CrossLink-NX User Tracking and Onlooker Detection on VVML Board Demonstration

User Guide

FPGA-UG-02140-1.1

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Abbreviations in This Document

A list of abbreviations used in this document.

Abbreviations	Definition
AT	Attention Tracking
FPGA	Field-Programmable Gate Array
SPI	Serial Peripheral Interface
SS	Shoulder Surfing
SRAM	Static Random Access Memory
USB	Universal Serial Bus
VVML	Voice and Vision Machine Learning

1. Introduction

Lattice vision sensing technology safeguards the user data against visual hacking by tracking onlookers and their intent to look onto the user screen content.

This document describes the CrossLink™-NX User Tracking and Onlooker Detection on VVML Board Demonstration. You need prebuilt .mcs and .bit files to program the Crosslink-NX VVML board.

2. Functional Description

The User Tracking and Onlooker Detection Demonstration design has a total application power consumption of less than 80 mW using the CrossLink-NX FPGA and processing at up to 60 FPS and 160 × 160 resolution.

Figure 2.1 and Figure 2.2 show the top view and bottom view of the VVML board used in this demonstration.

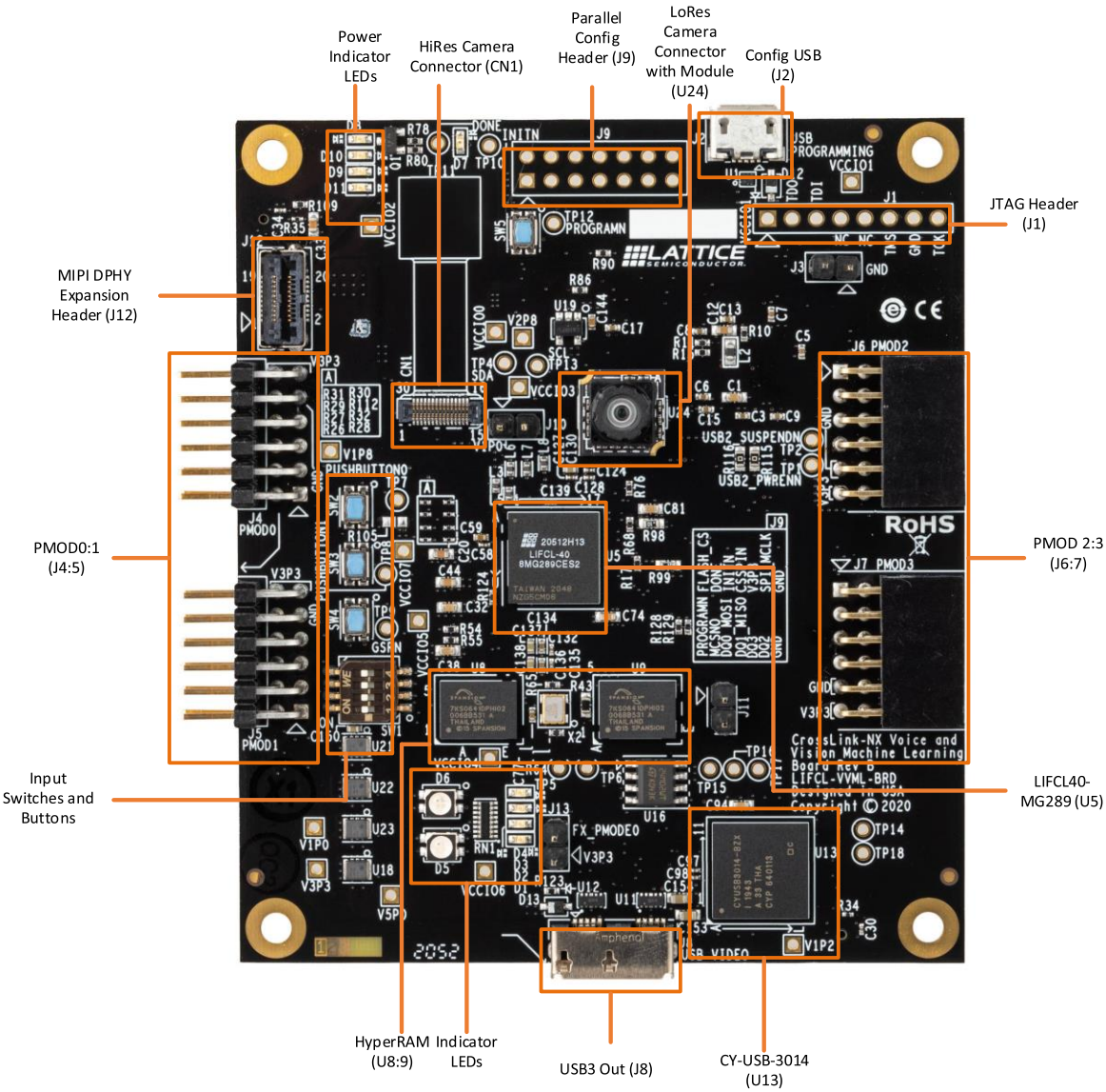

Figure 2.1. Top View of the CrossLink-NX Voice and Vision Machine Learning Board

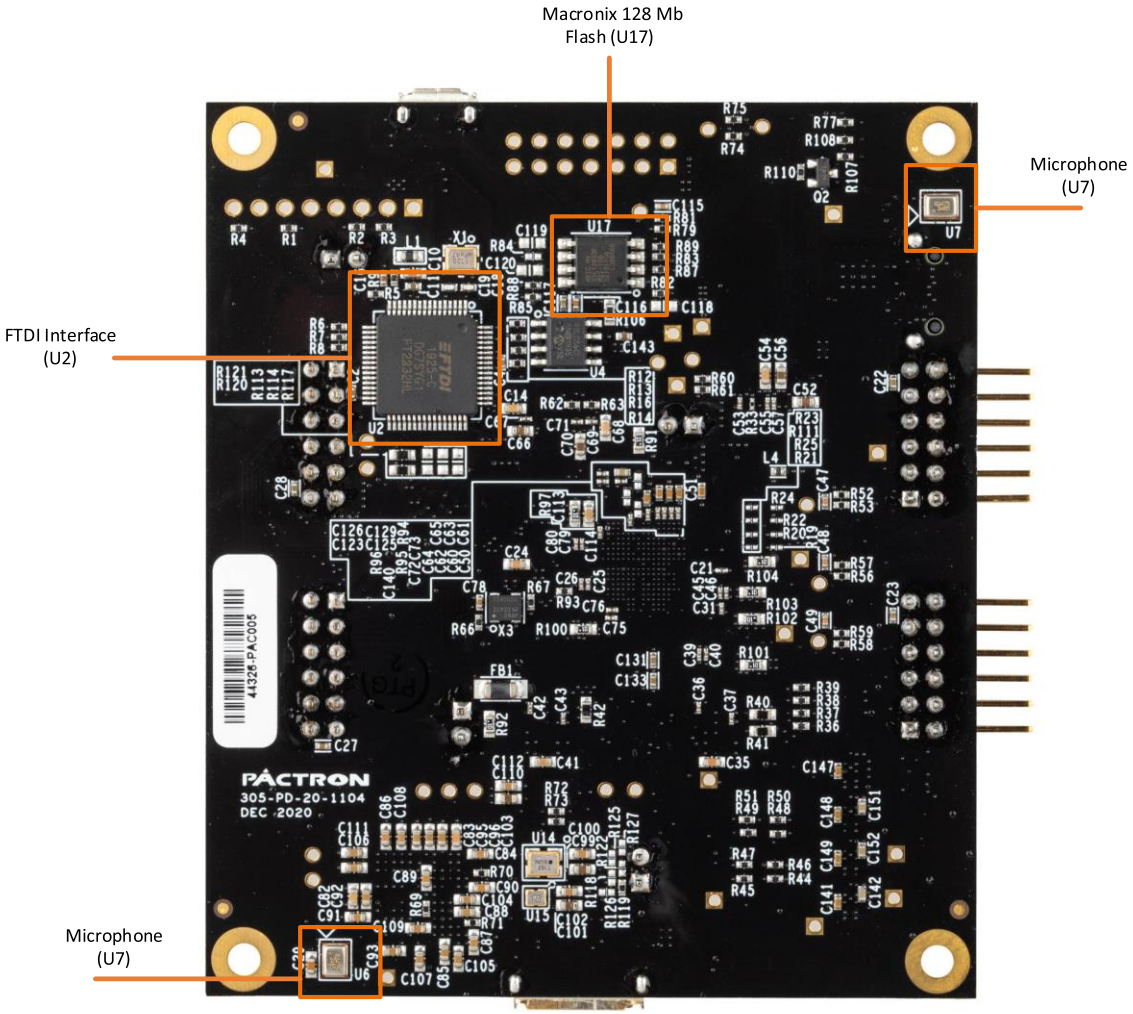

Figure 2.2. Bottom View of the CrossLink-NX Voice and Vision Machine Learning Board

3. Demo Setup

This section describes the demo setup.

3.1. Hardware Requirements

- CrossLink-NX Voice and Vision Machine Learning Board, Rev. B
- USB3 cable
- Personal computer

3.2. Software Requirements

- Lattice Radiant™ Programmer version 3 (Refer to http://www.latticesemi.com/programmer)

