CS 350 Final Project Report

In order to be fully functional, the thermostat needs to support the following peripherals: an I2C temperature sensor, at least one GPIO LED output, at least two GPIO buttons, and UART data simulation. Other business requirements that must be met include Wi-Fi compatibility for connection to the cloud, and adequate Flash and RAM for supporting the code.

Texas Instruments has several solutions for smart thermostats through SimpleLink. In particular, the CC3220SF LaunchPad includes many of the required features. Very similar to CC3220S used for development of the thermostat code, TI’s CC3220SF includes all the required peripherals including I2C, GPIO, and UART peripherals, which will enable interactions with the temperature sensor, LED lights, and buttons on the board. It also has a Wi-Fi network processor (NWP) subsystem, which greatly simplifies wireless internet connection and therefore cloud connectivity. Additionally, the CC3220SF goes beyond the CC3220S in computing power with 1MB of Flash and 256KB of RAM (Texas Instruments, 2021) (Texas Instruments, 2020).

Microchip technology also offers solutions suitable for a smart thermostat applications. One example is the PIC24FJ256DA210, which is a microcontroller recommended specifically for a thermostat application on the Microchip website. It has 96 Kb of RAM and 256 KB of flash program memory available, which is significantly less than that available in TI’s CC3220SF. As far as peripherals, the PIC24FJ256DA210 has three I2C modules and four UART modules, but I could not find information about GPIO modules specifically (Microchip, 2010). Unlike CS3220SF, this microcontroller does not have a temperature sensor or Wi-Fi compatibility built in. Instead, additional hard ware needs to used, such as the MCP9808 temperature sensor and the MRF24WB0MA Wi-Fi module (Microchip, n.d.). This a la carte-style construction can add flexibility in features, but also complexity when it comes to configuration and system maintenance.

Freescale (NXP) also has microcontrollers that can be considered for this solution. For example, the MC9S08LL16 microcontroller is one recommended by Freescale for thermostat applications. For peripherals, it has GPIO, but I couldn’t find any information to suggest it has I2C or UART peripherals (Freescale Semiconductor, 2009). It has a built-in temperature sensor with 0.1 degC precision, as well as buttons and LEDs. One thing this controller has that CC3220SF lacks is a built-in display specifically designed for thermostat functions, including temperature and time displays (Freescale Semiconductor, Inc., 2009). As far as memory goes, this solution has the least of the three options with 2080 bytes of RAM and 16384 bytes of flash (Freescale Semiconductor, 2009). Similar to the Microchip microcontroller, this solution also would require additional components for Wi-Fi connectivity.

While I was unable to evaluate every microcontroller solution from each of these three companies, TI, Microchip, and Freescale, I was able to thoroughly evaluate the microcontrollers that were the most highly recommended for a thermostat application from each company. For SysTec, I can only recommend going with a TI microcontroller, specifically CC3220SF. This microcontroller has the most RAM, Flash, and built-in features and peripherals for this product without needing any additional add-ons to meet business requirements.

# References

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