

User Manual

Ping-Pong game

using mouse

CECS 561: Hardware Software Co design

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Table of Contents

Introduction.....	3
Objectives	3
Pre-required resources:	3
General Flow for this Lab	3
Step 1: Download and setup Xillinux Operating system's environment on the SD Card	4
➤ Generate and setup Xillinux binaries in the SD card	4
➤ ZyBo board Jumper setting.....	5
Step 2: Run Xillinux OS in the ZYBO board and setup environment for GUI based game development.....	6
➤ Hardware setup.....	6
➤ Download and install all the required libraries.....	6
Step 3: Compile and execute game source	7
➤ Copy game source code and execute it	7
Conclusion	7

Introduction

This lab guides you through the process of installing the Xilinx operating system on the Zybo board, install the libraries required for accessing the GUI and developing the ping pong game on top of it. Firstly, set up the Sd card and load it with the files required for running the operating system. Next run the Operating system and install the required libraries for developing the game. And lastly, develop the code for the game. These steps are given in detail in the sections below.

Objectives

After completing this lab, you will be able to:

- Install the xilinx operating system on the Zybo board
- Access the mouse, keyboard and HDMI components on the Zybo
- Access the ethernet
- Add the libraries to the operating system
- Develop the ping pong game

Pre-required resources:

A Zybo board

A 5V Power adaptor,

An SD card (8gb preferred)

