Monday, January 29, 2019

ECE530 Winter 2018-2019 XILINUX and Breathing LED with Python on Zybo

This tutorial shows how to create a boot loader on microSD card start full-blown Xilinux Linux on Zybo and to run a Python code to breathe an LED. The Xilinux Linux runs on Zybo with a VGA display, Ethernet, a USB mouse and keyboard. The main ideas are from http://www.xillybus.com and http://digilent.com.cn/community/466.html.

1 Download Source Files

1.1 Source Files from http://www.xillybus.com/xillinux.

The SD card image file, xillinux-2.0.img.gz of 1.1GB. The boot partition kit for Zybo xillinux-eval-zybo-2.0c.zip. Unzip xillinux-2.0.img.gz to create SD card image file xillinux-2.0.img.

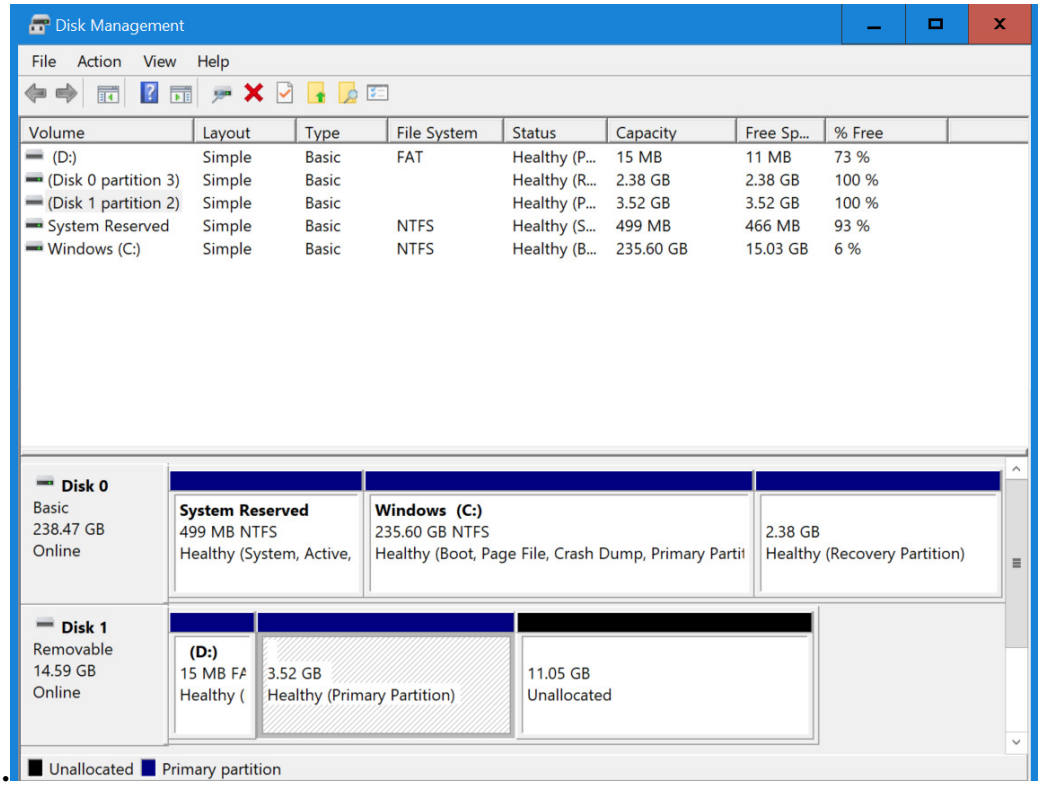
1.2 Win32 Disk Imager

Download win32diskimager-1.0.0-install .exe file from https://sourceforge.net. This file is needed to install Win32 Disk Imager to write images to USB sticks or SD/CF cards.

