MDP Based Face Detection Demonstration

User Guide

FPGA-UG-02047 Version 1.1

September 2018

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Acronyms in This Document

A list of acronyms used in this document.

Acronym	Definition
BNN	Binary Neural Network
FPGA	Field-Programmable Gate Array
LED	Light-emitting diode
MDP	Mobile Development Platform
SOIC	Small Outline Integrated Circuit
SPI	Serial Peripheral Interface
USB	Universal Serial Bus

1. Introduction

This document describes how to operate the Face Detection demo on the iCE40™ UltraPlus Mobile Development Platform (MDP) board. The design features a Binary Neural Network (BNN) using our Compact CNN Accelerator soft IP which is used in face detection.

2. Functional Description

There are four iCE40 UltraPlus devices on the MDP board. The iCE40UP5K_D (U4 on the MDP board) device is used to run this demo.

In this demo, an LED indicates when a face is detected. When the camera detects the face, the LED indicator turns ON. When the camera does not detect a face, the LED stays OFF.

Figure 2.1 shows the diagram of the Face Detection demo. The camera captures the image data and sends it to the iCE40 device. iCE40 then uses the image data with the firmware file from the external SPI Flash to determine if the face is detected.

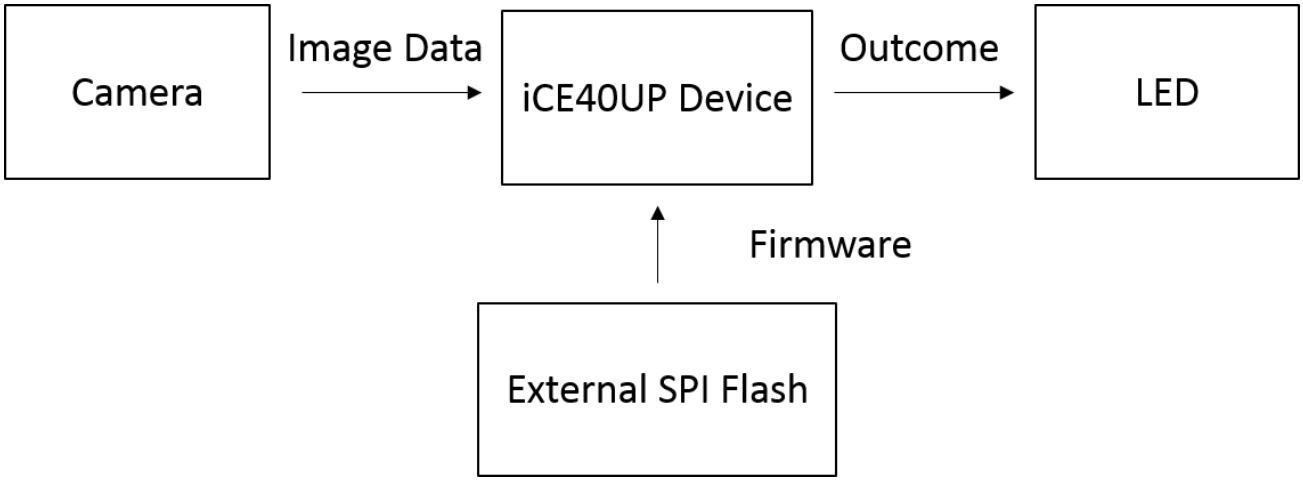

Figure 2.1. Face Detection Demo Diagram

3. Demo Setup

Before running the demo, the MDP board must be configured by setting the switches and jumpers as shown in Figure 3.1.

Note: Figure 3.1 is a default image of the MDP board and the switch/jumper configurations shown here are wrong. The orange rectangles are provided only to help you locate the correct locations of the switches/jumpers. Be sure to read the information in Table 3.1 for the correct configuration settings.

