1. Introduction

This document illustrates how to setup the painter demo on the DE10-Standard and the LT24 as shown in **Figure 1**. The demo is designed in Qsys and running by Nios II processor. Altera SPI IP in Qsys is used to retrieve the touch information from the touch screen. Terasic custom display component in Qsys is used to display image on the 2.4" LCD. This demo requires the following hardware.
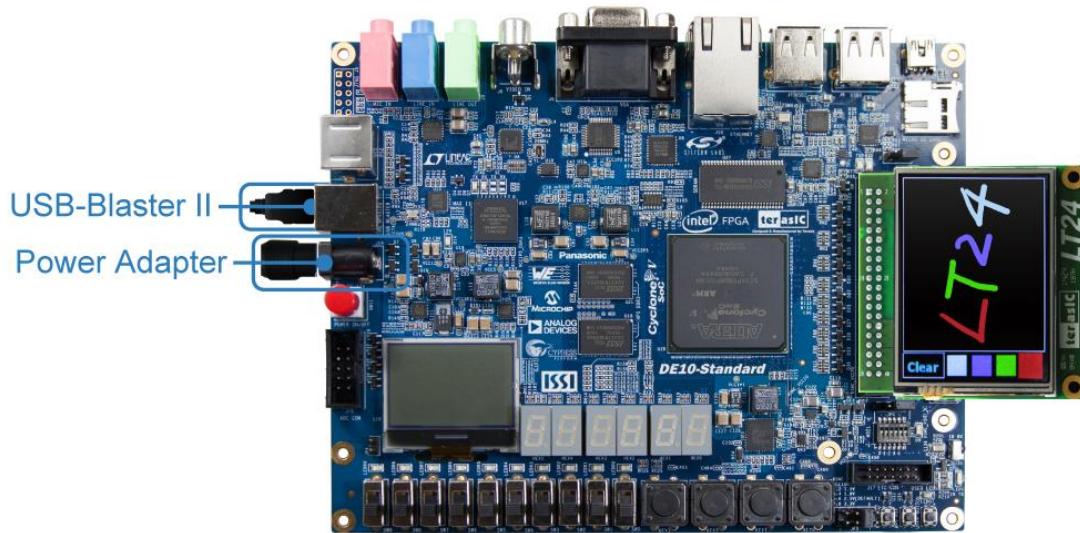

Figure 1 LT24 Painter Demo

2. System Requirements

The following items are required to perform this demonstration:

- ◼ DE10-Standard and power supply
- ◼ LT24 LCD touch module

3. Execute Demonstration

Please follow the procedures below to setup the demonstration:

1. Make sure both Quartus II and USB-Blaster II driver are installed on the host PC.
2. Power off the DE10-Standard board.
3. Connect a mini-USB cable to an UB2 port of the DE10-Standard and the host PC.
4. Mount the LT24 onto the 2x20 GPIO (JP1) expansion header of the DE10-Standard.
5. Power on the DE10-Standard Board.
6. Make sure Quartus II 16.1 or later is installed on your host PC.

7. Launch the "test.bat" from the folder demo_batch of the **DE10_Standard_OnChipMemory_LT24_Painter**

or

DE10_Standard_SDRAM_LT24_Painter Project.

The difference between these projects is also the memory where the Nios II program is running on.

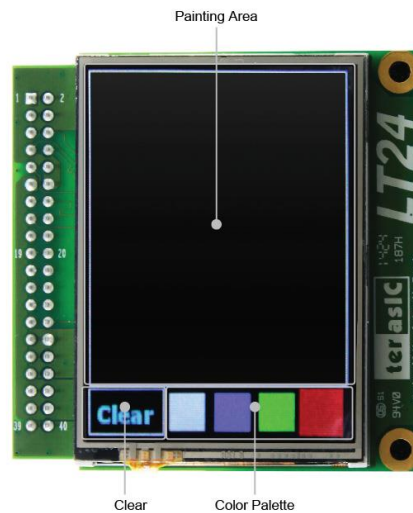8. Now, you should see the painter GUI on the LCD of LT24.

Figure 2 GUI of Painter demo

4. Project Description

Figure 3 shows the system block diagram of Painter demonstration. Terasic custom Qsys component - **LT24 LCD controller** is used to display 240(H) x 320(V) image. Its source code is located in the "/ip/LT24_Controller" folder of Painter demo project. Qsys built-in SPI controller is used to communicate with the AD7843 ADC via SPI interface to retrieve data from the touch screen. The Nios II program handles touch event and image display. It is stored in either on-chip memory or external memory. The LCD module should be initialized before sending image data to the LCD for image display.

The project is built by Quartus Prime 16.0.2 Standard Edition. If developers want to recompile the project, the same Quartus build is recommend for best compatibility.
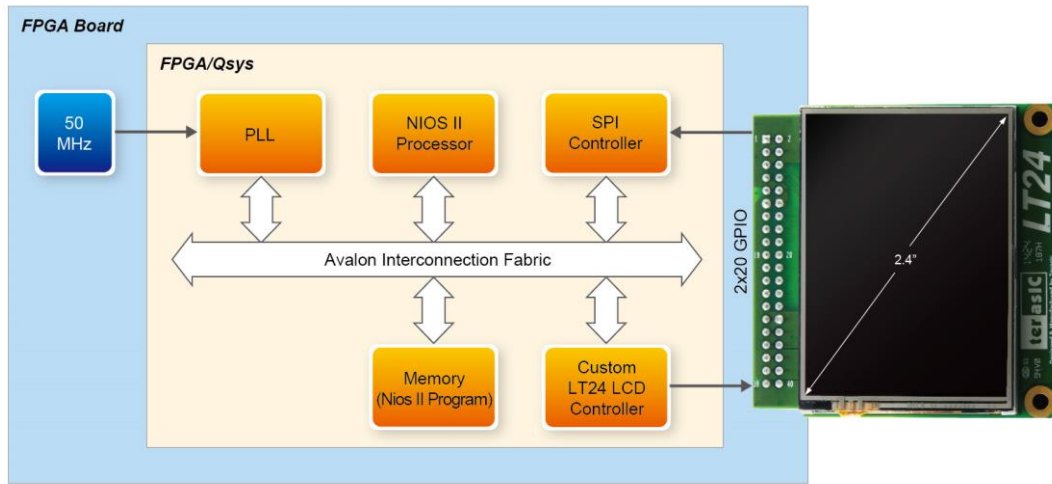
Figure 3 System Block Diagram

The LT24 LCD controller is a custom Qsys component developed by Teraisc. Its source code is located in the "/ip/LT24_Controller" folder of Painter demo project. The table below shows the register definition of LT24 LCD controller. The controller base address is defined as LT24_BASE in the Nios II program. The function of writing a control command to the LCD driver is IOWR(LT24_ BASE, **0x00**, CommandValue). The function of writing data to the LCD driver is IOWR(LT24_BASE, **0x01**, DataValue).

Byte Offset	Register Name	Description
0	Control Port	Write control command to the LCD driver
4	Data Port	Write data to the LCD driver