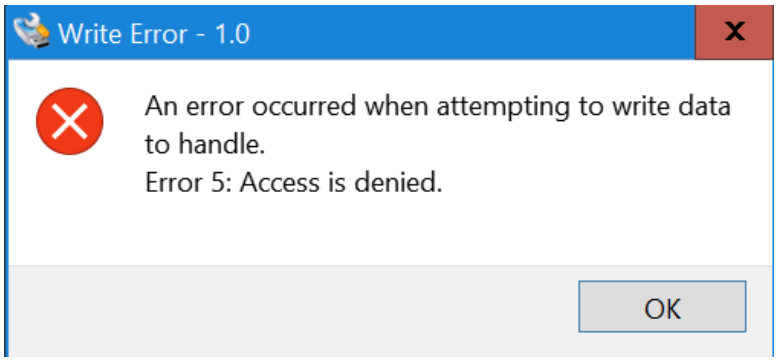
2 Create a boot loader microSD card

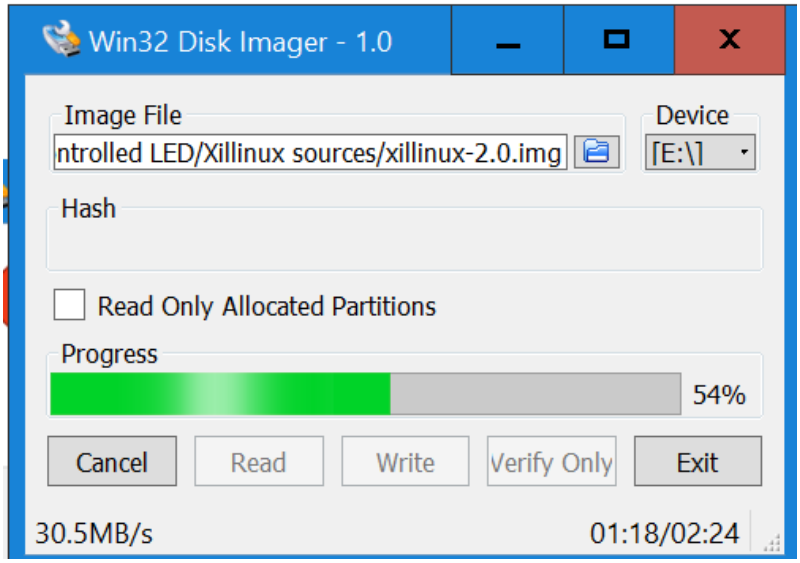
2.1 Run Win32 Disk Imager to copy xillinux-2.0.img to microSD

You may want to run Disk Management to remove partitions on your microSD card first to make sure the card is accessible by Win32 Disk Imager. You can choose a Disk 1 partition as shown below and click X to remove it so that the microSD card is unallocated. Make sure you select the removable disk not the hard drive.

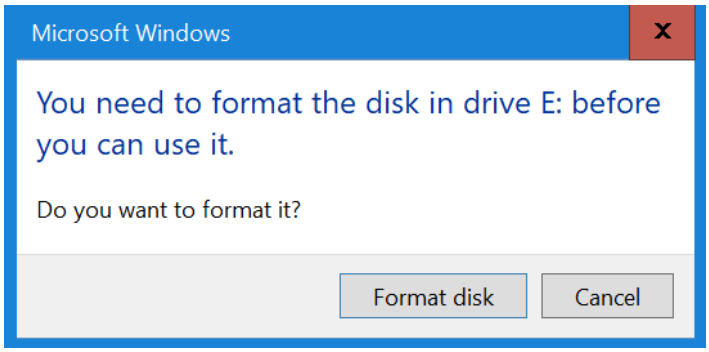


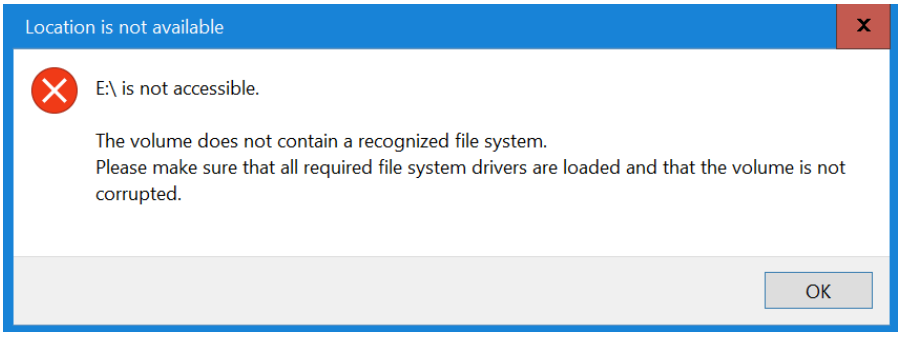
Run Win32 Disk Imager and choose xillinux-2.0.img. Insert your microSD card and click Write on Win32 Disk Imager to create the boot loader on the SD card. If you see the following error, try to remove all partitions from the card.