A USB hub

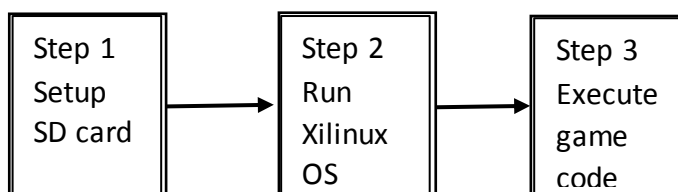
A mouse & keyboard set,

A VGA/HDMI cable,

A Monitor/ Screen,

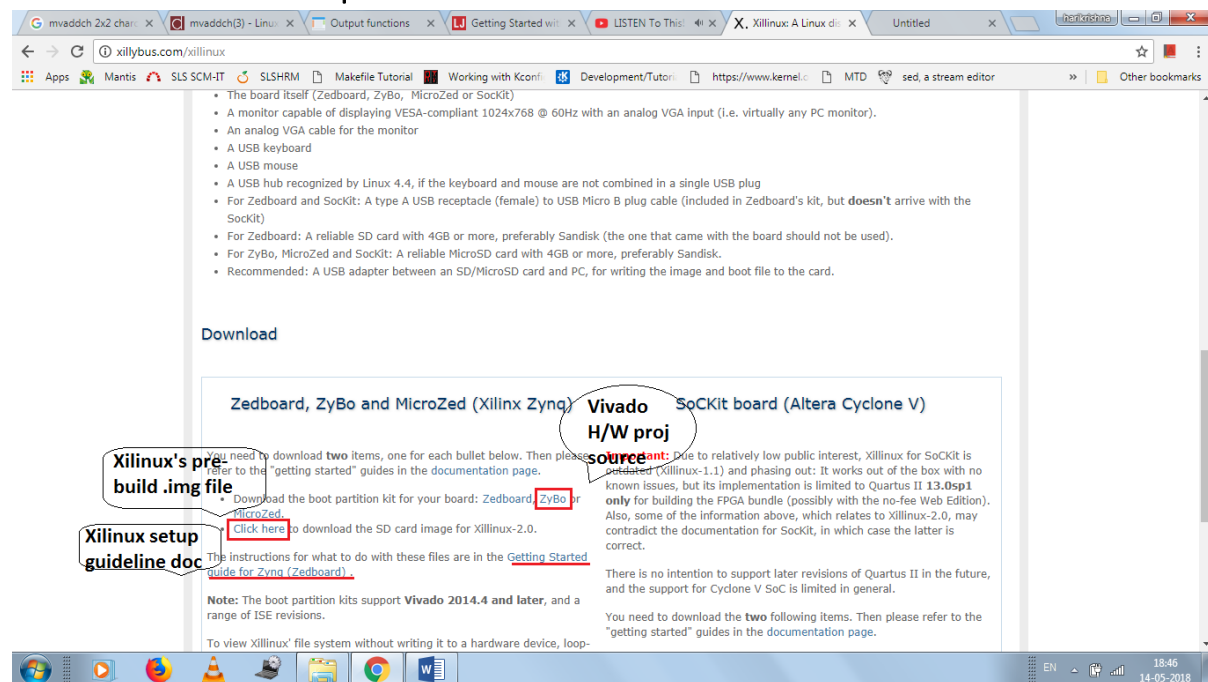
Ethernet cable

General Flow for this Lab



Step 1: Download and setup Xilinx Operating system's environment on the SD Card

➤ Generate and setup Xilinx binaries in the SD card



In this step, we are going to setup Xilinx operating system in the (Micro)SD card

First, download **two** files (distribution) from the xillybus.com, one for each bullet below.

- Download the boot partition kit for the **ZyBo** board
- Download the SD card image for Xilinx-2.0.

The instructions for what to do with these files are in the [Getting Started guide for Zynq \(ZyBo\)](#).

- Build Xilinx hardware image using vivado (Generate bitstream & boot partition image)
- Using [Win32 Disk Imager](#) load Xilinx binary image into the (Micro)SD card
- Copy boot.bin and devicetree.dtb from the boot partition kit's bootfiles/subdirectory, into the (Micro)SD card's boot partition (the first partition).
- Copy xillydemo.bit that (bitstream) was generated in Vivado project (from the verilog/ or vhdl/subdirectory, whichever was chosen).

Before attempting to boot, please verify that the boot partition is populated as follows. To boot, four files need to exist in the (micro)SD card's first partition (the boot partition):

- **ulmage** – The Linux kernel binary. This is the only file in the boot partition after writing the Xilinx (Micro)SD image to the card. The kernel is board independent.
- **boot.bin** – The initial bootloader. This file contains the initial processor initializations and the U-boot utility, and is significantly different from board to board.

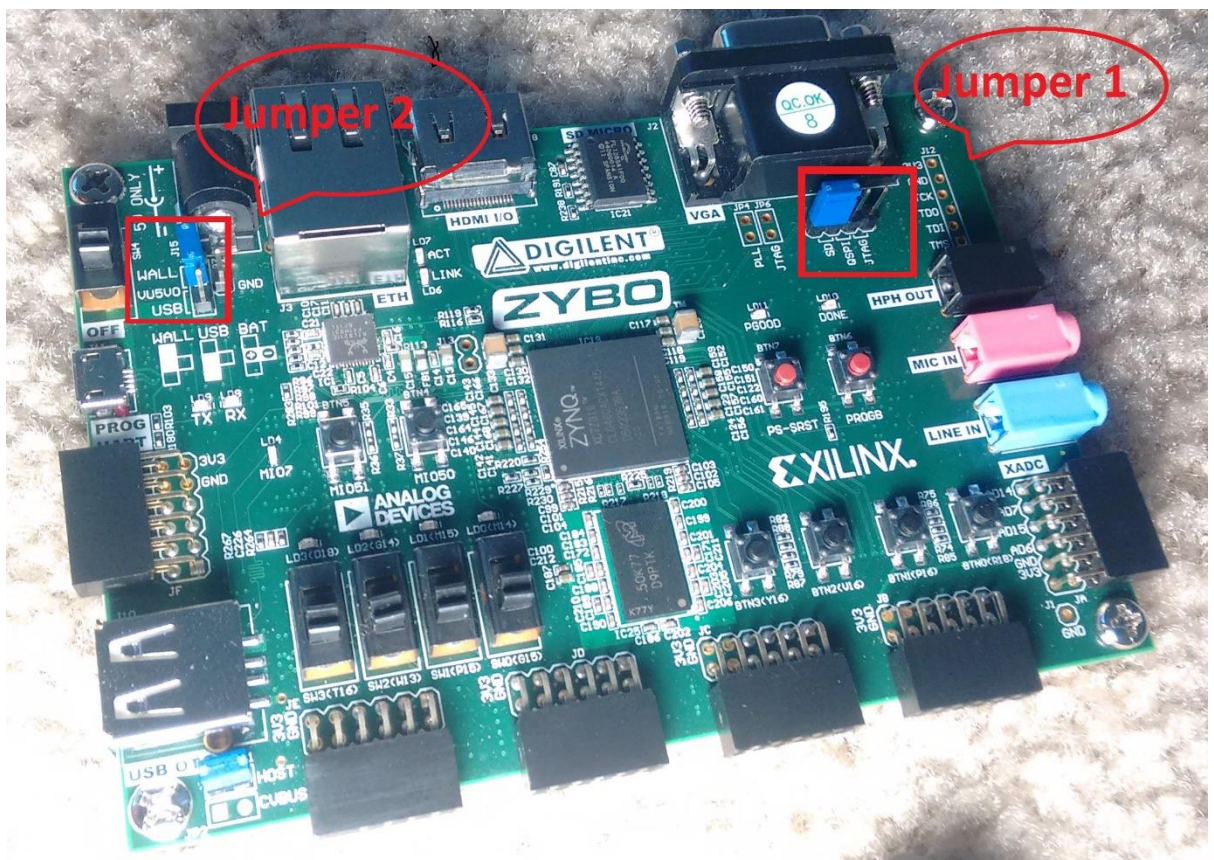
- **devicetree.dtb** – The Device Tree Blob file, which contains hardware information for the Linux kernel.
- **xillydemo.bit** – The PL (FPGA) programming file, which was generated in Vivado project