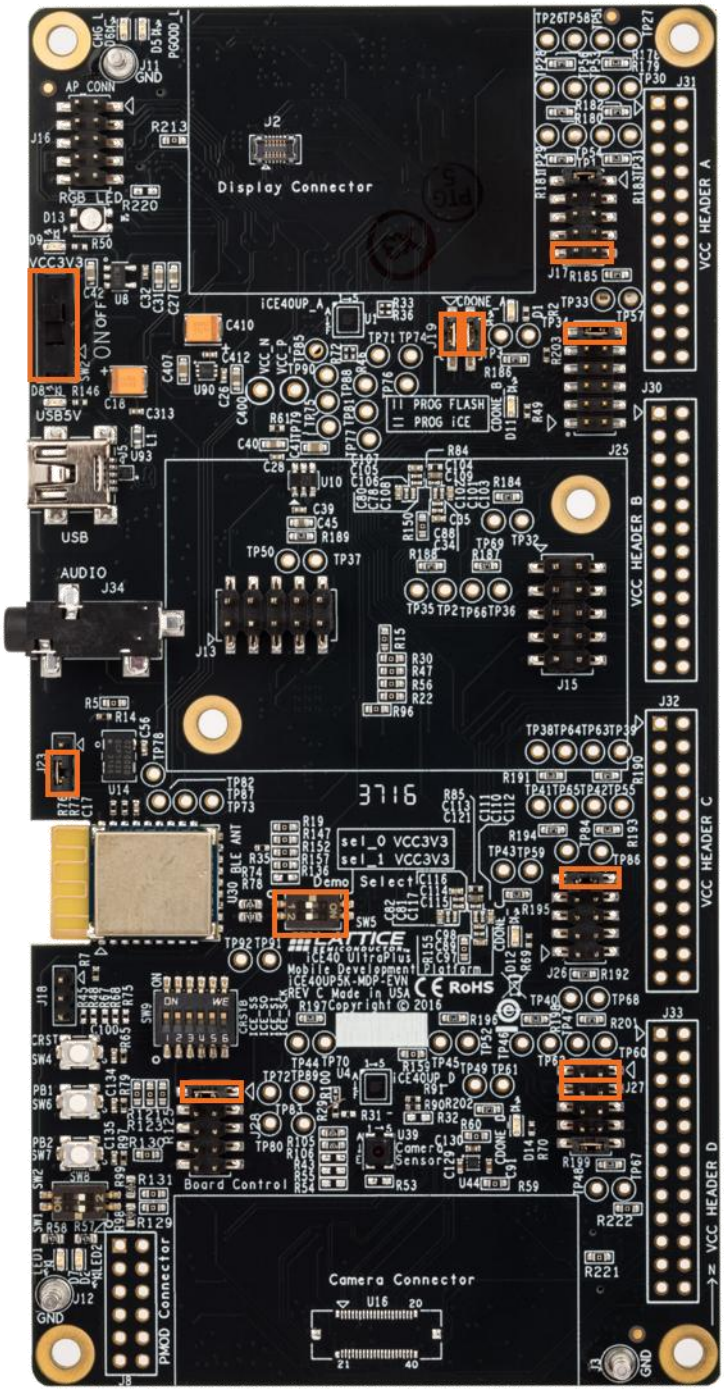

Figure 3.1. MDP Board with Configuration Locations Highlighted

Table 3.1 provides detailed information on the MDP switch and jumper configuration.

Table 3.1. MDP Board Configuration Details

Items	Configuration	Description
J17,J26	Shunt pin 9-10	Disable ICE40UP5K_A/C devices.
J25	Shunt pin 11-12	Disable ICE40UP5K_B device.
J27	Shunt pin 1-2	Enable ICE40UP5K_D device.
J27	Shunt pin 3-4	Provide power supply to camera sensor from USB cable.
J28	Shunt pin 1-2	Board control, for programming SPI Flash.
J19	Shunt pin 1-3,2-4 (vertical)	Enable programming SPI Flash.
J23	Shunt pin 2-3	Use Xtal U14 as clock source.
SW2	Set to ON	Power switch, slide down for power-on.
SW5	All set to ON	Slide right to select ICE40UP5K_D as target device.

Important:

- Make sure that the protective film is removed from the camera sensor U39.
- If using Rev C MDP board, check the MDP Revision Guide to ensure that your MDP board has the correct resistor series. The MDP Revision Guide is provided in the Documentation folder of MDP Based Face Detection Demonstration Bitstream.

4. Programming the Face Detection Demo

This section provides the procedure for programming the SPI Flash on the MDP Board.

Two different files should be programmed into the SPI Flash. These files are programmed to the same SPI Flash but at different addresses:

- bitstream file
- firmware file

To program the SPI Flash in Radiant Programmer:

1. Connect the MDP board to the PC using a USB cable and power ON the MDP board.
2. Start Radiant Programmer. In the Radiant Programmer Getting Started dialog box, select **Create a new blank project** as shown in Figure 4.1.
3. Click **OK**.

