7-1 Project

Gavin M. Bish

Southern New Hampshire University

CS350: Emerging Systems Architectures & Technologies

Professor Eric Gregori

December 13th, 2024

7-1 Project

The thermostat system developed for this project integrates a range of peripherals and functionalities to achieve a comprehensive temperature monitoring and control solution. This report reflects on how the thermostat supports the peripherals utilized in the project, explains its cloud connectivity via Wi-Fi, and discusses the architecture’s Flash and RAM resources across the TI, Microchip, and Freescale hardware platforms.

The thermostat leverages several peripherals to achieve its functionalities. The GPIO pins are employed to interact with buttons and LEDs. GPIO interrupts are configured to detect button presses, allowing the user to increment or decrement the temperature setpoint. The LED indicates the heating status, turning on when the system detects that the current room temperature is below the setpoint. Additionally, the I2C peripheral is utilized to communicate with the TMP006 temperature sensor, retrieving accurate room temperature readings in real-time. The UART interface plays a critical role in simulating data transmission to a server by sending system status updates over a serial connection. Finally, the timer peripheral drives the task scheduler by generating periodic interrupts to execute specific tasks, such as reading the temperature, updating the LED, and reporting the status. These peripherals ensure that the system operates efficiently and responds dynamically to user inputs and environmental conditions.

The thermostat’s ability to connect to the cloud via Wi-Fi ensures that it can serve as a modern IoT device. Using the integrated Wi-Fi capabilities of the TI CC3220S microcontroller, the thermostat can transmit data to a remote server, enabling centralized monitoring and control. For Microchip platforms, such as those using the ATWINC1510 module, Wi-Fi connectivity would require integration with the microcontroller’s communication interfaces to establish a connection to cloud services. Similarly, Freescale’s platforms, such as the i.MX RT series, can leverage their robust processing power and integrated peripherals to support Wi-Fi modules and cloud interactions. Across all three architectures, secure communication protocols, such as TLS, would ensure the safe transmission of data, enabling the thermostat to participate effectively in an IoT ecosystem.

The hardware architectures of TI, Microchip, and Freescale provide sufficient Flash and RAM resources to support the thermostat’s firmware. The TI CC3220S microcontroller, with its integrated 256 KB of RAM and up to 1 MB of Flash, is well-suited for the thermostat’s tasks, including storing sensor data, executing tasks, and handling network communications. Microchip’s microcontrollers, such as the PIC32MZ series, offer similar capabilities, with up to 2 MB of Flash and 512 KB of RAM, ensuring ample storage for code and runtime variables. Freescale’s i.MX RT series, known for its high-performance capabilities, provides even larger memory resources, with up to 4 MB of Flash and 1 MB of RAM in certain models. These resources are essential for implementing the system’s functionalities, including interrupt handling, data processing, and network operations, while maintaining responsiveness and reliability.

In conclusion, the thermostat system demonstrates a robust integration of peripherals to support user interaction, environmental monitoring, and data reporting. Its capability to connect to the cloud via Wi-Fi ensures it remains relevant in an IoT-enabled world. Across TI, Microchip, and Freescale architectures, the availability of sufficient Flash and RAM resources supports the efficient execution of the system’s tasks, highlighting the flexibility and adaptability of the thermostat design.

**References**

Texas Instruments. (n.d.). SimpleLink™ Wi-Fi® CC3220SF wireless MCU. Retrieved from <https://www.ti.com/product/CC3220SF>

Microchip Technology Inc. (n.d.). 8-bit AVR microcontrollers. Retrieved from <https://www.microchip.com/en-us/products/microcontrollers-and-microprocessors/8-bit-mcus>

NXP Semiconductors. (n.d.). *Kinetis K series MCUs*. Retrieved from <https://www.nxp.com/products/processors-and-microcontrollers/arm-microcontrollers/general-purpose-mcus>

IEEE Standards Association. (2021). *IEEE 802.11: Wireless LANs*. Retrieved from <https://standards.ieee.org/802_11/>

Texas Instruments. (n.d.). *CC3220SF Flash and RAM memory usage*. Retrieved from <https://www.ti.com/lit/ug/swru469a/swru469a.pdf>