CS152B Lab 3 – Microblaze System Setup + Serial Communication

Required Equipment

FPGA Board	FPGA Power Supply	Micro USB Cable	USB-to-Serial cable	Serial Adapter Cable

Part 0 – Reading Assignment (No Demo Required)

Please read the following documents carefully to understand FPGA operation, reconfigurable logic, and soft-processor based design. Beyond preparing you for the exam, I hope you find this document interesting. It explains *why* FPGAs are used, why we put processors on them (ie. Microblaze), and how various features are implemented.

Several exam questions are directly from these documents: especially Study Guide 1. Please let me know if you have any questions: you can download these files from CCLCE.

"StudyGuide1.pdf":
Section 1, 2, 3.1.2, Section 4.3, Section 5.3

"StudyGuide2.pdf":
Read the entire document, except section 11.3.

Part 1 - Microblaze "Hello World" (No Demo Required)

Though this lab is simple, it is important to learn these concepts for your final project. Throughout this quarter, we have synthesized various digital designs onto the FPGA board. In this lab, we will synthesize a processor (called "a MicroBlaze") onto the FPGA, which will allow us to execute C code on our Virtex5 boards. This will dramatically improve development time while still retaining some of the advantages of an FPGA.

To begin, please follow the following tutorial to setup your MicroBlaze platform and execute a simple "Hello World" application. We will work together to debug any software compatibility issues.

-See the PDF tutorial "EDK Tutorial – Working.pdf"

> **Board Selection:** Digilent Genesys System Board
> **System Selection**: PLB System (NOT AXI)
> If you cannot locate this board in the drop-down list, you must download the Xilinx BSB Design folder. Refer to the "EDK Tutorial – Working" PDF for specific instructions on system setup made by another student in our class with our exact hardware platform.
>
> **Debugging: Connect Virtex5 to PC Terminal:**
> Connect the serial cable to the serial port of the FPGA board. The other end of the cable should be connected to the computer via USB. You will need to use a Serial/USB cable and a Serial/Serial adapter cable for this.
>
> ****For this lab, please connect your FPGA to the PC using the Xilinx port, rather than the Digilent port. ****

-Once you are ready to program the device, please consult this tutorial on the Xilinx SDK environment:

Xilinx SDK Application Development
http://www.fpgadeveloper.com/2014/02/create-an-application-using-the-sdk.html

You are also encouraged to refer to this manual if you have some questions:
http://www.xilinx.com/support/documentation/sw_manuals/xilinx14_6/edk_ctt.pdf

The baud rate should be 9800. You may have to go to Project / Run Configurations / STDIO to set this up. Select the appropriate COM port, which you can find through the device manager.

Part 2 – Serial Communication (Demo Required)

Now that you have a working MicroBlaze system, your goal is to send and receive strings of any reasonable length between the MicroBlaze CPU and a PC terminal via an RS232 serial connection. The Xilinx EDK software has a built-in serial terminal you can use. Alternatively, you can use other programs such as HyperTerminal. This will require that you connect your FPGA board to your PC using a USB-to serial cable, and a serial adapter cable.

Data is transmitted to/from the FPGA using STDOUT and STDIN function calls in the C-language. Below shows one approach:

```
int main()
{
       print("Please enter a number. \n\r");
       scanf("%d", &a);
       getchar();

     if (a == 1)
     {
          print("Hello World!\n");
     }
}
```

Part 2.a :

For this lab, please create a system using the Microblaze platform that receives two numbers via serial, delimited by a character of your choice. The FPGA then multiplies these numbers together, and transmits the product back to the PC via serial.

Example input: 8/6
Example output: 48

If the product of these two numbers exceeds 100, an LED should be lit on your FPGA board.

Part 2.b :

Create a simple rock-paper-scissors game in which first player is playing with PC terminal and second player is using Digilent Keypad connected to the FPGA. Each player will enter a number on their keyboard/keypad that represents one of the three possible inputs. After they both entered their values, FPGA decides who is the winner and prints a proper message on terminal and the next round begins.

Example input (PC terminal): 1 (as rock)
Example input (Keypad): 2 (as paper)
Example output: "FPGA won! paper > rock"

You can refer to this link for information about Digilent Keypad.

Please demo the functionality of your system when you have completed this.

****If you would like an example of how to access the GPIO pins, create a new "Application Project" from your Eclipse Xilinx SDK environment, selecting the "peripheral" project template.****

****Do not use the printf function: use print instead!****

Report Requirements

Please submit a brief written report based on the specifications outlined in the course syllabus. Please include any simulation results, relevant Verilog/VHDL code snippets, and C code.