CS 350 Project

Jose Lara Hernandez

10/19/2024

**SysTec Smart Thermostat Project Report**

In developing the smart thermostat prototype for SysTec, the goal was to create a system capable of reading room temperature using the TMP006 sensor via I2C, controlling heat output using an LED through GPIO, adjusting temperature setpoints using two buttons with GPIO interrupts, and simulating data transmission to a server using UART. The system successfully integrates the specified peripherals, ensuring that the thermostat responds to real-time temperature changes by toggling the LED to represent heat being turned on or off. Button presses to adjust the setpoint are captured using interrupts, and the system displays the current temperature, setpoint, and heat status over UART, simulating data transfer to SysTec’s server.

The task scheduler, driven by a hardware timer, was implemented to handle various tasks on different time intervals to ensure proper multitasking. Every 200ms, the system checks for button presses, enabling users to increase or decrease the setpoint with minimal delay. Every 500ms, the temperature is read from the sensor, and based on the result, the LED is updated to indicate whether the heat is on (LED on) or off (LED off). These timed checks ensure smooth, responsive interactions and reliable temperature monitoring without overwhelming the system.

Additionally, the system outputs data to the UART every second, simulating communication with SysTec’s server. The periodic tasks were carefully designed to operate without overlap, maintaining efficient operation and preventing any task interference.

For the next phase of the project, connecting the thermostat to the cloud via Wi-Fi requires a detailed analysis of different hardware architectures. Three architectures—TI (Texas Instruments), Microchip, and Freescale—were compared based on their support for peripherals, cloud connectivity, and memory capacity. The TI CC3220x series, used in this prototype, offers native support for Wi-Fi and has sufficient Flash and RAM for cloud-enabled thermostat applications. Microchip’s solutions, like the ATSAMW25, provide robust Wi-Fi integration with secure cloud capabilities but may require additional considerations for peripheral support. Freescale (now NXP) offers the Kinetis KW41Z, which integrates both Wi-Fi and Bluetooth, making it ideal for IoT applications. The decision on which architecture to select should balance the need for cloud connectivity, performance, and cost-efficiency while ensuring sufficient Flash and RAM to support future updates.

In conclusion, the current prototype demonstrates the low-level functionality of the thermostat, and the next phase focuses on enabling cloud connectivity to leverage SysTec’s server infrastructure for remote control and analytics. A cloud-based Internet of Things (IoT) solution, as demonstrated in studies such as Fox, Kamburugamuve, and Hartman (2012), highlights the significance of cloud architectures in managing sensor-centric applications, like smart thermostats. The integration of cloud computing will allow SysTec to process large-scale data efficiently while providing real-time control and monitoring of the thermostat remotely.

***References***

Fox, G. C., Kamburugamuve, S., & Hartman, R. D. (2012). Architecture and measured characteristics of a cloud based internet of things. *2012 International Conference on Collaboration Technologies and Systems (CTS)*, 6-12. <https://doi.org/10.1109/CTS.2012.6261020>