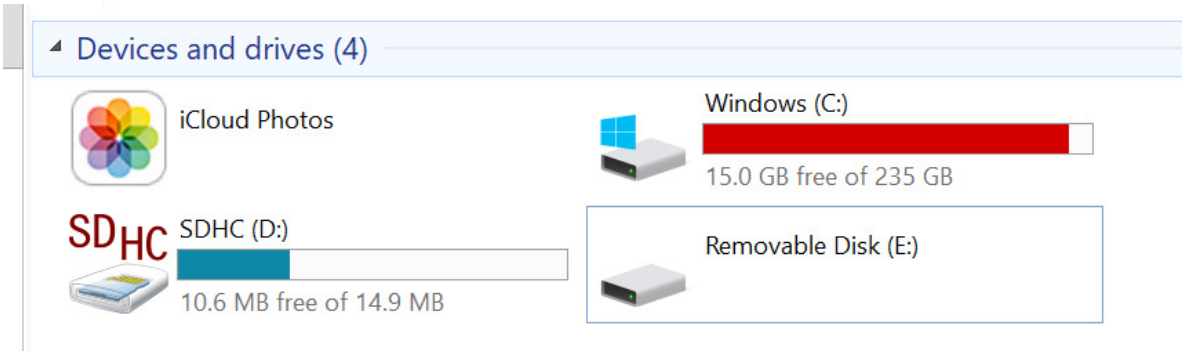


Do not format your microSD card when you see the following message. Just click "Cancel". You will see a warning that E:\ is not accessible. Your microSD card is partitioned into two sections: D:\ and E:\. D:\ contains two small startup files: boot.bin and image.ub. E:\ section seems to contain the rest of the boot loader files.



