**7-1 Project Submission**

Mark Meyer

Prof. Bryant Moscon

CS-350-T4529

April 17, 2022

**7-1 Project Submission**

The microcontroller used for this thermostat prototype is the Ti LaunchPad kit with SimpleLink Wi-Fi MCU featuring the SimpleLink CC3220SF MCU. This single-chip microcontroller was created for the Internet of Things (IoT) and boasts a 32-bit ARM Cortex-M4 processor core with a 3-stage pipeline Harvard architecture (Texas Instruments, 2017). According to the Code Composer Studio Resource Explorer documentation in the SimpleLink CC32xx Software Development Kit (SDK) (4.30.00.06), the CC3220SF variant uses “Single-Band 2.4 GHz Wi-Fi, MCU with 1 MB user-dedicated flash, 256KB of RAM, IoT networking security, device identity/keys as well as MCU level security such as file system encryption, user IP (MCU image) encryption, secure boot, and debug” (Texas Instruments, 2020). Additionally, this board also supports the GPIO peripheral necessary for interfacing with button presses, and the I2C peripheral which interfaces with the temperature sensor and allows the temperature to be read, and the UART peripheral that allows for the information to be transmitted to the server (Texas Instruments, 2017).

In comparison to other manufacturers, the CC3220SF meets and exceeds the requirements for supporting all peripherals (I2C, GPIO, UART) as well as the support needed for Wi-Fi, Flash, and RAM. To drive this point, let us take a look at Microchip Technology Inc.’s PIC18F87J90 LCD-drive microcontroller and Freescale Semiconductor’s MPC8569E 45-nm Communications’ processor. We will abbreviate them as PIC and MPC respectively. The PIC is an 8-bit MCU with a mere 64-128 KB Flash and 4 KB RAM. Impressively, this tiny MCU includes a real-time clock and calendar (RTCC) and charge time measurement unit (CTMU) that allows for being very precise and being sensitive to the touch (DesignNews, 2017). According to Microchip’s documentation, this board supports a serial peripheral interface (SPI) as well as I2C which means the board can be utilized for high speed and low power applications as well as communication with several peripherals of any master-slave mode respectively (2010). The problems I see with this board would be the lack of UART support, lack of GPIO support, and the possibility of not having enough Flash or RAM.

Freescale’s MPC appears be a little closer to the requirements with the support of GPIO signals, dual I2C support, dual UART support, Wi-Fi support, a programmable interrupt controller, 16 GB of main memory, a temperature diode to support temperature monitoring devices, as well as various security features such as DDR2/DDR3 SDRAM with full ECC support, parity checking, cryptographic execution units, and battery-backed main memory. While Freescale’s board is more than enough to run the prototype; however, finding one of these boards available for purchase is another story. In fact, due to the recent pandemic, many chips and processors are out of stock.

For example, Freescale’s LPC4076FBD144 is even more suitable for this job with 512 KB Flash, 96 KB of SRAM, 4032 bytes of EEPROM, SPI support, five UARTs 3 I2C interfaces, 4 general purpose timers, a battery supply, up to 165 GPIO pins, an ARM Cortex-M4 processor core with a 3-stage pipeline Harvard architecture, and Ethernet support at a price point of under $7.00 per unit. Unfortunately, the manufacturer has a current lead time of at least 52 weeks. With that said, it appears we should stick with the Ti SimpleLink CC3220SF in moving forward with the thermostat prototype.

**References**

Alldatasheet.com. (2012, February). Freescale SemiconductorData Sheet: Technical Data. ALLDATASHEET.COM - Electronic Parts Datasheet Search. <https://pdf1.alldatasheet.com/datasheet-pdf/view/458365/FREESCALE/MPC8569E.html>

DesignNews. (2017, May 22). Freescale, microchip, TI roll out Microcontrollers. designnews.com. Retrieved April 17, 2022, from <https://www.designnews.com/freescale-microchip-ti-roll-out-microcontrollers-0>

Microchip. (2010). Microchip PIC18F87J90 Family Data Sheet. Retrieved April 17, 2022, from <https://ww1.microchip.com/downloads/en/devicedoc/39933d.pdf>

Texas Instruments. (2017, February). CC3220 SimpleLink™ Wi-Fi® and Internet of Things Technical Reference Manual. Analog | Embedded processing | Semiconductor company | TI.com. Retrieved April 17, 2022, from <https://www.ti.com/lit/ug/swru465/swru465.pdf?ts=1650219885142&ref_url=https%253A%252F%252Fwww.ti.com%252Ftool%252FSIMPLELINK-CC32XX-SDK>

Texas Instruments. (2020, October). SimpleLink™ Wi-Fi® CC3x20, CC3x3x Network Processor. Analog | Embedded processing | Semiconductor company | TI.com. Retrieved April 17, 2022, from <https://www.ti.com/lit/ug/swru455m/swru455m.pdf?ts=1650219279744&ref_url=https%253A%252F%252Fwww.ti.com%252Ftool%252FSIMPLELINK-CC32XX-SDK>