TicTacToe

Introduction

This lab guides you through the process of building and running a Vivado/SDK on a Zybo z7-10 in which the system used input from the dip switches and push buttons to output a TicTacToe game through HDMI to an external monitor.

Objectives

After completing this lab, you will be able to:

- Clone GitHub Repositories
- Run TicTacToe Game with output to HDMI on your Zybo board

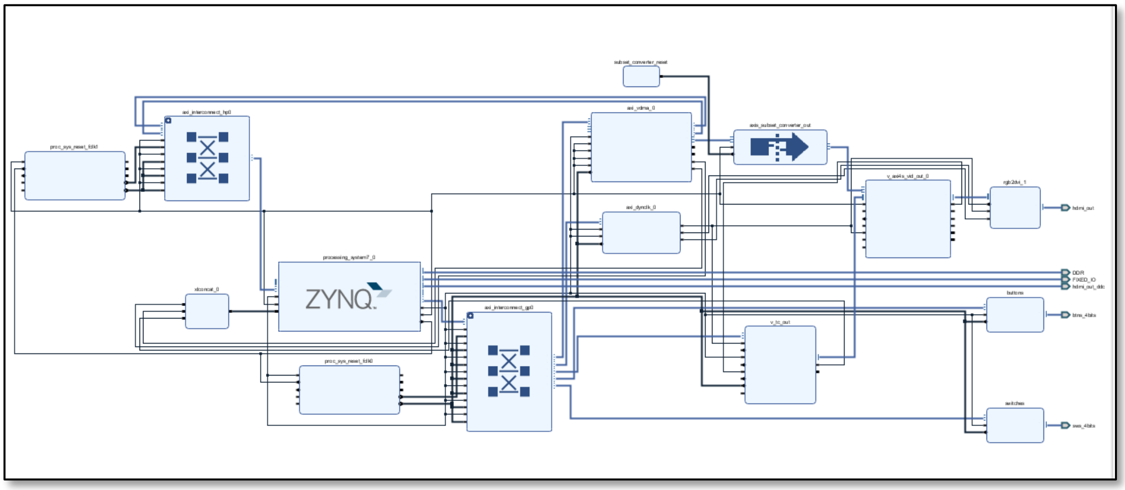
Procedure

This lab is separated into steps that consist of general overview statements that provide information on the detailed instructions that follow. Follow these detailed instructions to progress through the lab.

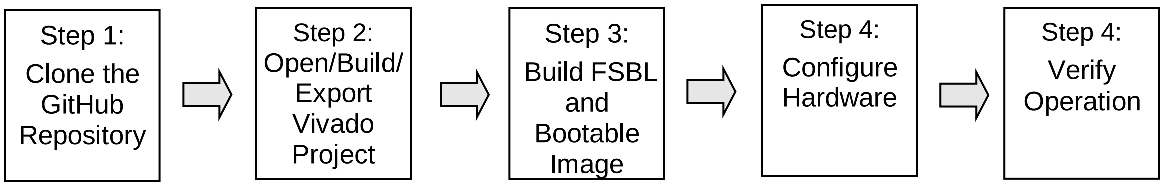
This lab comprises 5 primary steps: Clone the GitHub repository, Build and Export the Hardware Project, Build the FSBL and Bootable Image, Configure the Hardware, and then Verify the Functionality.

Design Description

This project is build from the Zybo HDMI example project and removes certain components, as well as adds GPIO instances for push buttons and dip switches.



General Flow for this Lab

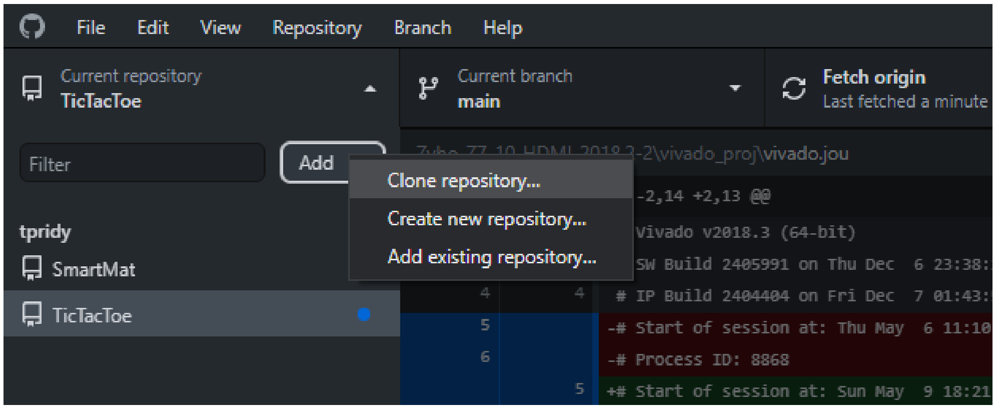

Step 1:
Clone the GitHub Repository
Step 2:
Open/Build/ Export Vivado Project
Step 3:
Build FSBL and Bootable Image
Step 4:
Configure Hardware
Step 4:
Verify Operation

Clone the GitHub Repository Step 1

1-1. Clone the repository from GitHub at link https://github.com/TPridy/TicTacToe

1-1-1. Download and install GitHub Desktop.