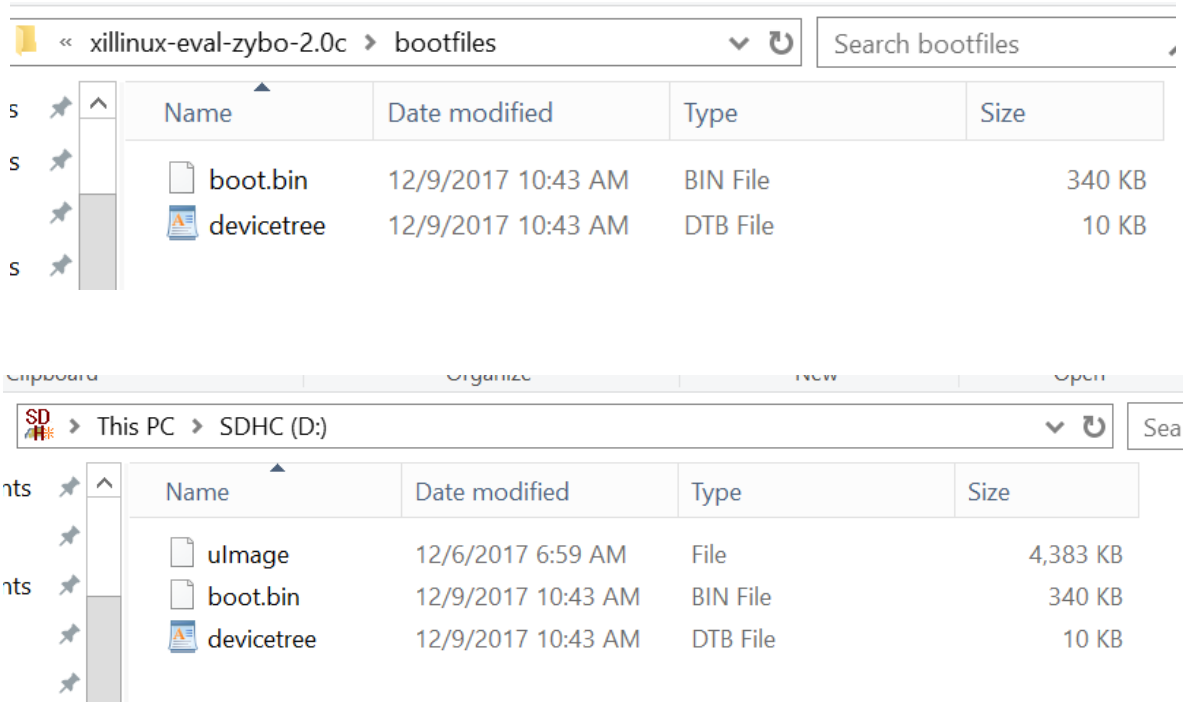


You may see two partitions on your microSD: D:\ and E:\, where E:\ is not accessible.



2.2 Copy boot.bin and devicetree.dtb to D:\

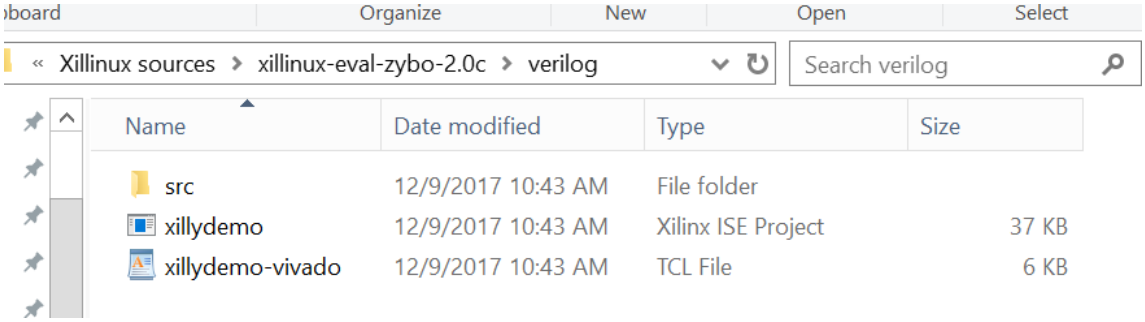
Unzip xillinux-eval-zybo-2.0c.zip. Copy boot.bin and devicetree.dtb files to D:\ of your microSD card.