4. Programming the Demo

4.1. Package Folder Structure

Figure 4.1 shows the demo folders and files after unzipping the package.

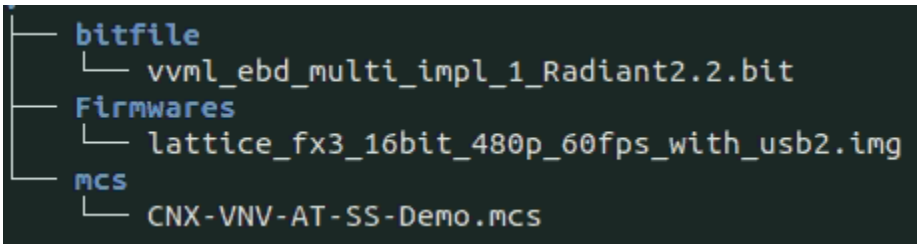

Figure 4.1. Demo Package Folder Structure.

Refer to the CrossLink-NX User Tracking and Onlooker Detection on VVML Board Demo – Bitstream link to the reference design.

4.2. Loading FX3 Firmware from I2C EEPROM

To load the firmware:

1. Connect the USB3 port of the CrossLink-NX VVML board to the PC using the USB3 cable.
2. Open the USB Control Centre application. The Cypress FX3 SDK should be installed.
3. In the CrossLink VVML board, set the jumper on J13 to make the FX3 firmware programmable.
4. Connect the FX3 cable to the display monitor.
5. Press the SW5 button to reset the FX3 chip. Figure 4.2 shows the boot loader device screen.

