ECE 178 - Embedded Systems
Spring 2015 - Assignment 5

Interactive-eye-tracking-hand-synchronization embedded system

An embedded application program usually involves direct access to I/O devices to monitor and coordinate the operation of I/O peripherals for a range of embedded processing. The purpose this assignment is to develop a set of software device drivers for low-level access of the embedded PIO, JTAG-UART and the Timer peripheral IP cores to facilitate the implementation of a FPGA based *interactive eye-tracking-hand-synchronization* embedded system. All the IP cores are Avalon-MM interface. The interactive-eye-tracking-hand-synchronization embedded system consists of the following components:

1. FPGA based Nios II Processor
2. Two LEDs as the visual stimulus
3. Seven-segment LEDs to display information
4. PIO IP core
5. JTAG UART IP core
6. Timer IP core

Part I

Using the above IP cores, develop low-level embedded application routines to simulate the ability of the eyes and hands to function concurrently to perform a task. The interactive-eye-tracking-hand-synchronization embedded system has three push buttons which corresponds to the *clear*, *start*, and *stop* operations. It also uses two LEDs that flash on and off alternatively as a visual stimulus and seven-segment for displaying relevant operational information. The timer can be used to keep track of time, as well as to create time delays. By pressing the *clear* button, the interactive-eye-tracking-hand-synchronization embedded system should initially display "HELLO" with the flashing LEDs being in off state. To start the embedded system; the user pushes the *start* button to initiate the experiment and to turn off the seven-segment LED display.

After a random interval between 2 and 15 seconds, the stimulus LEDs will flashes on and off alternatively and the timer will starts to count. The timer increases every millisecond and its value is displayed in the format of "0000" millisecond on the seven-segment LED display. After the stimulus LED flashes, the user should try to push the *stop* button as soon as possible. The timer pauses counting once the *stop* button is asserted and the seven-segment LED shows the response time. If the *stop* button is not pushed, the timer stops after 1 second and displays "OUT." If the *stop* button is pushed before the stimulus LED goes on, the embedded system displays "OOPS" on the seven-segment LED and the system should start over.

Part II

In the second part of the experiment use the host's keyboard via JTAG UART IP core to replace the pushbuttons switches for the interactive-eye-tracking-hand-synchronization embedded system. The key input is used as follows:

- C key: used as the *clear* signal.
- S key: used as the *start* signal.
- P key: used as the *stop* signal.
- All other key activities will be ignored.