ECE3623 Embedded System Design Laboratory

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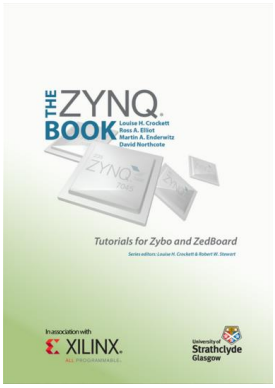
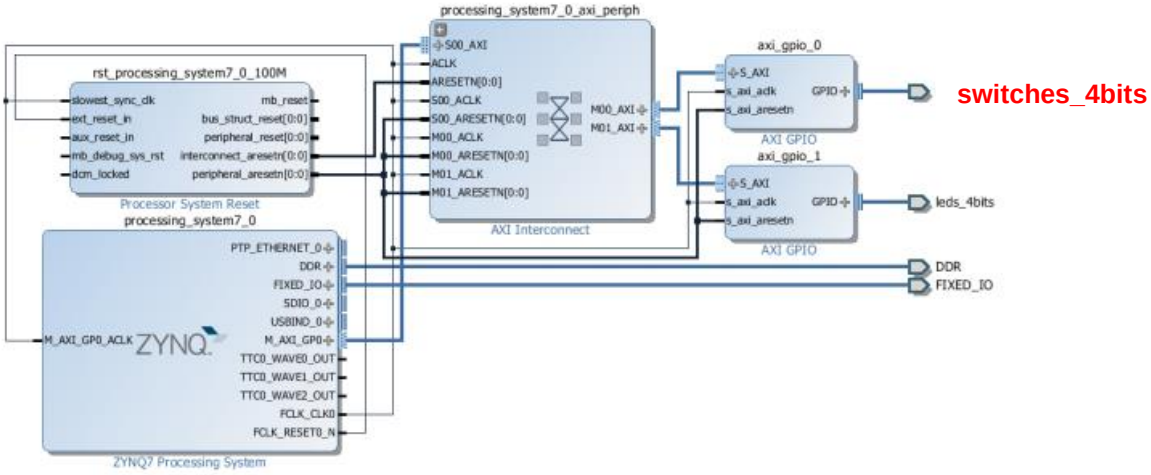
Vivado SDK Basic IP Integrator

In this Laboratory you will be introduced to the embedded development of a Vivado Zynq Processor System (PS) with a basic IP integrator on the Zybo Board. The initial task and references are the eText *The Zynq Book Tutorials* with the supporting files in the *The Zynq Book Tutorials Sources,* both of which are posted on *Canvas*, and the Lecture PowerPoints.



This Laboratory requires you to generate Vivado hardware and modify the SDK software for a new process. Exercises 1A, 1B and 1C result in a project that uses the LEDs with a *single* GPIO interface. As a reference Exercise 2A and 2B add a *second* GPIO that inputs the push buttons but here you are to use the *slide switches*. Also, you are *not* to add *interrupts* as described in Exercise 2B.

A new project *initials_LED.SWITCHES.prj* with *two* GPIO interfaces is to be generated with the basic Vivado hardware design shown below, similar to that of Exercise 2B, and where *initials* are your initials for identification. It is suggested that you create a project folder for examples and labs on the root directory C:\



Once the Vivado hardware design is verified, SDK would import the template program *LED_test_tut_1C.c* which you are can modify and name as *LED_SWITCHES_initials.c* (where *initials* are your initials for identification) to

input the switches on the second GPIO interface and implement the task. The LED display delay remains the same. The LED output is not just a toogle. The modification includes integrating the new *#define* and setup now with the switches into your *LED_SWITCHES_initials.c* program*.* The typical sections are shown below:

```
#define BTNS_DEVICE_ID          XPAR_AXI_GPIO_0_DEVICE_ID
#define SW_DEVICE_ID            XPAR_AXI_GPIO_1_DEVICE_ID

  int status;
  //----------------------------------------------------


  // INITIALIZE THE PERIPHERALS & SET DIRECTIONS OF GPIO
  //----------------------------------------------------
  // Initialize LEDs
  status = XGpio_Initialize(&LEDInst, LEDS_DEVICE_ID);
  if (status != XST_SUCCESS) return XST_FAILURE;
  // Initialize slide switches
  status = XGpio_Initialize(&SWInst, SW_DEVICE_ID);
  if (status != XST_SUCCESS) return XST_FAILURE;
  // Set LEDs direction to outputs
  XGpio_SetDataDirection(&LEDInst, 1, 0x00);
  // Set slide switch direction to inputs
  XGpio_SetDataDirection(&SWInst, 1, 0xFF);
```

You are to reconfigure the new project file *LED_SWITCHES_initials.c* to perform as follows and demonstrate the result during the Lab recitation. The LED count is a new register which is then outputted to the LEDs through GPIO 1 for display.

1. The rightmost slide switch 0 (SW0) is the system RESET and when ON the LED count and display is set at 0 (0000) and when OFF the LED process set by the other slide switches is enabled. SW0 as a RESET overrides all other slide switch operations.

2. If slide switch 1 (SW1) is ON and no other slide switches are ON, all further LED count and operations are *suspended* (LED count is fixed)*.* When slide switch 1 is OFF the LED operations and display continue.

3. If slide switch 2 (SW2) is ON and no other slide switches are ON the LED count and display is set to 0 (0000) and proceeds as an increasing and decreasing, repeating *bar graph* with a delay (that is, 0000, 0001, 0011, 0111, 1111, 0111, 0011, 0001, 0000, 0001, 0011…).

4. If slide switch 3 (SW3) is ON and no other slide switches are ON the LED count and display is set to 1001 and then is a repeating *pattern* with a delay (that is, 1001, 0110, 1010, 0101, 1100, 0011, 1001, 0110, …).

5. If more than one slide switch is ON and an ERROR condition occurs and the LEDs alternately display 1001 and 0011 with a delay.

6. The LED delay is used to observe the LED pattern as in the template 1c program.

You are to *describe in detail* and *list the modifications* to the basic template program *LED_test_tut_1C.c* to accomplish this Laboratory task. Verify the performance of the Laboratory task and be prepared to demonstrate and describe the project and at some point during the semester to the Laboratory Assistant.

These completed Laboratories should be archived on your laptop and will form the basis of the Exams.

You are to use the *Project Report Format* posted on *Canvas*. The *Laboratory Procedures* document is the guideline for performance. You are to upload your *Report* to Canvas (but *not* the project) for time and date stamping to avoid a late penalty.

This Laboratory is for the week of January 20th and due no later than 11:59 PM Sunday January 26th.