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Tutorial on Embedded Systems - Module I: Introduction to the DE2i-150 Development Board

Greg Drayer
VIP Program

Outline

- This module presents the following content:
  - Getting started – materials and software
  - Layout of the board
  - USB-Blaster driver installation
  - Setting up the DE2i-150 Control Panel
  - Exploring the DE2i-150 board
  - Safe shutdown
  - Summary

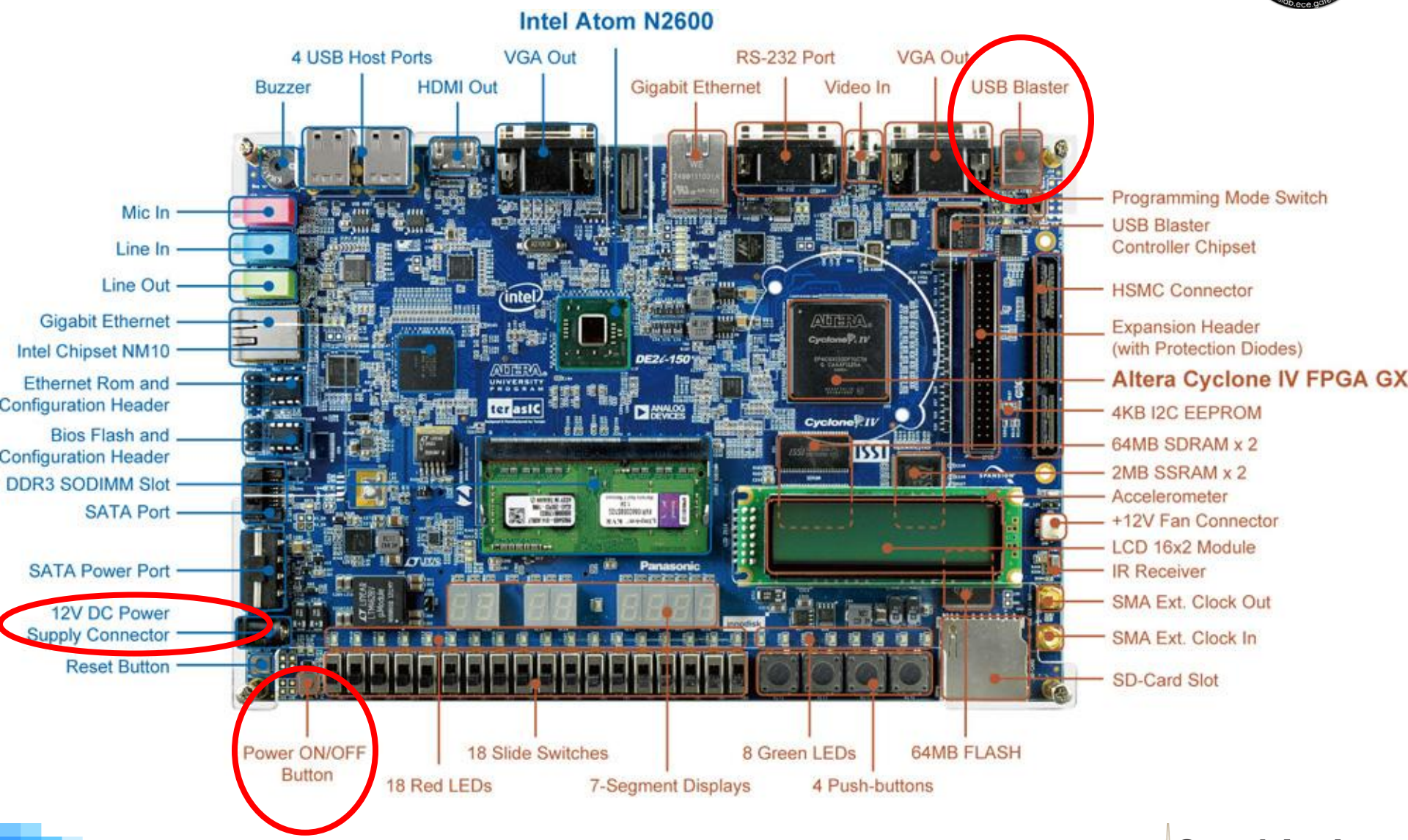
Objectives

- By the end of this module, you will:
  - know how to set up and power up the DE2i-150 development board.
  - have installed the USB-Blaster driver to program the field-programmable gate array (FPGA) with JTAG standard and active serial programming (ASP).
  - have set up the DE2i-150 Control Panel that allows to “bring up” and test the board.
  - be familiar with its sensors and some of its input & output (I/O) devices and displays.
  - have explored state-of-the-art hardware for the development embedded systems.