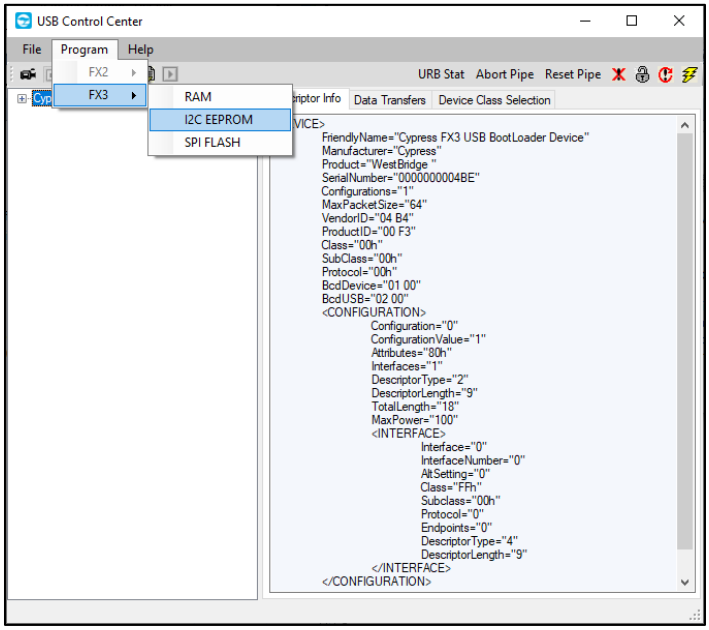

Figure 4.2. Selecting FX3 I2C EEPROM in USB Control Centre

6. Select **Cypress USB Bootloader**.
7. Click **Program > FX3 > I2C E2PROM**.
8. Locate and select the FX3 image file for the 640 × 480p 60 Hz 16-bit configuration.
9. The Firmware is programmed in the I2C E2PROM.
10. After the operation is completed, a message acknowledging successful programming is shown at the bottom taskbar.
11. Remove jumper J13.
12. Power OFF and then power ON the board.
13. The FX3 boots from I2C E2PROM.

4.3. Programming the CrossLink-NX Voice and Vision SPI Flash

4.3.1. Erasing the CrossLink-NX Voice and Vision SRAM Prior to Reprogramming

If the CrossLink-NX device is already programmed (either directly, or loaded from SPI Flash), follow this procedure first to erase the CrossLink-NX SRAM memory before re-programming the SPI Flash. If you are doing this, keep the board powered when re-programming the SPI Flash (so it does not reload on reboot).

To erase the CrossLink-NX device:

1. Launch Lattice Radiant™ Programmer. In the **Getting Started** dialog box, select **Create a new blank project**.

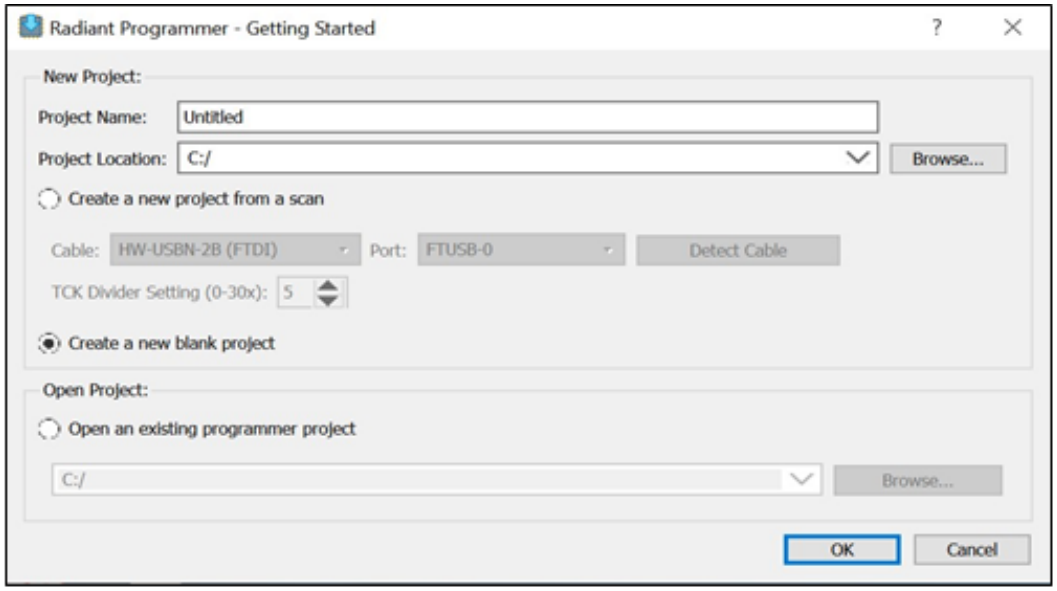

Figure 4.3. Lattice Radiant Programmer Default Screen

2. Click **OK**.

3. In the Lattice Radiant Programmer main interface, select **LIFCL** for Device Family, as shown in Figure 4.4. Select **LIFCL** for Device Vendor, and **LIFCL-40** for Device,

