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**CS350**  
**08/18/24**  
**7-1 Thermostat Project**

**Introduction**

The purpose of this project was to design and implement a prototype of a smart thermostat using the Texas Instruments CC3220x LaunchPad board. The thermostat was required to read room temperature via an I2C temperature sensor, adjust the set temperature using buttons (SW2 and SW3), and indicate whether heating is on or off via an LED (D10). The system also simulated data being sent to a server over UART. Finally, we analyzed three hardware architectures—Texas Instruments (TI), Microchip, and Freescale—to determine the best option for connecting the thermostat to the cloud via Wi-Fi.

**Supporting Peripherals**

The smart thermostat supports several peripherals critical to its functionality. The TMP006 temperature sensor is interfaced via the I2C protocol to measure the ambient room temperature. The GPIO peripherals are used to control an LED (D10), which acts as an indicator of whether the heating system is active. The buttons on the LaunchPad, specifically SW2 to decrease the set-point temperature and SW3 to increase the set-point temperature, allow the user to adjust the thermostat settings. The UART is used to simulate the transmission of temperature and status data to a remote server, ensuring that the system can effectively communicate the necessary information in a real-world application. These peripherals are crucial for the thermostat's operation and are well supported by the selected hardware architecture.

*A screenshot of a computer error

Description automatically generated*

**Wi-Fi Connectivity**

Connecting the thermostat to the cloud via Wi-Fi will be a crucial requirement for the future of this project. The Texas Instruments CC3220x LaunchPad offers built-in Wi-Fi capabilities, making it a strong candidate for this project. The CC3220x is part of the SimpleLink Wi-Fi family, which includes robust support for cloud connectivity, secure communication, and low power consumption, all of which are essential for a smart thermostat. The detailed specifications and capabilities of this architecture are documented in the TI SimpleLink CC3220x Wi-Fi® and Internet of Things (IoT) Solution, as outlined in the TI Reference Guide (Texas Instruments, 2023).

Additionally, two other architectures were considered: Microchip and Freescale. Microchip’s Wi-Fi solutions, such as the ATWINC1500 module, offer reliable connectivity and are commonly used in embedded systems requiring cloud connectivity. The ATWINC1500 is compatible with various microcontrollers, including those from Microchip, and supports secure Wi-Fi connections with TLS and WPA2. However, it would require additional hardware integration compared to TI’s CC3220x.

Freescale offers the KW41Z family, which includes Bluetooth and IEEE 802.15.4 radios but not native Wi-Fi. While Freescale does offer other solutions with Wi-Fi capabilities, such as the i.MX series, they are generally more complex and might be overkill for a simple thermostat application. The additional complexity and power requirements of Freescale’s solutions make them less attractive for this specific project.

*A diagram of a machine diagram

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**Flash and RAM Support**

When selecting a hardware architecture, it is crucial to ensure that the microcontroller has adequate Flash and RAM to support the thermostat's code. The Texas Instruments CC3220x microcontroller offers up to 256KB of RAM and 1MB of Flash memory, which is more than sufficient to handle the thermostat's functionality, including peripheral control, cloud connectivity, and data processing.

Microchip’s microcontrollers, like the PIC32 series, provide up to 512KB of RAM and 2MB of Flash, which also makes them a viable option for this application. However, this would involve more complex integration, as mentioned earlier.

Freescale’s i.MX RT1050, with 512KB of RAM and 4MB of Flash, offers the most significant memory resources. Still, this would also involve using a more powerful processor than necessary for a thermostat, leading to increased power consumption and potentially higher costs.

**Conclusion**

Based on the requirements of this smart thermostat project, the Texas Instruments CC3220x architecture is the most suitable option. It natively supports all the necessary peripherals, provides built-in Wi-Fi for cloud connectivity, and offers adequate Flash and RAM for the thermostat’s code. While Microchip and Freescale provide robust solutions, they require additional hardware and may involve unnecessary complexity for this particular application. Therefore, the TI CC3220x LaunchPad is recommended as the optimal choice for developing a smart thermostat.

**References**

Texas Instruments. (2023). *SimpleLink™ Wi-Fi® CC3220SF-LAUNCHXL LaunchPad™ development kit User's Guide*. Retrieved from <https://www.ti.com/lit/ug/swru465/swru465.pdf>