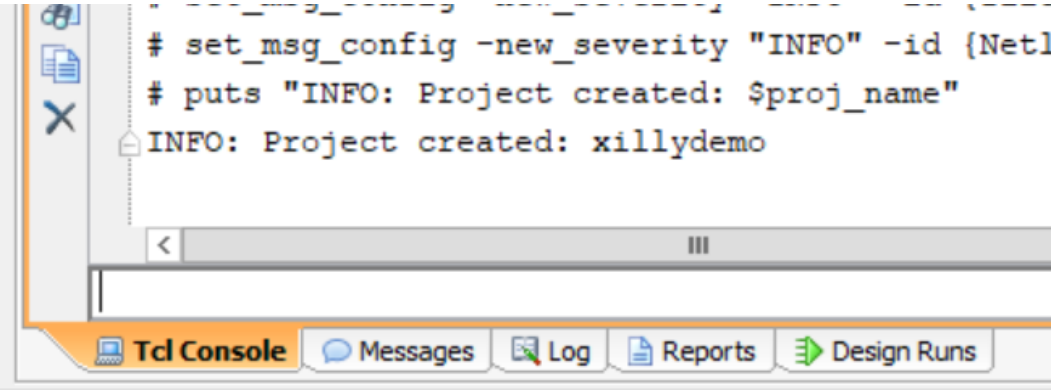


3 Create the Bitstream File xillinux-eval-zybo-2.0c.zip

3.1 Generate the Vivado Project from xillinux-eval-zybo-2.0c.zip

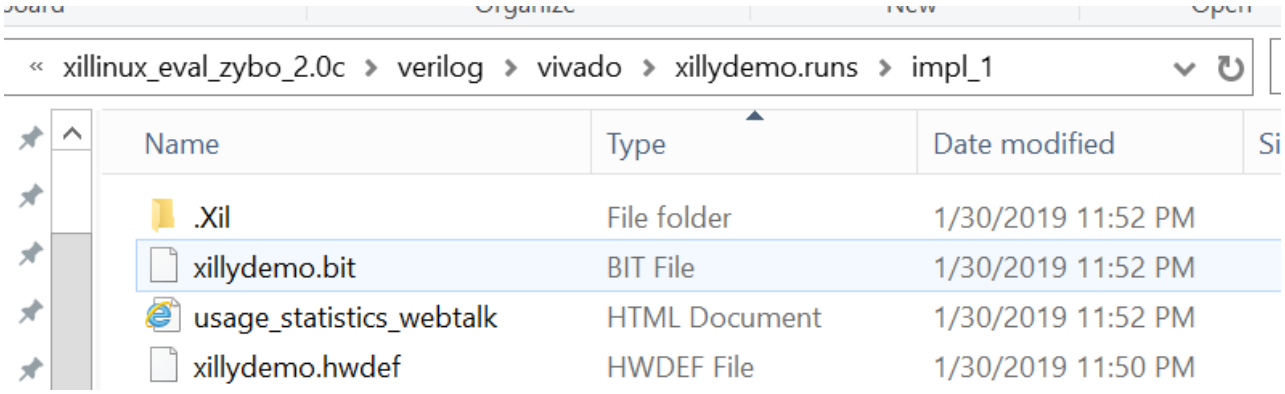
Start Vivado 2015.4 without opening any project. Choose Tools>Run Tcl Script and choose xillydemo-vivado.tcl in verilog/, vhdl/ or blockdesign/ subdirectory of your preference. The project should be deployed successfully if the following message is shown under Tcl Control.

