CS 350 Project Report

The goal of the project was to create a thermostat that supported three peripherals, including I2C, GPIO, and UART. I2C (Inter-Integrated Circuit) allows multiple circuits to communicate with one, or multiple, controllers. GPIO (General Purpose Input/Output) manages incoming and outgoing signals. UART (Universal Asynchronous Receiver-Transmitter) is a device-to-device communication protocol, which transmits and receives serial data bit by bit. This protocol involves a single line or wire. Also, the thermostat should connect to the cloud via Wi-Fi, and the used architecture should have enough Flash and RAM to support the coded project. Comparing boards from various manufacturers, such as TI, Microchip, and Freescale, can help further development of the thermostat.

Experience from using the TI microcontroller shows that it supports the use of all three peripherals. With I2C, the microcontroller communicates with the temperature sensor to read the temperature. With a thermostat that uses an LED to represent heat on/off, GPIO can control the specific LED on the microcontroller and output the LED as either on or off, while taking input via GPIO interrupts to increase or decrease the temperature. The CC3220 microcontroller from TI also supports UART, which is used to simulate data being sent to the server. Also, this microcontroller is Wi-Fi enabled, comes with 256kb of RAM, and can directly connect to a PC to use development tools such as Code Composer Studio Cloud IDE.

Microchip Technology provides embedded solutions, such as microcontrollers and other products, which can be used for things such as connectivity, timing, memory, power, etc. While they have a vast number of microprocessors, at least one board, the PIC32 WFI32E Curiosity Board, supports all the requirements. There are similar boards on the microchip website, but some do NOT support Wi-Fi, so care must be taken while selecting a board. The PIC32 Curiosity Board includes on-board LEDs, configurable buttons, a temperature sensor, and supports I2C, GPIO, and UART. This includes two buttons, a user-configurable switch, and a reset switch. This may not be fully ideal for a thermostat since it should have two buttons for raising and lowering the thermostat temperature. This microcontroller supports Wi-Fi with a single band (2.4GHz) module mounted on the board. There is also 32mb of external SPI Flash memory, but unfortunately, I cannot find an accurate amount of memory (this specific board does not have any statistics for memory on the data sheets, but the web page it is on has similar boards with 320kb RAM.

In 2006, the company Freescale was purchased by an investor group, and merged into “NXP Semiconductors” in 2015. Searching the NXP website and trying Google searches for things like “NXP microcontroller with LED” (and replacing “LED” with “temperature sensor”), resulted in no definite matches for a microcontroller that supported all the peripherals. It appears many of the results on the website give a product guide of which parts to purchase to make a working microcontroller, but some did not support I2C, while others did not support other peripherals, or just did not contain LEDs, buttons, etc. One example is the MC9S08LL16 from Freescale, which I could only find a reference design on the NXP website. This seemed like a great option, but it does not appear to support Wi-Fi. They do have other microcontrollers with Wi-Fi, but many lack the peripheral system required for this thermostat.

The best options for further development of the thermostat are either TI or Microchip Technology. Both developers have microcontrollers that support all the peripherals required, support Wi-Fi for connectivity, and have enough Flash memory and RAM to support the coded work. The choice depends on the code developer, and since the code has been developed using a TI product, the simplest choice would be to continue development with the TI CC3220 board.

Citations

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