Note:

- The boot partition kits support **Vivado 2014.4 and later**, and a range of ISE revisions.
- For adding extra features or resolving other issues please refer [Xillybus documents](#) for the ZyBo board

➤ ZyBo board Jumper setting

- The **boot mode** is selected by a jumper near to the VGA connector, which should be set on the two pins marked with “SD”.
- The other jumpers are set depending on the desired **operating mode**. For example, the power supply jumper can be set to take power from an external 5V source, or from the UART USB jack – both are fine for booting Xilinx.



Step 2: Run Xillinux OS in the ZYBO board and setup environment for GUI based game development.

➤ Hardware setup

After step 1, ZyBo board is ready to run the Xillinux Operating system (using SD card).

- Insert the (micro)SD card into specific slot
- Power on the board using **5V external power source**.
- It shows OS power up debug prints on the attached display screen.
- Type “**startx**” to OS terminal to start GUI based Xillinux operating system.
- Once after you get an access of GUI based Operating system open terminal from the Desktop
- Before installing required libraries to develop a GUI based interactive game, increase the partition size using help of section 4.4 of in the [Getting Started guide for Zynq \(ZyBo\)](#) .

➤ Download and install all the required libraries

Before you start following steps verify Ethernet connection of the ZyBo board. Open browser from the bottom left corner and check internet access is available properly to download libraries from the internet.

Below are the required steps to install libraries and its dependencies for executing game code: (For installing libraries open terminal from the Xilinx desktop.)

```
sudo apt-get update
```

To update your basic packages

```
sudo apt-get install build-essentia
```

Now install all required libraries

```
sudo apt-get install libncurses5-dev libncursesw5-dev
```

```
sudo apt-get install gtk+-
```

```
sudo apt-get install libX11-dev
```

For the last library setup, download the [libgraph](#) Source code. Copy the file libgraph-1.0.2.tar.gz to our home folder. Right click on the file and select *Extract* here. Open a terminal and run the following commands, one by one.

```
cd libgraph-1.0.2
```

```
./configure
```

```
sudo make
```

```
sudo make install
```

```
sudo cp /usr/local/lib/libgraph.* /usr/lib+
```

After all above steps, required environment for the game development is ready. So now you are ready to compile your program!

Step 3: Compile and execute game source

➤ Copy game source code and execute it

Copy given game source code (**ping_pong**) folder to **/root/src** path (either using usb pen-drive or downloading from the internet).

Open a new terminal from the Desktop and execute following commands to run the game.

```
Cd /root/src/ping_pong
```

```
Gcc -o ping_pong ./pong.c ./support.c -lpthread -lncurses
```

```
./ping_pong
```



Conclusion

Using this project, understand overall work flow of developing an application on the ZyBo board using Xilinx's Vivado tools. Learn how to install the Xillinux operating system on the Zybo board. Get an idea of how a FPGA based hardware peripherals work. Also go through all the basic development phases of designing an application on a development board. Get an experience of using graphic's library functions and hardware peripherals (Mouse & Keyboard) in the software application.