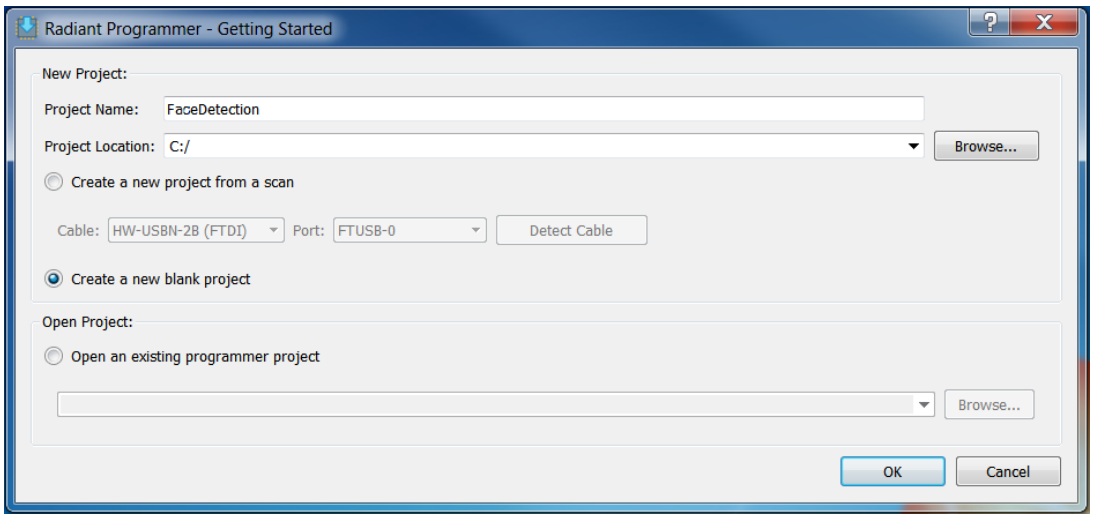

Figure 4.1. Create a New Blank Project

4. In the Radiant Programmer main interface, set Device Family to **iCE40 UltraPlus** and Device to **iCE40UP5K**.
5. Click the iCE40 UltraPlus row and select **Edit > Device Properties**.
6. In the **Device Properties** dialog box, apply the settings below that are common to the two files to program.
   a. Under Device Operation, select the options below:
      - Target Memory: **External SPI Flash Memory**
      - Port Interface: **SPI**
      - Access Mode: **Direct Programming**
      - Operation: **Erase, Program, Verify**
   b. Under **SPI Flash Options**, select the options below:
      - Family: **SPI Serial Flash**
      - Vendor: **Micron**
      - Device: **SPI-M25P80**
      - Package: **8-pin SOIC**
7. To program the bitstream file, select the options below as shown in Figure 4.2.
   a. Under Programming Options, select the bitstream file **FaceDetection_bitstream.bin** in Programming file.
   b. Click **Load from File** to update the Data file size (Bytes) value.

c. Ensure that the following addresses are correct:
   - Start Address (Hex): **0x00000000**
   - End Address (Hex): **0x00010000**

d. Click **OK**.

