now NXP) microcontrollers, such as the i.MX RT series, provide powerful ARM cores and integrated connectivity but are more complex to program at the bare-metal level.

Considering SysTec’s business goals—supporting I²C, GPIO, UART peripherals, and seamless Wi-Fi connectivity—the Raspberry Pi architecture is the most appropriate platform for both prototyping and early production phases. Its built-in networking stack and support for Python libraries simplify cloud communication. However, for long-term scalability, transitioning to a Freescale-based design could improve power efficiency and provide industrial reliability.

This project demonstrates how embedded systems integrate sensors, displays, and communication peripherals into a single cohesive solution. The prototype successfully achieves SysTec’s functional requirements and lays the groundwork for a future smart thermostat product with full cloud-based analytics capabilities.

**References**

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