Hunter Richards

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CS-350

Final Project Report

The initial phase of the project involves creating a low-level functional prototype using a Texas Instruments (TI) development board. This prototype incorporates a TMP006 sensor for ambient temperature detection through I2C protocol, a key feature ensuring precise temperature readings crucial for maintaining optimal indoor conditions. To simulate thermostat activity, an LED is employed as a visual indicator, illuminating when heating is active, controlled directly via GPIO. Additionally, user interaction is facilitated through two buttons connected as GPIO interrupts, allowing manual adjustments to the desired temperature setpoints. These elements are critical as they form the basic user interface and control mechanism of the thermostat. The system’s state, including current and target temperatures and heater status, are relayed through UART, simulating data transmission to server-based applications, setting the groundwork for future integration with SysTec's analytics platforms.

The next phase involves the strategic selection of a hardware architecture that not only supports these peripherals but also introduces Wi-Fi connectivity for cloud integration. Three primary candidates—Texas Instruments, Microchip, and NXP Semiconductors—offer distinct advantages and limitations.

* **Texas Instruments**: The TI CC3200 SimpleLink™ Wi-Fi® MCU integrates a high-performance ARM Cortex-M4 core with built-in Wi-Fi functionality, suitable for internet-of-things applications. It provides robust support for I2C, UART, and GPIO interfaces and features sufficient memory with up to 256KB of RAM and 1MB of flash, meeting the needs for basic data handling and peripheral management ([Texas Instruments, 2015](https://www.ti.com/lit/ds/symlink/cc3200.pdf)).
* **Microchip**: The Microchip PIC32MZ W1 MCU features a high-performance MIPS M5150 processor and includes integrated Wi-Fi capabilities designed specifically for IoT applications. It supports essential peripherals like I2C, SPI, UART, and GPIO, and is equipped with 2MB of flash and 512KB of RAM. The PIC32MZ W1 is further enhanced with a hardware-based security accelerator, making it exceptionally capable in applications requiring high data throughput and advanced security features ([Microchip Technology Inc., n.d.](https://ww1.microchip.com/downloads/aemDocuments/documents/WSG/ProductDocuments/DataSheets/PIC32MZ-W1-and-WFI32E01-Family-Data-Sheet-DS70005425.pdf)).
* **NXP Semiconductors**: The NXP MKW41Z series is tailored for IoT applications, combining an ARM Cortex-M0+ core with Wi-Fi and Bluetooth capabilities. This series supports I2C, UART, and GPIO, and is characterized by its low power consumption and compact form factor, with 512KB of flash and 128KB of RAM, which provides a balanced solution for connected devices ([NXP Semiconductors, 2018](https://www.nxp.com/docs/en/data-sheet/MKW41Z512.pdf)).

In terms of connecting the thermostat to the cloud, all three platforms are capable of supporting IoT communication protocols such as MQTT and LwM2M over their Wi-Fi interfaces, which are crucial for seamless integration with SysTec servers. Each manufacturer offers comprehensive development tools and software libraries that facilitate secure and reliable cloud connectivity, an essential attribute for deploying updates and managing data remotely.

Given its advanced processing capabilities, ample memory, and integrated Wi-Fi that simplifies the design by eliminating the need for additional communication modules, Microchip’s PIC32MZ W1 emerges as the strongest candidate. It not only meets but also exceeds the requirements for supporting sophisticated smart thermostat functionalities and future expansions. However, the final selection would involve empirical testing to validate performance metrics and ensure compatibility with SysTec's development environment.

References

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