Theme Report 1: Observe

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Theme

The first theme in the course revolves around the theme of observing. In the context of intelligent systems, observation is the process of acquiring, processing, and acting on data to make informed decisions. Intelligent systems rely on sensory input from analog and digital signals to perform several functions. This theme is important in this course where our microcontroller interacts with the physical world through various types of inputs.

Background

Observation in intelligent systems involves detecting changes through either digital or analog signals. These signals provide the date with which the system can operate.

In Lab 1, digital signals were explored through GPIO manipulation. Using switches, we were able to control LEDs. This showcased how a microcontroller can use digital input to perform binary operations. In Lab 2, a finite state machine (FSM) was created to manage digital input sequences -in our case it was lock system. This showcased another way with which intelligent systems can interact with digital input and use it for decision making. In Lab 3, analog signals and their processing was explored. Analog signals are all around us, and as such it is important to understand how an intelligent system can interpret them and use them as part of its input. As such, ADC conversion was a focus.

Theme Exemplars

Exemplar 1: Analog-to-Digital Conversion (Lab 3)

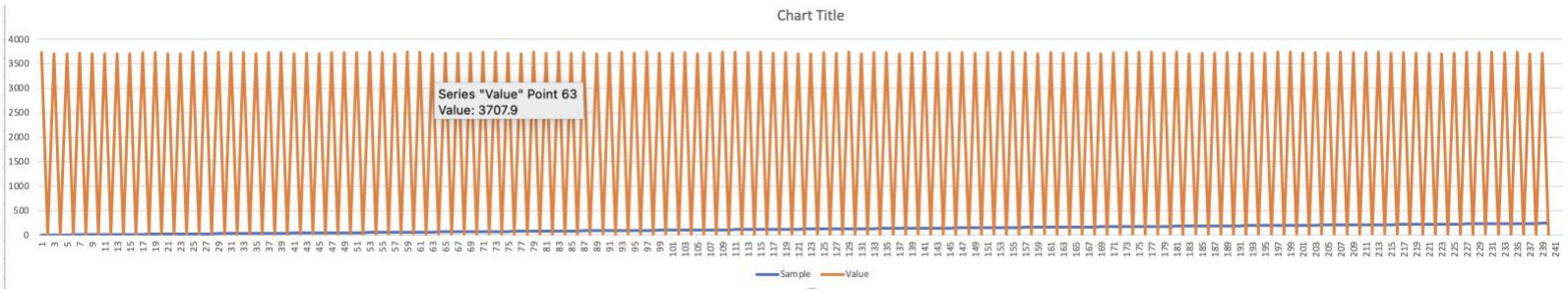
The ADC functionality of the microcontroller was tested by converting continuous analog voltage into digital values. This is important in enabling intelligent systems interpret real-world data.

Method:

- Configure the ADC peripheral of the microcontroller.
- Provide a known analog voltage wave using the AD3.
- Capture the digital output and plot it.

Validation:

- Milestone 2 produced the following graph:



- This was expected as sampling at only 480Hz is only enough to keep the frequency component of the wave but the shape or exact amplitude.

Debugging Exemplar

A debugging step that was performed during this round of laboratories was in Lab 2 when a FSM failed to transition correctly between states. The issue was traced to be an error with how the button was being de-bounced.

Debugging Method:

- Used an oscilloscope to monitor button press signals checking to see how long the bouncing state lasted.
- Observed that the delay that was in our code was not long enough to account for all the bouncing that occurred.
- Added a longer delay to account for bouncing.
- Verified the FSM state transitions using the uKeil MDK debugger.

Synthesis

The exemplar selected illustrates how observation is performed by intelligent systems. Lab 3 introduced important ADC techniques for handling real-world continuous data. This is important for the final project in the course as it will constantly be sampling real-world continuous data. This demonstrates and teaches how the microcontroller can observe the world around them. This capability is critical for applications such as sensor data acquisition.

Reflection

Through these labs, I have developed a deeper understanding of how embedded systems observed and process data. The practical experience of working throughout these labs has reinforced the theoretical concepts learned during the lectures. Observation is foundational to all intelligent systems; this enables data driven decision making. Effective signal acquisition and processing are important for designing responsive and reliable intelligent systems.