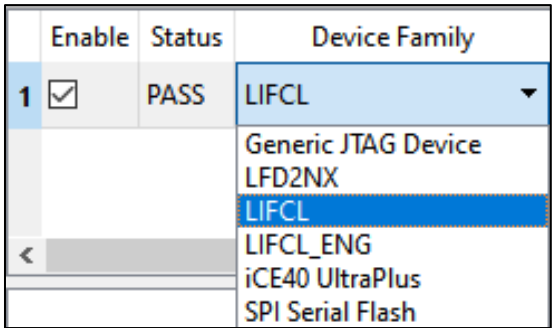

Figure 4.4. Lattice Radiant Programmer- Device Selection

4. Right-click and select **Device Properties**.
5. Select **JTAG** for **Port Interface**, **Direct Programming** for Access Mode, and **Erase Only** for Operation, as shown in Figure 4.5.

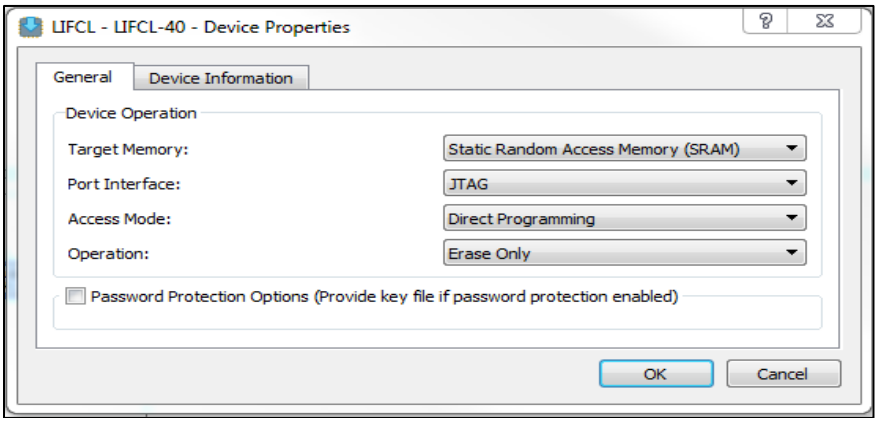

Figure 4.5. Lattice Radiant Programmer – Device Operation

6. Click **OK** to close the **Device Properties** dialog box.
7. Press and hold SW5 until you see the *Successful* message in the Lattice Radiant log window.
8. In the Radiant Programmer main interface, click the Program button to start the erase operation.

4.3.2. Programming the CrossLink-NX Board

To program the CrossLink-NX Voice and Vision SPI Flash:

1. Ensure that the CrossLink-NX Voice and Vision device SRAM is erased by performing the steps in the Erasing the CrossLink-NX Voice and Vision SRAM Prior to Reprogramming section.
2. In the Lattice Radiant Programmer main interface, right-click the CrossLink-NX Voice and Vision row and select **Device Properties**.

