iCE40 UltraPlus Face Detection Demo

User Guide

FPGA-UG-02027 1.1

November 2017

Contents

1. Introduction 3
2. Functional Description 3
3. Demo Platform Setup 4
3.1. Configuring the MDP Board 4
3.1.1. Setting Jumpers and Switches 4
3.1.2. Programming SPI Flash on the MDP Board 5
4. Running the Face Detection Demo 6
Technical Support 7
Revision History 8

Figures

Figure 2.1. Face Detection Demo Diagram 3
Figure 3.1. MDP Board with Configuration Locations Highlighted 4
Figure 3.2. Programming Settings in Diamond Standalone Programmer 5
Figure 4.1. UART Printout Information 6

Tables

Table 3.1. MDP Board Configuration Details 4

© 2017 Lattice Semiconductor Corp. All Lattice trademarks, registered trademarks, patents, and disclaimers are as listed at www.latticesemi.com/legal. All other brand or product names are trademarks or registered trademarks of their respective holders. The specifications and information herein are subject to change without notice.

1. Introduction

This document describes how to perform the Face Detection demo on the iCE40 UltraPlus™ Mobile Development Platform (MDP) board. It detects when a person is in the field of view of the camera, ideally located roughly one to two feet away from the board. Lighting conditions must be normal, without extreme shadows, brightness, or backlight.

2. Functional Description

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

In this demo, information is printed through the universal asynchronous receiver/transmitter (UART) serial port for the iCE40 UltraPlus device. The printed-out information is a list of scores in different categories, which shows the quality of the image captured by the camera sensor.

Figure 2.1 shows the diagram of the Face Detection demo. The camera sensor captures the detected image, then sends the captured image to the iCE40 device through DVP interface. iCE40 device then analyzes the incoming image data, and uses the UART Tx channel to send out information representing captured image quality. In addition, a positive result is indicated by an LED on the board.

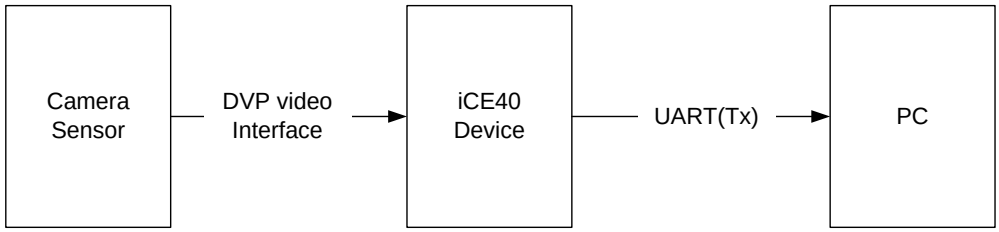

Figure 2.1. Face Detection Demo Diagram

© 2017 Lattice Semiconductor Corp. All Lattice trademarks, registered trademarks, patents, and disclaimers are as listed at www.latticesemi.com/legal. All other brand or product names are trademarks or registered trademarks of their respective holders. The specifications and information herein are subject to change without notice.

3. Demo Platform Setup

3.1. Configuring the MDP Board

3.1.1. Setting Jumpers and Switches

Before running the demo, the MDP board must be configured by setting the switches and jumpers as shown in Figure 3.1. Be sure to read the information in Table 3.1 for the correct configuration settings. The board photo shown here (Figure 3.1) is a generic photo and may not match the correct settings for this demo.

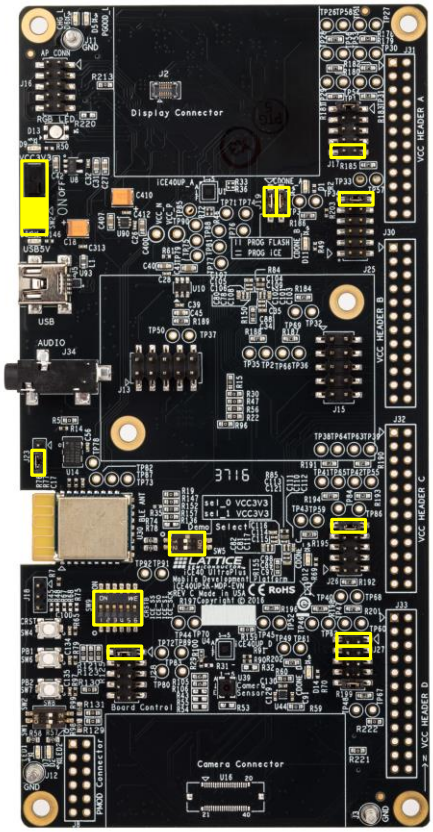

Figure 3.1. MDP Board with Configuration Locations Highlighted

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

Table 3.1. MDP Board Configuration Details

ITEMS	CONFIGURATION	DESCRIPTION
J17,J25,J26	Shunt pin 9-10	Disable ICE40UP5K_A/B/C devices.
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 the protective film is removed from the camera sensor U39.