Getting Started

- List of materials and software:
  - Laptop or desktop running Windows (XP at least)
  - DE2i-150 development board
  - Power adapter and cord
  - Standard USB cable (Type A/B connector)
  - Quartus II Web Package 13.0 SP1
    - https://www.altera.com/download/
    - Installing this software on your PC is required (at least version 12.1)
    - Important: Make sure to include Cyclone IV devices during download/installation
  - Folder containing the USB-Blaster driver
    - http://humanslab.ece.gatech.edu/IntelCurriculum/USB-Blaster_Driver.zip
  - Folder containing the DE2i-150 Control Panel
    - http://humanslab.ece.gatech.edu/IntelCurriculum/DE2i-150_Control_Panel.zip

Layout of the Board



USB-Blaster Driver Installation

1) Unzip the folder containing the driver files
   - Place the folder on a temporal folder or your preference

2) Connect the board to the PC with the USB cable
   - Make sure you do not connect the power connector to the SATA power input

3) Feed power to the board with the power adapter
   - A green LED comes on

4) Turn on the board
   - Pressing the power button (highlighted on layout)

USB-Blaster Driver Installation

5) Install from the driver folder
   - Select “Install from a list or specific location”
   - Click on “Next >”

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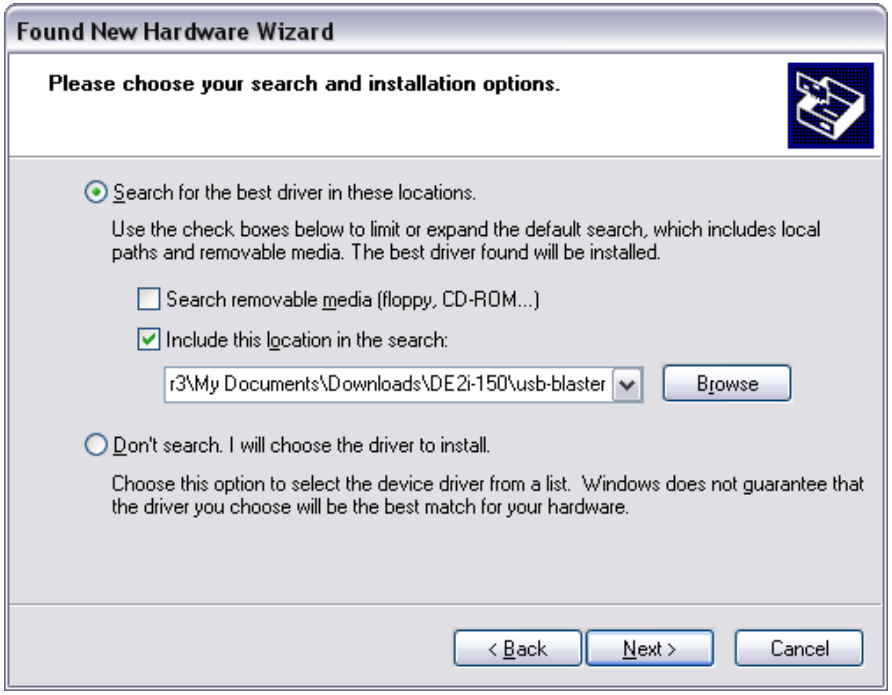
USB-Blaster Driver Installation

6) Search in the unzipped usb-blaster folder
   - Select “Search for the best driver in these locations”
   - Check the box with “Include this location in the search”
   - Browse for and include the folder with the unzipped files
   - Click on “Next >”