3. In the **Device Properties** dialog box, apply the settings shown in Figure 4.6.

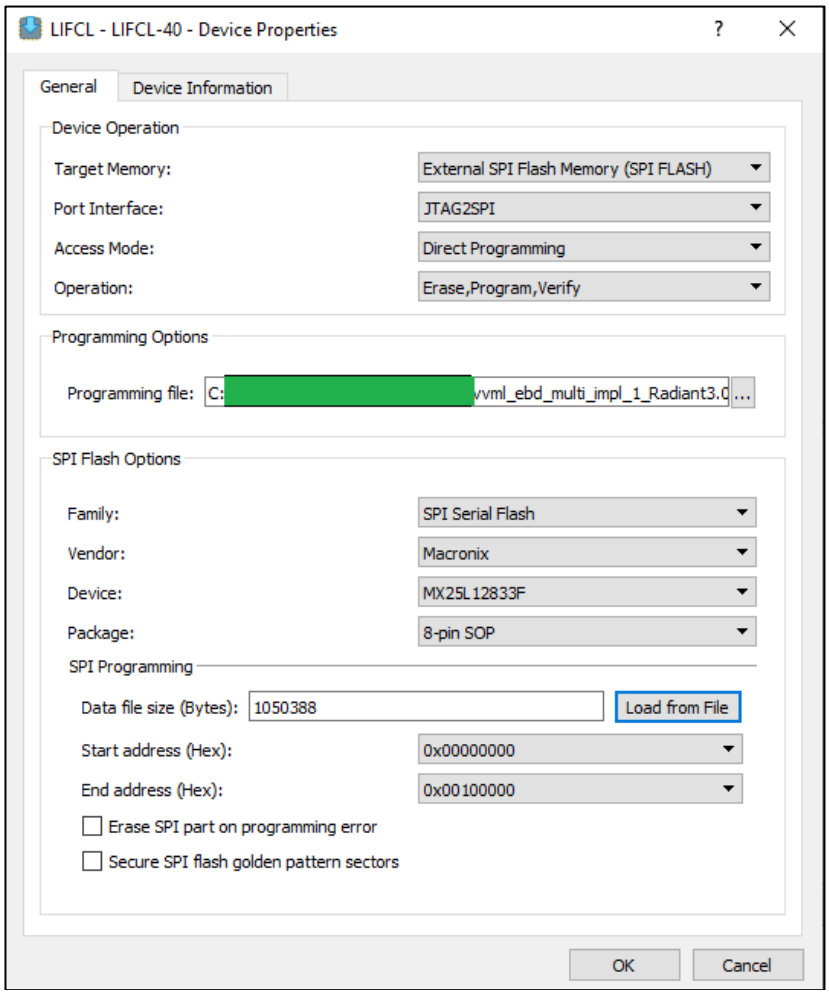

Figure 4.6. Lattice Radiant Programmer – Selecting Device Properties Options for CrossLink-NX Flashing

Notes:

- In **Programming file**, browse and select the CrossLink-NX Voice and Vision bit file (*.bit).
- Click **Load from File** to update the Data file size (bytes) value.
- Ensure that the following addresses are correct:
  - Start Address (Hex) – 0x00000000
  - End Address (Hex) – 0x00220000