© 2017 Lattice Semiconductor Corp. All Lattice trademarks, registered trademarks, patents, and disclaimers are as listed at www.latticesemi.com/legal. All other brand or product names are trademarks or registered trademarks of their respective holders. The specifications and information herein are subject to change without notice.

3.1.2. Programming SPI Flash on the MDP Board

To program SPI flash in Diamond Programmer (version 3.8 or higher):

1. Connect the MDP board to the PC using a USB cable and power ON the MDP board.
2. Start Diamond Programmer.
3. In the Diamond Programmer Getting Started dialog box, select **Create Blank Programmer Project**.
4. Set **Programming Speed Settings** to **Use customer Clock Divider** and select the value **5**.
5. Make sure the Cable Settings/Port: setting is FTUSB-0.
6. Set Device Family to “iCE40 UltraPlus” and Device to “iCE40UP5K”.
7. Open the Device Properties dialog. Apply the settings as shown in Figure 3.2.

   Access mode: set to “SPI Flash Programming”.

   Operation: set to “SPI Flash Erase, Program, Verify” mode.

   Programming File: load bit stream file for demo.

   SPI Flash Options: select correct Flash chip.

   Load from File button should be used to refresh fields such as “Data file size” and “End address (Hex)”.
8. Click **OK** to exit Device Properties dialog.
9. Click the **Program** button in Diamond Programmer to program the iCE40 UltraPlus FPGA device.

