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7-1 Final Project: Thermostat Lab Report

The global smart thermostat market is projected to grow significantly, reaching nearly $9 billion by 2026 (Fortune Business Insights, 2021). Recognizing this opportunity, SysTec has initiated development on a smart thermostat that complements its analytics software platform. The prototype, developed using a Raspberry Pi, showcases core thermostat functionalities including temperature monitoring via an AHT20 sensor, state-based heating and cooling control, user interaction through buttons and an LCD display, and serial output for logging (Raspberry Pi Foundation, n.d.). While the prototype meets the initial requirements for embedded systems behavior and user interaction, the long-term goal is to transition to a production-ready system that sends temperature and system state data to SysTec’s server software via Wi-Fi.

To move into production, three hardware architectures were evaluated based on the business requirements: peripheral support, integrated Wi-Fi capability, and sufficient memory for firmware and network operations. The Raspberry Pi Zero 2 W provides an easy-to-develop environment with built-in Wi-Fi and a full Linux stack, making it ideal for prototyping but too resource-heavy and expensive for large-scale deployment (Raspberry Pi Foundation, n.d.). Freescale’s NXP i.MX RT1020 offers low-power, bare-metal operation with solid peripheral support, but with limited Flash and more complex integration (NXP Semiconductors, n.d.). Microchip’s ATSAME54P20A, however, provides the best balance—supporting necessary interfaces (GPIO, I2C, UART), offering ample Flash (1MB) and SRAM (256KB), and pairing well with Wi-Fi modules like the WINC1500 for cloud communication (Microchip Technology Inc., n.d.). It supports development using FreeRTOS and is optimized for low power consumption and scalability in commercial hardware.

Based on these findings, the Microchip ATSAME54P20A is recommended for the next development phase. It enables cloud integration through lightweight MQTT protocols, allows firmware upgrades, and supports battery-efficient operation—aligning perfectly with SysTec’s goals of building a cost-effective, connected, and reliable smart thermostat. The transition will involve rewriting the codebase in C/C++, integrating Wi-Fi modules, and enabling secure telemetry to SysTec’s cloud services. With this foundation, SysTec is well-positioned to bring a competitive, cloud-enabled smart thermostat to market.

**Works Cited**

Fortune Business Insights. (2021). *Smart thermostat market size, share & COVID-19 impact analysis, by type (connected, learning), by application (residential, commercial, industrial), and regional forecast, 2019–2026.* Retrieved from https://www.fortunebusinessinsights.com/smart-thermostat-market-103682

Microchip Technology Inc. (n.d.). *ATSAME54P20A - 32-bit microcontroller with 1 MB Flash and 256 KB SRAM.* Retrieved from https://www.microchip.com/en-us/product/ATSAME54P20A

NXP Semiconductors. (n.d.). *i.MX RT1020 Crossover MCU.* Retrieved from https://www.nxp.com/products/processors-and-microcontrollers/arm-microcontrollers/i-mx-rt-series/i-mx-rt1020-crossover-mcu-with-arm-cortex-m7-core:i.MX-RT1020

Raspberry Pi Foundation. (n.d.). *Raspberry Pi Zero 2 W.* Retrieved from https://www.raspberrypi.com/products/raspberry-pi-zero-2-w/