

## Lab 1: Set up Lab Hardware and Software

The main purpose of this lab is to test the equipment and software tools that we will be using for lab assignments.

### 1. Introduction

The hardware we will use in this lab course is the DE-10 standard development board. You may have used the Field Programmable Gate Array (FPGA) portion of the development board previously. The DE-10 standard board is centered on an Intel system-on-chip (SoC) device that integrates an Intel Cyclone V FPGA and a dual-core ARM Cortex-A9 processor. The two parts of chip are connected with a bridge so they can communicate with each other, including the peripherals connected to their respective sides of the development board. This class will focus on utilizing the ARM processor and various peripherals on the development board.

Each lab assignment will have a number of parts that should be done in order. You are not required to submit any sort of formal lab reports. Your lab work will be graded based on your code. Some lab assignments have prelab readings that should be completed before the start of the lab. You will find what should be submitted at the end of each lab assignment. Please append your last name to the name of all your submission files, e.g. for John Doe Lab1\_Doe.zip.

#### 1.1. Software and hardware needed in this class

- Hardware: DE10 Standard development board
- Software: Quartus and Monitor Program

#### 1.2. Introduction to the DE10 hardware

For the labs in this course, we will be working on the “bare metal”, i.e. writing and debugging programs that run directly on the ARM hardware with no operating system and drivers in between. The system implemented to support the ARM processor is called a hardware processor system (HPS). An HPS implementation named *the DE10 Computer System* has been defined for you to use in this class. The DE10 Computer system will be loaded to the DE10 before you can run your program on the board. The details of the DE10 Computer System can be found in its manual in Bb, which you will need to refer to throughout the course.

#### 1.3. Intel Monitor program

The main software environment you will use for the labs is the Intel Monitor program, which is a simple software development environment that enables you to develop and test bare-metal ARM assembly/C programs. This program hides the complicated process of programming the ARM processor on the board so you can focus on the assignments.

### 1.4. Testing the hardware and software

You will use a simple C program to test if the software and hardware development environment on your computer is ready.

- Go to the blackboard Lab Assignments folder, find the ***Intel Monitor Program Tutorial***.
- Complete the steps of the tutorial. After you are done, capture a snapshot of the Intel Monitor program window showing the correct messages and a picture of the DE10 board showing the illuminated LEDs.

#### **Prelab Reading for Lab 2:**

- DE10-Standard\_Computer\_ARM.pdf – sections 2.1 & 2.10.1-4
  - The manual can be found on the Bb *Major References* folder.

#### **What to submit:**

- Zip the entire Lab1 folder, including the screenshot of Intel Monitor Program and the picture of the DE10 board showing correct result, and submit the zip file to Lab1 assignment in Blackboard.