1-1-2. Click clone repository and enter the GitHub link.



```
Zybo-Z7-10-HDMI-2018.2-2\vivado_proj\vivado.jou
-2,14 +2,13 @@
Vivado v2018.3 (64-bit)
SW Build 2405991 on Thu Dec  6 23:38:
 # IP Build 2404404 on Fri Dec  7 01:43:
-# Start of session at: Thu May  6 11:10
-# Process ID: 8868
+# Start of session at: Sun May  9 18:21
```

Open/Build/Export Vivado Project Step 2

2-1. Open Vivado Project File at /”repo location”/TicTacToe/Zybo-Z7-10-HDMI-2018.2-2/vivado_proj/zybo-z7-10-hdmi.xpr

2-1-1. Navigate to above directory and open Vivado file

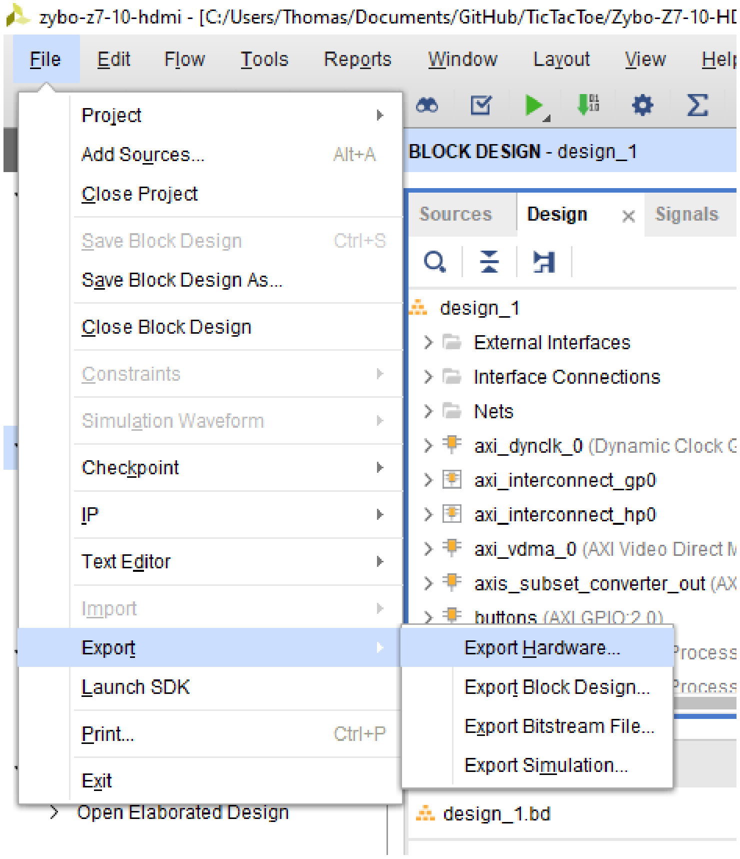
2-2. Generate Bitstream

2-2-1. Open Block Design and right click and click Validate Design to verify lack of errors.

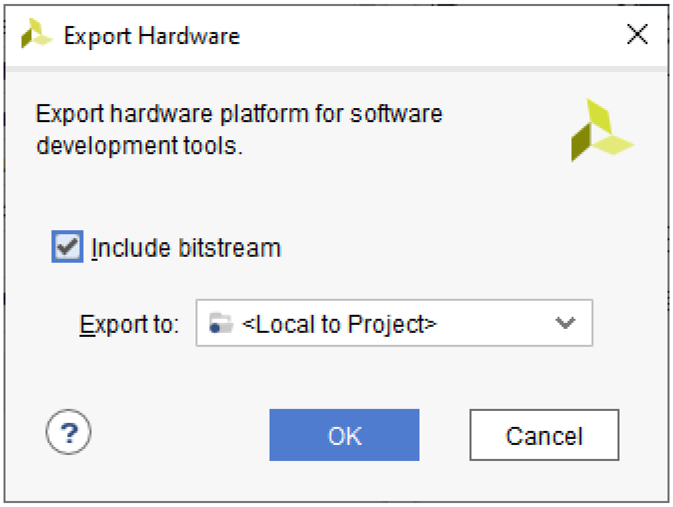
2-2-2. Once Validated, click on generate bitstream. This will run Synthesis and Implementation if they are out of date and will generate hardware for the SDK.