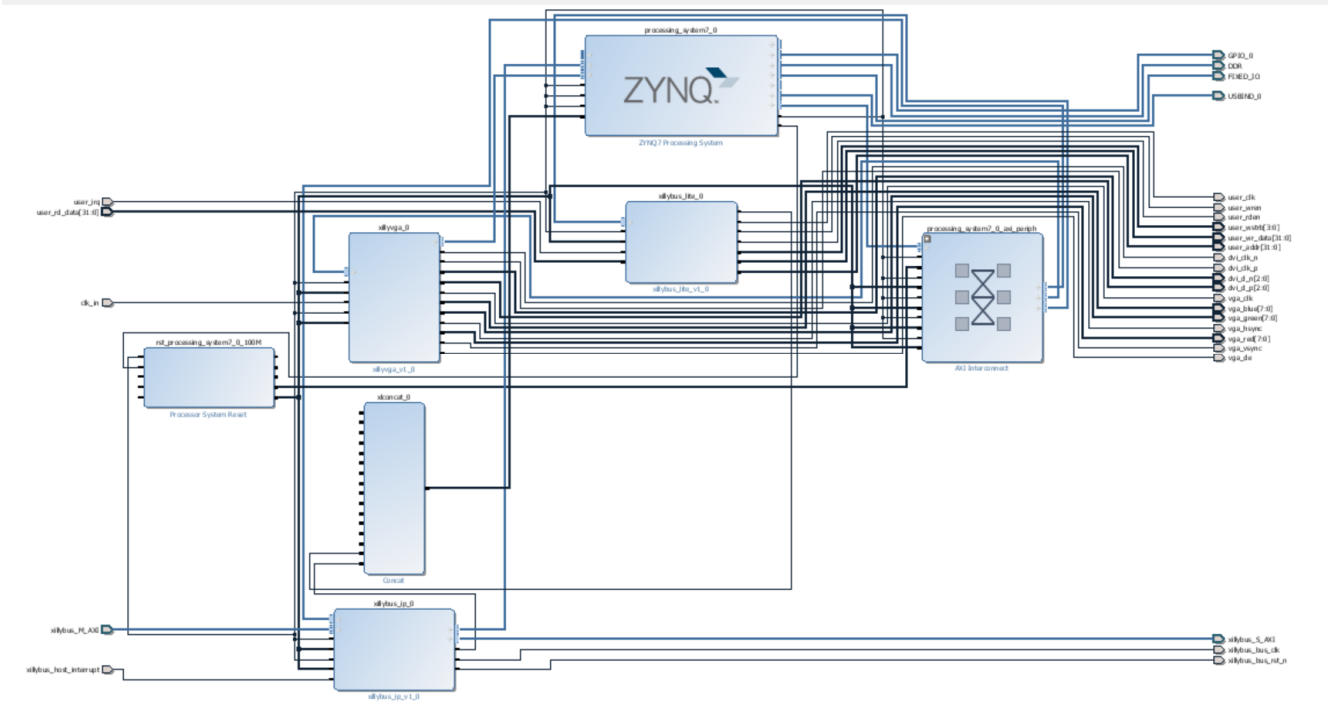




3.2 Generate the Bitstream File xillydemo.bit

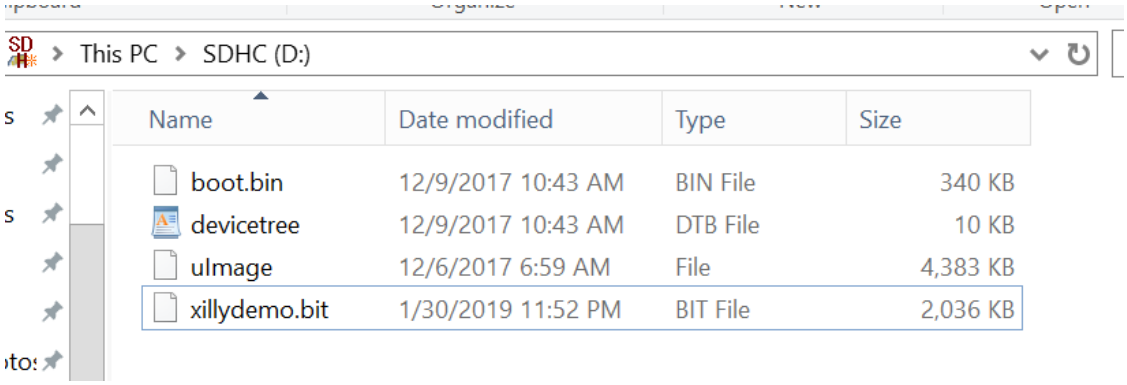
The following block design should be seen. Change the project device to Zybo board by opening Project Settings. Generate the bitstream file from this block design. The bit stream file should be in xillinux_eval_zybo_2.0c/verilog/vivado/xillydemo.runs/impl_1/xillydemo.bit.



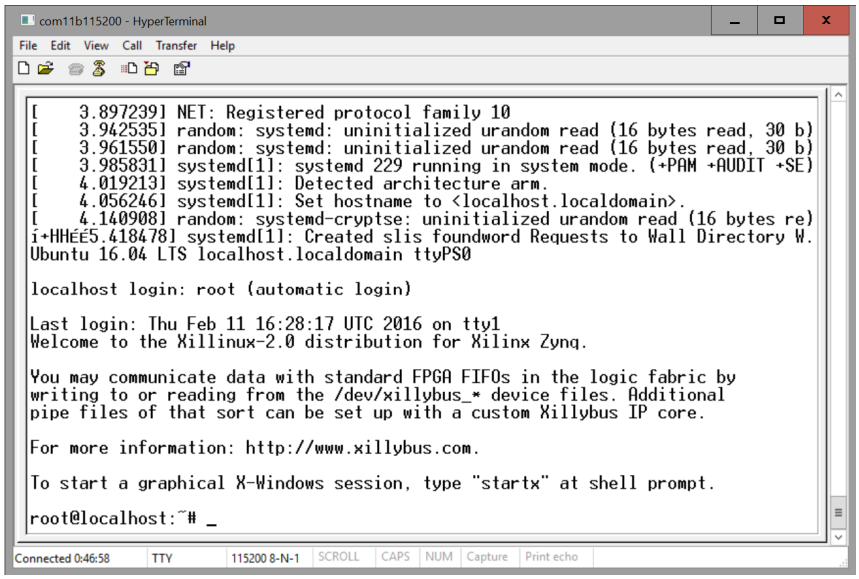


4 Copy xillydemo.bit to D:\ of microSD card

Copy xillydemo.bit file from xillinux_eval_zybo_2.0c/verilog/vivado/xillydemo.runs/impl_1/ to D:\ partition of the microSD card so that D:\ contains four files as follows.