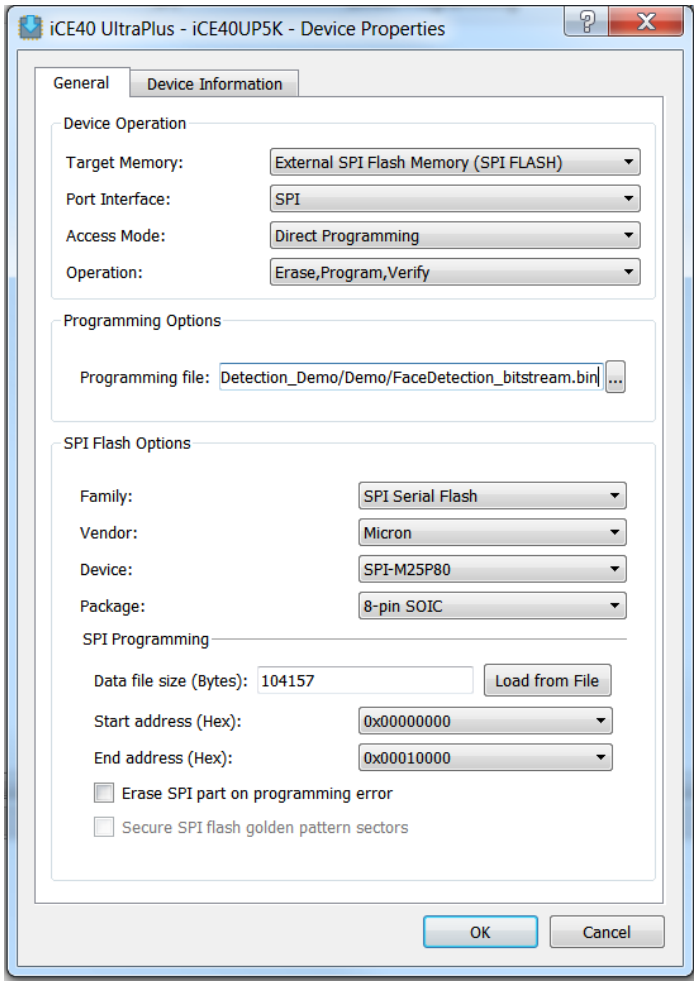

Figure 4.2. Bitstream File Settings

e. In the main interface, click **Program Device** to program the bitstream file **FaceDetection_bitstream.bin**.

8. To program the binary firmware file, select the options below as shown in Figure 4.3.
   a. Under Programming Options, select the binary file **FaceDetection_firmware.bin** in Programming file.
   b. Click **Load from File** to update the Data file size (Bytes) value. Ensure that Data file size is **7844**. If not, manually change the value to **7844**.
   c. Ensure that the following addresses are correct:
      - Start Address (Hex): **0x00020000**
      - End Address (Hex): **0x00030000**
   d. Click **OK**.

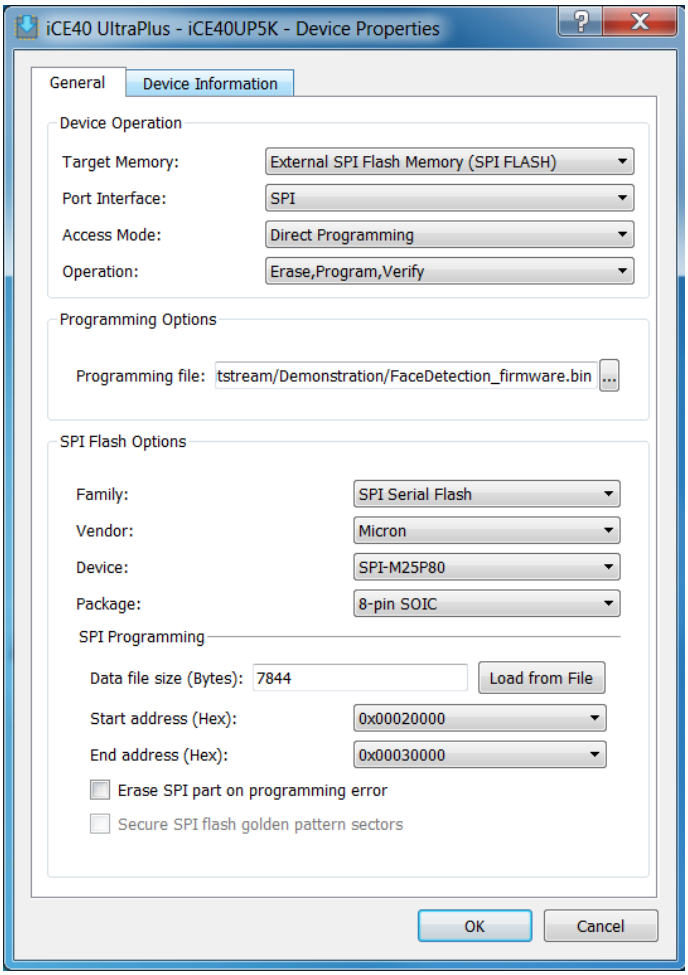

Figure 4.3. Binary Firmware File Settings

e. In the main interface, click **Program Device** to program the binary file **FaceDetection_firmware.bin**.

