

## Computer Systems Engineering Technology CST 345 – HW/SW Co-Design

Lab 04 – Keypad Controller  
Winter 2015  
Instructor: Troy Scevers  
Possible Points: 20

Name \_\_\_\_\_  
Due Date: Monday, February 9<sup>th</sup> @ 5 pm

### Objectives:

- To learn the steps required to construct an interrupt driven keypad controller for the PicoBlaze micro-controller in the Xilinx ISE environment
- To write an assembly language program to implement interrupt driven input/output required to get data from the keypad and write it to the multiplexed display IP you designed in Lab 1
- To use the PicoBlaze assembler to assemble your source code and test the results in hardware (Nexys3 board)

### Keyboard Controller Lab Overview:

In this lab, you will be reading input from a keypad and display the corresponding button pressed onto a seven segment display. You will be required to write a Verilog program which will determine which key has been pressed on the key pad. This will interrupt the Picoblaze processor and we will use software to input and format the data that will then display the corresponding character on the multiplexed seven segment display IP from lab 1.

Each BCD character (0-F) will be displayed in the least significant digit and shifted over (in software) when a new key is entered. You will use one of the push buttons as a “CLEAR” key which will cause the display to clear.

Keypads are often used as a primary input device for embedded systems. The keypads actually consist of a number of switches, connected in a row/column arrangement as shown. Please see the user manual and schematic for the PMOD keypad we will be using for this lab on the blackboard site.



## **PicoBlaze Programming Overview:**

Write a PicoBlaze assembly language program that will:

- Work like a Calculator Keyboard Display - allowing it to hold 4 digits.
- Write to the Multiplexed display unless an interrupt from the keypad has occurred.
- When an Interrupt occurs go into an interrupt handling routine that reads a register from the keypad IP that you designed.
- Formats the information so that it is in the proper position on the display.
- Outputs the formatted data to the Multiplexed display.

## **Deliverables:**

1. Demonstrate your working circuit to the lab instructor.
2. Provide the Verilog (or VHDL) code , RTL, and Simulation for your design.
3. Provide a listing of your assembly source code with your lab write up. Make sure you take a look at the PicoBlaze assembly language style file before you submit your source code.
4. A formal lab write up is required for this lab. This will include a cover page, high level lab overview, high level block diagrams of the hardware, documentation of software (flowchart, pseudocode, etc.), results of hardware and software simulation, Design of HW/SW interfaces and conclusions.
5. Zip up all of these materials and upload to blackboard.