2-3. Export Hardware

2-3-1. Click on File > Export > Export Hardware...



2-3-2. Then click on “Include bitstream” check box to include the hardware design in SDK.



☑ Include bitstream

Export to: <Local to Project>

2-4. Launch SDK

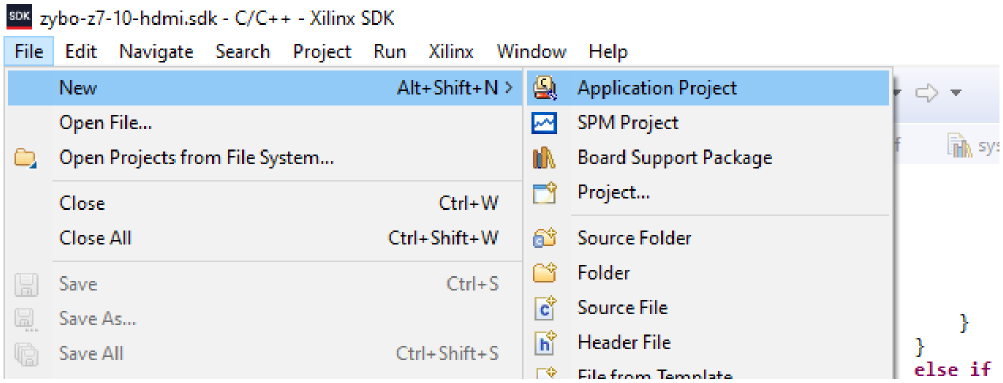
2-4-1. Click on File > Launch SDK to launch the SDK

Build FSBL and Bootable Image Step 3

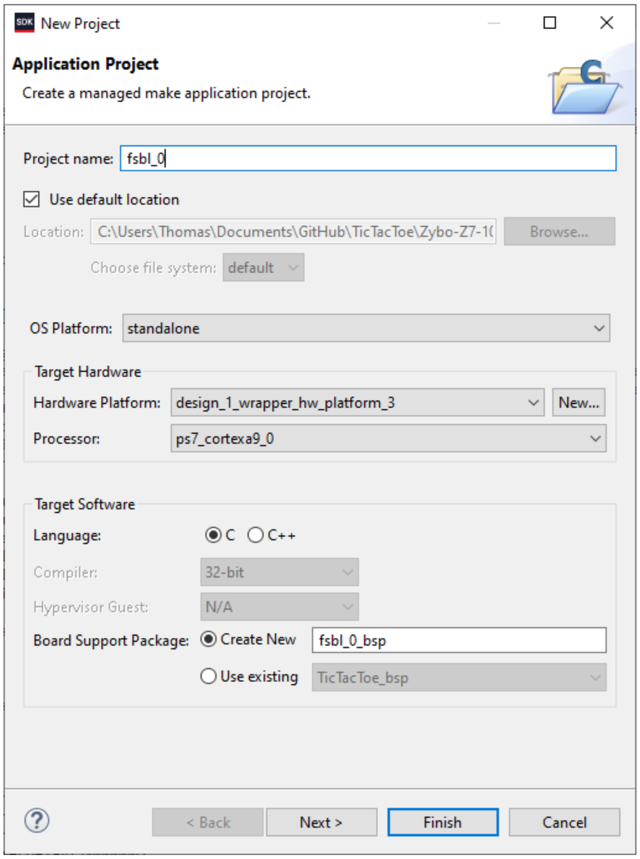
3-1. Build FSBL

3-1-1. You will see three projects in the SDK workplace, the software application project, the board support project, and the platform project.

3-1-2. Click on File > New > Application Project



3-1-3. Configure the Application Project as seen:



Project name: fsbl_0

☑ Use default location

Location: C:\Users\Thomas\Documents\GitHub\TicTacToe\Zybo-Z7-1(

Choose file system: default

OS Platform: standalone

Hardware Platform: design_1_wrapper_hw_platform_3

Processor: ps7_cortexa9_0

Language: ● C ○ C++

Compiler: 32-bit

Hypervisor Guest: N/A

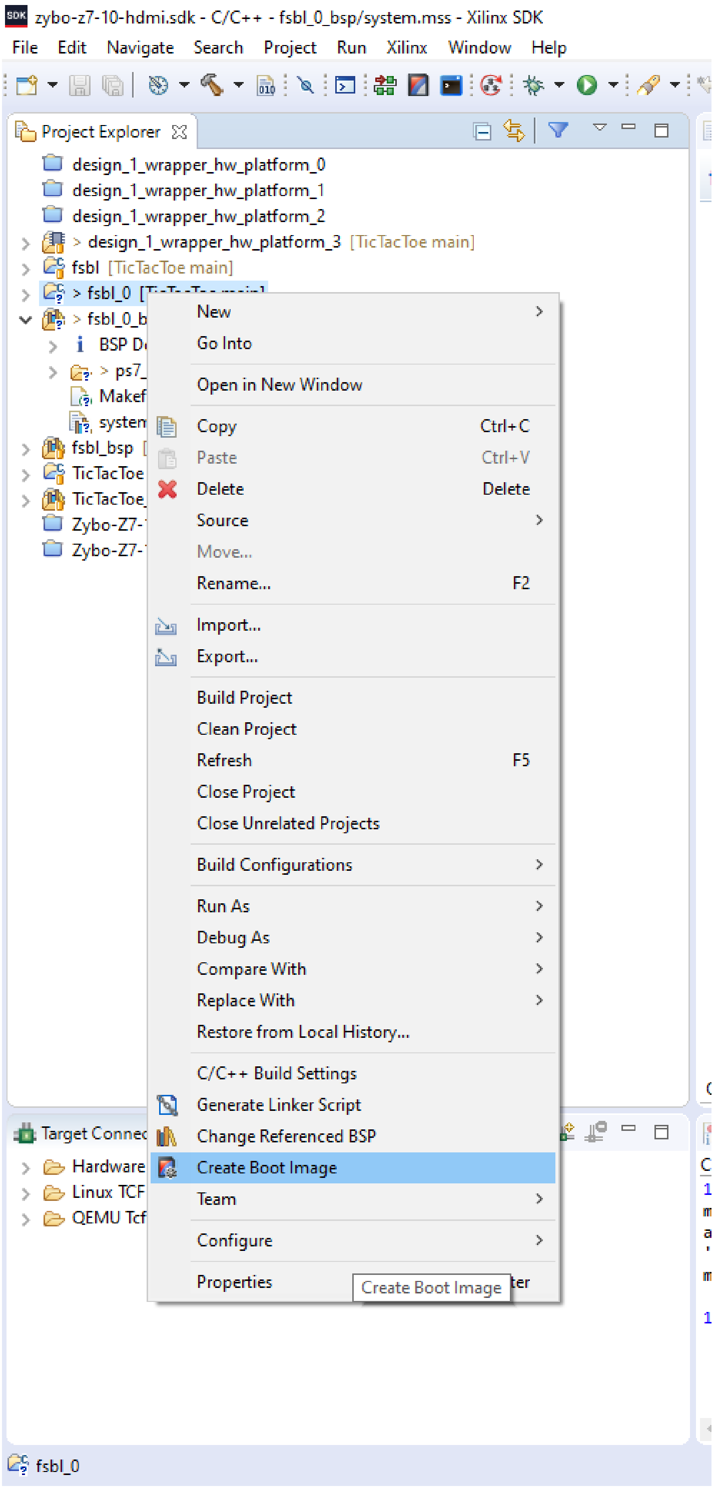
Board Support Package: ● Create New fsbl_0_bsp

○ Use existing TicTacToe_bsp

3-1-4. Select Zynq FSBL as Template then click Finish.

3-2. Build BOOT.BIN

3-2-1. Right click on application project and select Create Boot Image.



3-2-2. Add partition to the boot image and select the TicTacToe.elf which is the elf of the Tic Tac Toe software application project.

3-2-3. Click on Create Image

Configure Hardware Step 4

4-1. Load BOOT.BIN onto SD Card

4-1-1. Copy BOOT.BIN file in /fsbl_0/bootimage/BOOT.BIN onto SD Card.

4-1-2. Insert SD Card in Zybo board SD Card slot located on underside of board.

4-2. Setup HDMI

4-2-1. Plug HDMI cable from HDMI TX into HDMI port of monitor.

4-3. Set BOOT mode

4-3-1. Configure BOOT mode pins to boot from SD Card rather than JTAG or QSPI.

4-4. Connect UART

4-4-1. Plug microUSB cable from UART terminal to get instructions of game from the application project.

Verify Operation Step 5

5-1. Turn Power On

5-1-1. Flip power switch on Zybo board and application will automatically launch and a tic tac toe board will be displayed on the screen.

5-2. Open Serial Terminal

5-2-1. Once Launched, open serial terminal so that the instructions and output to the user can be shown. This will greatly assist the user on how to play the game and that state of the game at any point.

5-3. Verify Functionality

5-3-1. With serial terminal and instructions, the user can play tic tac toe against the computer to verify that both the hardware and software are working properly.

Conclusion

This lab manual should have shown you how to successfully build and run the hardware/software project of the Tic Tac Toe game through HDMI output. We used Vivado to build the hardware, SDK to build the bootimage image and aoftware, and finally a serial terminal and monitor to verify that the game runs properly.