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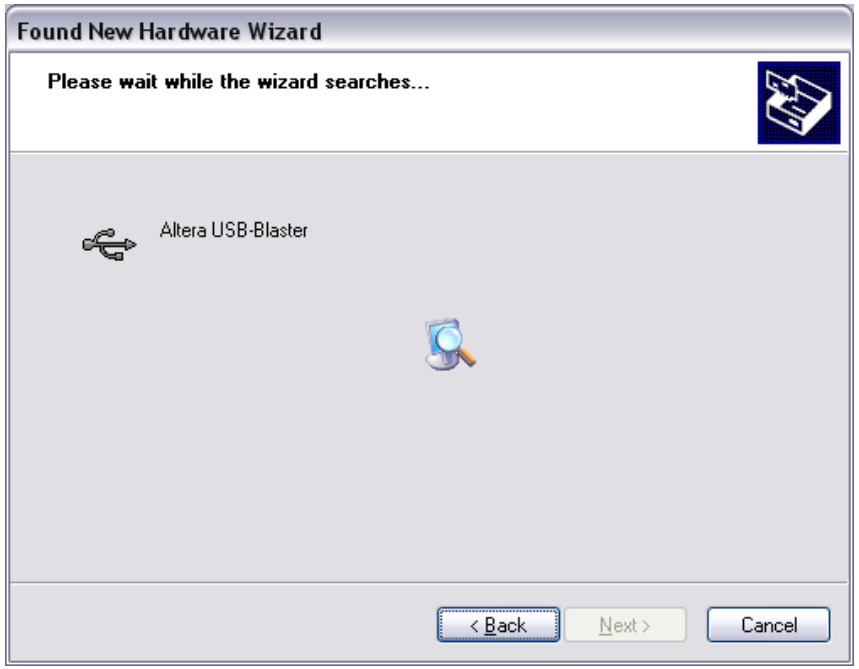
USB-Blaster Driver Installation

7) Finalize driver installation
   - Wait while the wizard searches and installs the driver
   - Click on “Finish” once the wizard has completed the installation



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Setting the DE2i-150 Control Panel

1) Unzip the folder containing the driver files
   - Place the folder on a temporal folder or your preference

2) Double click the DE2i-150 Control Panel icon
   - The Control Panel initializes
   - Simultaneously, the board receives a FPGA bit stream that allows control from the interface
   - A green LED lights up near the USB-Blaster connector

Setting the DE2i-150 Control Panel

- After the Control Panel has been set up, the interface will display the LED tab
- Each tab allows to explore various I/O devices as well as a few sensors and functions of the board
- Time to explore!

Exploring the DE2i-150 Board

The LED Tab

- Allows to control nine green LED's and 18 red ones
- Click on each LED and identify their location
- Try lighting them up altogether or turning them off
- LED's are useful as indicators when debugging your projects

Exploring the DE2i-150 Board

The LCD Tab

- Allows to set alphanumeric values on the LCD screen
- Each line on the interface corresponds to a different segment on the display
- Write a message on the interface and click on “Set”
- LCD displays are useful to provide information about the status of a system to human operators

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Exploring the DE2i-150 Board

- The 7-Segment Display Tab
  - This panel allows to control the 7-segment displays on the board
  - It works as a hexadecimal output
  - The arrows on the interface change the value of each module
  - Try setting today's date on the board
  - These displays are useful for numeric indicators and are found in many consumer electronics and automotive applications

Exploring the DE2i-150 Board

- The Switches Tab
  - Allows to display the state of the 18 switches and four buttons on the board
  - These work as digital inputs
  - Buttons are debounced; i.e., they will supress undesired noise during state transitions
  - Found in most electronic devices mean for human-system interaction
  - More recent input interfaces include touch screens, voice recognition, gesture recognition

Exploring the DE2i-150 Board

- The Memory Tab
  - Allows to write and read hexadecimal data with various memory devices
  - It employs addresses and write/read functions in their operation
  - Try reading various addresses from the Random Access memory
  - Memory is a fundamental resource in computer system architectures

Exploring the DE2i-150 Board

- The Gyroscopes' Tab
  - Allows to display the readings from a 3-axis gyroscope
  - It displays values with a resolution of a tenth of a thousand of 1g
    - How much is this in ft/s^2?
  - Try inclining the board and observing changes on the X/Y/Z values
    - Is it possible to make any of them close to zero?
  - The use of gyroscopes is greatly expanding; they are found today in most mobile devices and integrated with other sensors, such as GPS

Exploring the DE2i-150 Board

- The IR RX Tab
  - Allows to read hexadecimal values sent from a IR-based remote control
  - Displays the codes red by the IR sensor on the board
  - Try finding which buttons on the remote control display a hexadecimal codes that include letters
  - IR-controlled devices are found in many applications, from remote controls to IR short-distance data transmission

Safe Shutdown

1) Press the “Disconnect” button on the Control Panel

2) Press and hold the power button until the board shuts down completely

3) Store the parts in the bags and boxes for the next class

Summary

- In this session you have:
  - learned how to set up and powered up the DE2i-150 development board
  - installed the USB-Blaster driver in a PC
  - learned how to use the DE2i-150 Control Panel.
  - become familiar with its sensors and some of its input & output (I/O) devices and displays
  - explored a state-of-the-art development board meant to teach methods and approaches to designing and deploying embedded systems