9. After programming the files, perform a power cycle in order to start observing the demo.

5. Running the Face Detection Demo

To run the basic demo and observe results on the board:

1. Power ON the MDP board.
2. Position a face in front of the camera on the board.
3. When the face is detected, LED D14 turns ON. If the face is not detected LED D14 stays OFF.

Refer to Figure 5.1 for the location of LED D14 and camera (U39).

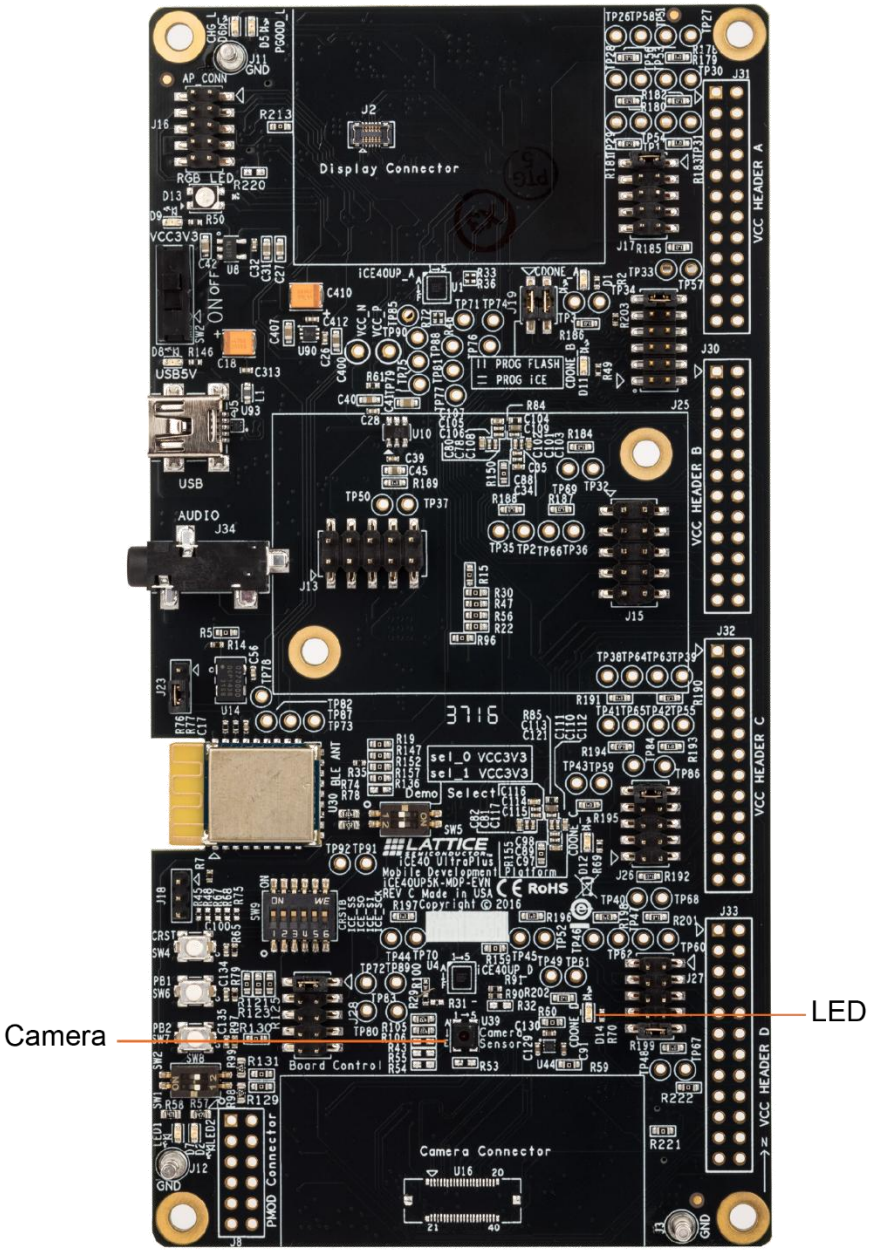

Figure 5.1. Camera and LED Location

Technical Support

For assistance, submit a technical support case at www.latticesemi.com/techsupport.

Revision History

Revision 1.1, September 2018

Section	Change Summary
All	General update.
Revision History	Updated revision history table to new template.

Revision 1.0, May 2018

Section	Change Summary
All	Initial release.

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