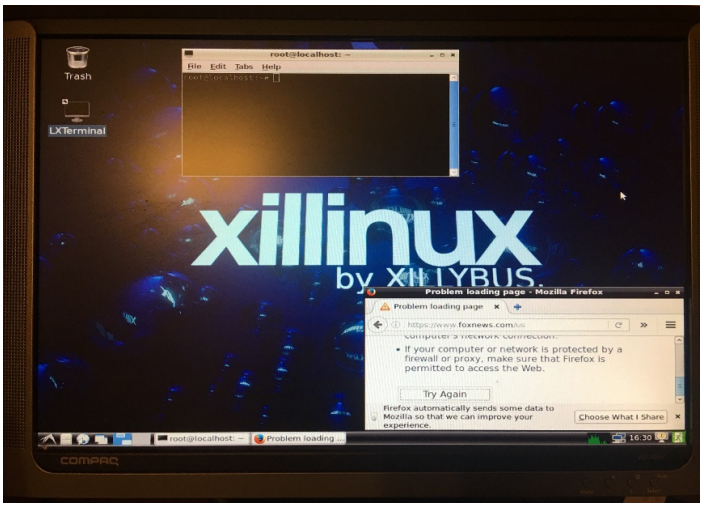
5 Start Xilinux Linux on your Zybo with a keyboard, a mouse and Ethernet



Find its MAC address as shown to be HWaddr by running ifconfig –a. This MAC address needs to be registered to connect to our school Ethernet.

```
root@localhost:~# ifconfig -a
eth0      Link encap:Ethernet  HWaddr 00:0a:35:00:01:22
          inet addr:137.112.41.194  Bcast:137.112.41.255  Mask:255.255.255.0
          inet6 addr: fe80::e227:cb6a:5b47:7732/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:457 errors:27 dropped:0 overruns:0 frame:27
          TX packets:172 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:45261 (45.2 KB)  TX bytes:18120 (18.1 KB)
          Interrupt:31 Base address:0xb000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:53 errors:0 dropped:0 overruns:0 frame:0
          TX packets:53 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:4440 (4.4 KB)  TX bytes:4440 (4.4 KB)

root@localhost:~# _
```

You can start an X terminal by typing startx & on the command line to see the following windows. You can connect a USB mouse, a USB keyboard, a VGA display and Ethernet cable to your Zybo board.



6 Install python3 if it is not installed yet and gedit

If your Ethernet works, you can install python3 now.

```
root@localhost:~# apt-get install python3 python3-dev python3-dbg
Reading package lists... Done
Building dependency tree
Reading state information... Done
python3 is already the newest version (3.5.1-3).
python3-dbg is already the newest version (3.5.1-3).
python3-dev is already the newest version (3.5.1-3).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
root@localhost:~# _
```

Install gedit as follows.

```
root@localhost:~# apt-get install gedit
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  gedit-common gir1.2-gtksource-3.0 gir1.2-peas-1.0 libpeas-1.0-0
  libpeas-1.0-0-python3loader libpeas-common
Suggested packages:
  gedit-plugins
The following NEW packages will be installed:
  gedit gedit-common gir1.2-gtksource-3.0 gir1.2-peas-1.0 libpeas-1.0-0
  libpeas-1.0-0-python3loader libpeas-common
0 upgraded, 7 newly installed, 0 to remove and 0 not upgraded.
Need to get 581 kB of archives.
After this operation, 5333 kB of additional disk space will be used.
Do you want to continue? [Y/n] _
```

7 Run a python code to control led at MIO7

Connect a VGA monitor to your Zybo board and start an X-terminal by running startx&.

