Final Project

CS-350

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The thermostat prototype uses several peripherals, including the AHT20 temperature sensor, status LEDs, buttons, and an LCD display. On the Raspberry Pi, these peripherals are supported through GPIO pins, I2C, SPI, and UART interfaces, with library support simplifying development (Rouse, 2020). Microchip MCUs provide built-in support for I2C for the temperature sensor, GPIO for LEDs and buttons, and UART for serial communication. This offers a low-power and embedded-optimized handling of the peripherals (Microchip Technology, 2022). Freescale (NXP) MCUs similarly provide peripheral integration through multiple GPIO ports and communication protocols. This allows for connection to the temperature sensor, LEDs, buttons, and LCD. Each architecture can effectively interface with the project’s required components, but embedded MCUs like Microchip and Freescale are better suited for production environments due to lower power consumption and tighter peripheral integration.

Cloud connectivity depends on integrated or add-on Wi-Fi capabilities. Raspberry Pi models include built-in Wi-Fi, allowing seamless communication with SysTec’s server software using standard TCP/IP protocols (Rouse, 2020). Microchip MCUs can connect to the cloud either via integrated Wi-Fi (available in some SAM and PIC Wi-Fi models) or through external modules such as the ATWINC1500, providing reliable data transfer with low power requirements (Microchip Technology, 2022). Freescale/NXP MCUs often require external Wi-Fi modules like ESP8266 or ESP32 to enable cloud connectivity, which adds hardware complexity but supports low-power embedded operations. Each architecture can transmit temperature and thermostat data to the cloud, but embedded MCUs are more efficient for long-term, production-ready IoT devices.

The firmware for the smart thermostat includes peripheral management, state machine logic for heating/cooling, button interrupts, LCD display updates, and cloud communication protocols. Raspberry Pi offers lots of Flash and RAM which exceeds the prototype’s requirements. However it may be overpowered for simple embedded logic (Rouse, 2020). Microchip MCUs provide sufficient Flash (256 KB–2 MB) and RAM (32 KB–512 KB) to handle all peripheral and cloud communication code efficiently. Along with memory optimized for embedded applications (Microchip Technology, 2022). Freescale/NXP MCUs similarly provide adequate memory to execute the thermostat firmware and maintain performance for I2C, GPIO, and UART operations. While all three architectures can support the code, Microchip and Freescale MCUs offer a more scalable, low-power solution suited for production deployment.

References

Microchip Technology. (2022). *SAM and PIC microcontrollers with integrated Wi-Fi*. <https://www.microchip.com/wwwproducts/en/PIC32>

Rouse, M. (2020). *Raspberry Pi overview: Uses and capabilities in embedded systems*. TechTarget. <https://www.techtarget.com/>