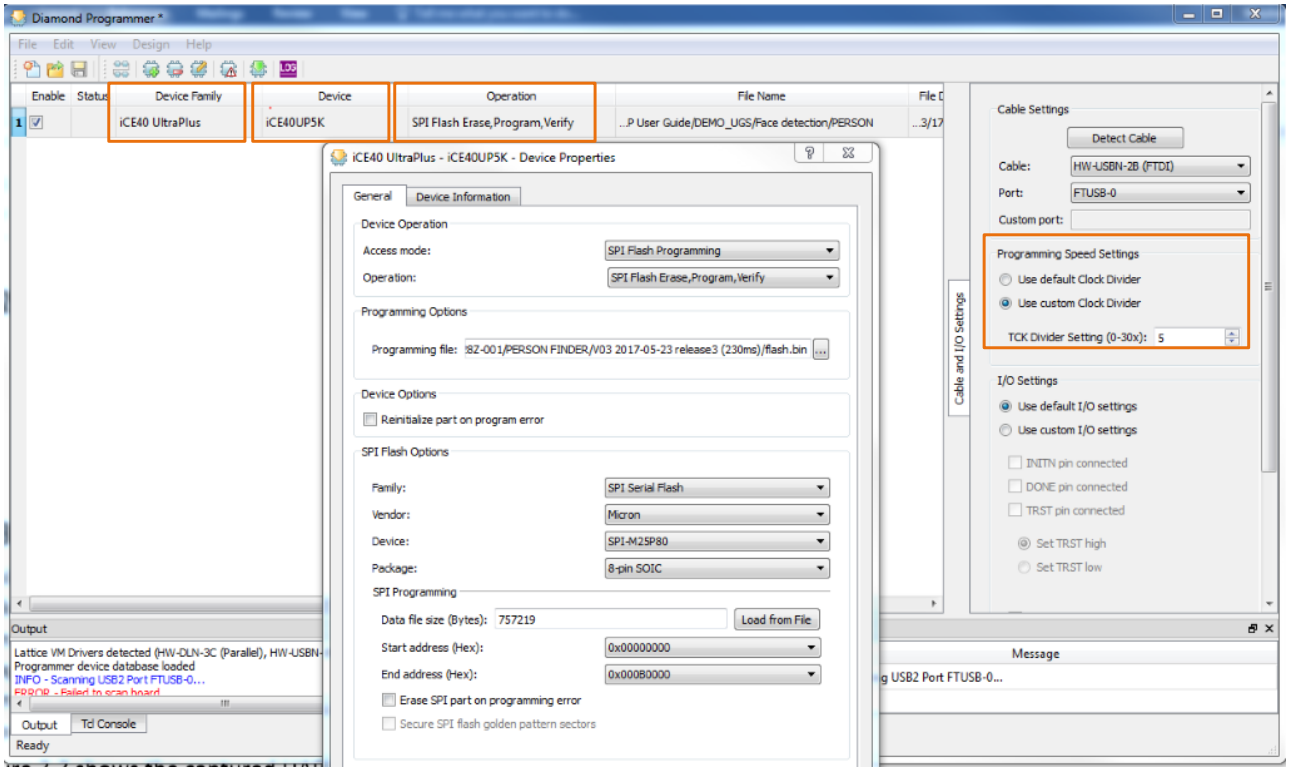

Figure 3.2. Programming Settings in Diamond Standalone Programmer

© 2017 Lattice Semiconductor Corp. All Lattice trademarks, registered trademarks, patents, and disclaimers are as listed at www.latticesemi.com/legal. All other brand or product names are trademarks or registered trademarks of their respective holders. The specifications and information herein are subject to change without notice.

4. Running the Face Detection Demo

There are two modes in this Demo, running the basic demo and observing detailed demo results via UART.

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

1. Power ON the MDP board.
2. LED D14 pulses rapidly about 10 times. After this, the pulse rate slows to about 1 pulse per second.
3. Position a face one to three feet from the board. Make sure that the camera sensor U39 is not obstructed.
4. When a face is detected, D14 stays illuminated. When a face is not detected, D14 pulses slowly.

To observe the detailed demo results via UART:

A universal external UART tool working in TTL mode can be used to monitor the serial information printed out from the ICE40UP5K_D device.

* **Note**: On the MDP board, J33 pin 3 is used as the Tx pin in the serial port. This connects the UART Tx channel from the iCE40UP5K_D device to the FTDI FT2232HL USB controller UART (U9 pin 39).

1. Connect the MDP board to the PC via the USB connector.
2. Set the UART to 115200, baud rate (8-N-1).
3. Power ON the MDP board.
4. LED D14 pulses rapidly about 10 times. After this, the pulse rate slows to about 1 pulse per second.
5. Position a human face roughly one to three feet away from the camera. Make sure that the camera sensor U39 is not obstructed.

   The camera sensor starts to acquire image frames. At the same time, the UART starts to print out information representing captured image quality.

Figure 4.1 shows the captured UART information sent out from the ICE40UP5K_D device.

```
 1 CES demo
 2 Lattice
 3 categories:
 4 noface
 5 face
 6 Frame 0: 446 ms Face Score = -47
 7 Frame 1: 439 ms Face Score = -38
 8 Frame 2: 439 ms Face Score = -26
 9 Frame 3: 439 ms Face Score = -45
10 Frame 4: 439 ms Face Score = -33
11 Frame 5: 439 ms Face Score = -41
12 Frame 6: 439 ms Face Score = -37
13 Frame 7: 439 ms Face Score = 20
14 Frame 8: 439 ms Face Score = 20
15 Frame 9: 439 ms Face Score = 21
16 Frame 10: 439 ms Face Score = 27
17 Frame 11: 439 ms Face Score = 25
18 Frame 12: 439 ms Face Score = 26
19 Frame 13: 439 ms Face Score = 26
```

Figure 4.1. UART Printout Information

There are two categories included, “noface” and “face". The Face Score value indicates the quality of the captured image. A higher score indicates a better match.

© 2017 Lattice Semiconductor Corp. All Lattice trademarks, registered trademarks, patents, and disclaimers are as listed at www.latticesemi.com/legal. All other brand or product names are trademarks or registered trademarks of their respective holders. The specifications and information herein are subject to change without notice.

Technical Support

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

© 2017 Lattice Semiconductor Corp. All Lattice trademarks, registered trademarks, patents, and disclaimers are as listed at www.latticesemi.com/legal. All other brand or product names are trademarks or registered trademarks of their respective holders. The specifications and information herein are subject to change without notice.

Revision History

Date	Version	Change Summary
November 2017	1.1	Various updates to clarify the demo operation.
June 2017	1.0	Initial release.

© 2017 Lattice Semiconductor Corp. All Lattice trademarks, registered trademarks, patents, and disclaimers are as listed at www.latticesemi.com/legal. All other brand or product names are trademarks or registered trademarks of their respective holders. The specifications and information herein are subject to change without notice.

7th Floor, 111 SW 5th Avenue
Portland, OR 97204, USA
T 503.268.8000
www.latticesemi.com