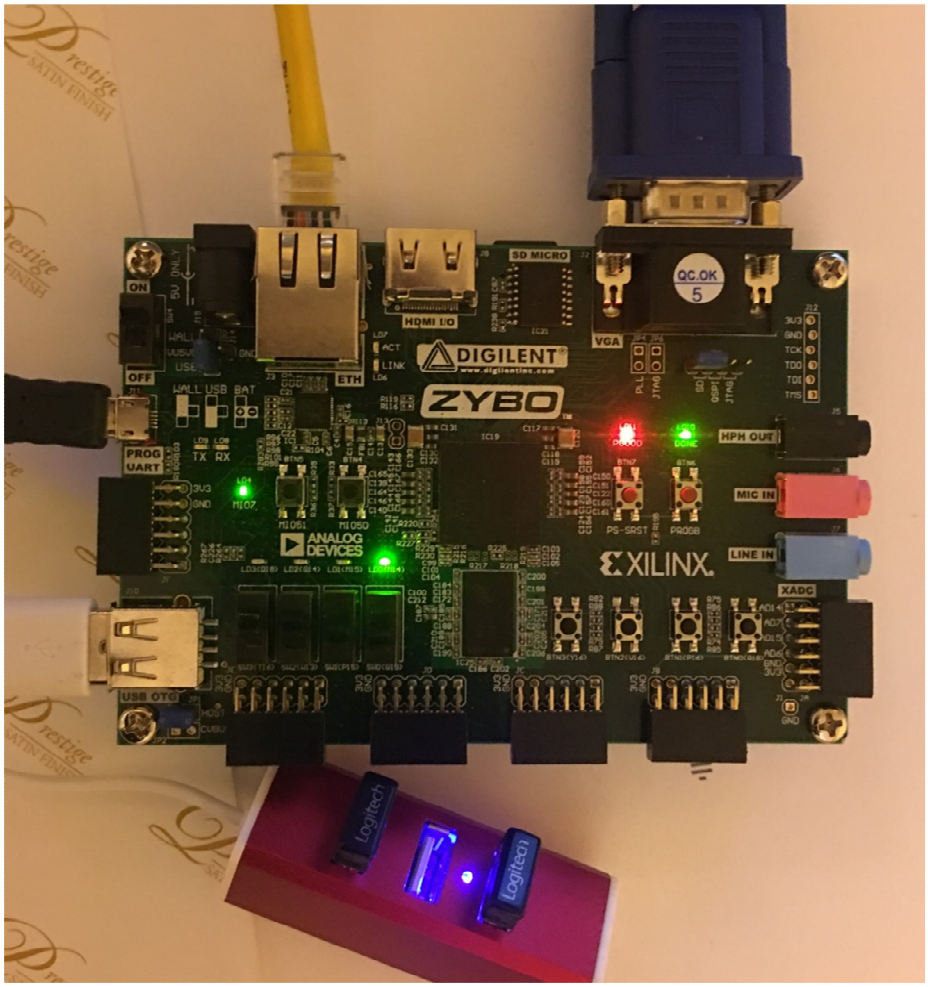
Start gedit to make a python file ledbreathing.py as follows. This is a plain text file with *.py suffix.

```
#!/usr/bin/python3
#-*- coding:utf-8 -*-

import time
import sys
import os

dir = 0
pwm = 0

try:
    while True:
        os.system('echo 1 > /sys/class/leds/mmc_led/brightness')
        time.sleep(0.01 * pwm / 100)
        os.system('echo 0 > /sys/class/leds/mmc_led/brightness')
        time.sleep(0.01 * (100 - pwm) / 100)
        if dir == 0:
            pwm = pwm + 10
        else:
```

```
                pwm = pwm - 10
            if pwm > 100:
                dir = 1
                pwm = 100
            if pwm < 0:
                dir = 0
                pwm = 0
except KeyboardInterrupt:
    os.system('echo 0 > /sys/class/leds/mmc_led/brightness')
    exit()
```

Running python script ledbreathing.py with python3 ledbreathing.py to see the LED on MIO7 flashing dimly.

```
root@localhost:~# ls
Desktop    Downloads  Pictures  Templates  ledbreathing.py
Documents  Music      Public    Videos     xillybus
root@localhost:~# python3 ledbreathing.py
```



8 References

1. www.xillybus.com.
2. http://digilent.com.cn/community/466.html. Python LED Breathing Light with Zybo.