4. Click **OK**.

5. Press and hold SW5 until you see the *Successful* message in the Lattice Radiant log window as shown in Figure 4.7.

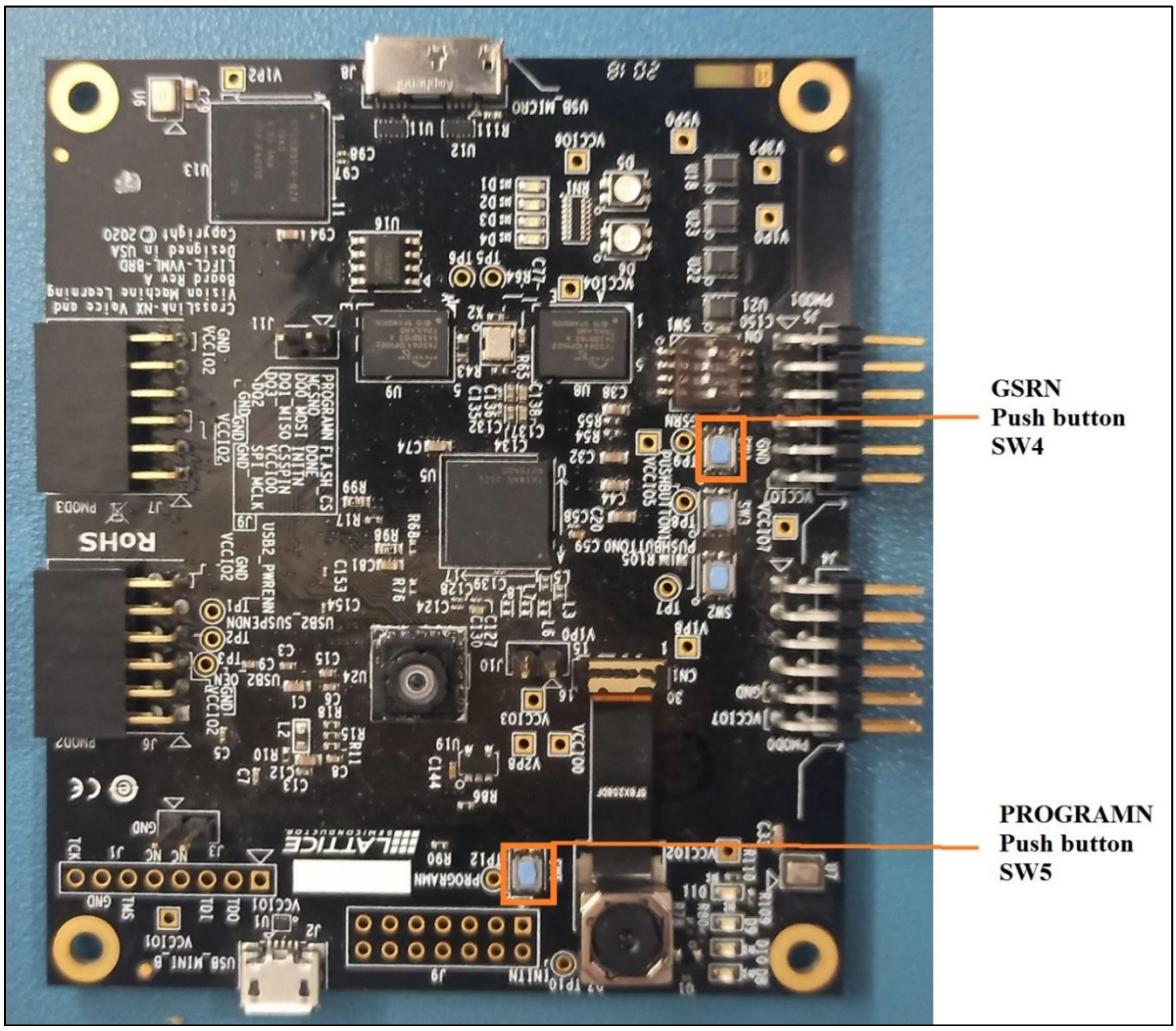

Figure 4.7. CrossLink-NX Flashing Switch – SW4 Push Button

6. Click the **Program** button to start the programming operation.
7. After successful programming, the **Output** console displays the result, as shown in Figure 4.8.

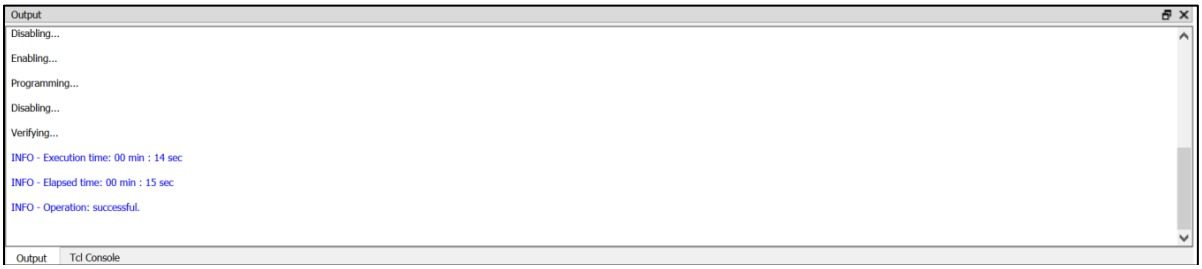

Figure 4.8. Lattice Radiant Programmer – Output Console

4.3.3. Programming sensAI Firmware Binary to the CrossLink-NX SPI Flash

4.3.3.1. Converting Flash sensAI Firmware Hex to CrossLink-NX SPI Flash

To program the CrossLink-NX SPI flash:

1. Ensure that the CrossLink-NX device SRAM is erased by performing the steps in the Erasing the CrossLink-NX Voice and Vision SRAM Prior to Reprogramming section before flashing bitstream and sensAI firmware binary.
2. In the Lattice Radiant Programmer main interface, right-click the CrossLink-NX row and select **Device Properties**.
3. In the **Device Properties** dialog box, apply the settings as shown in Figure 4.9.

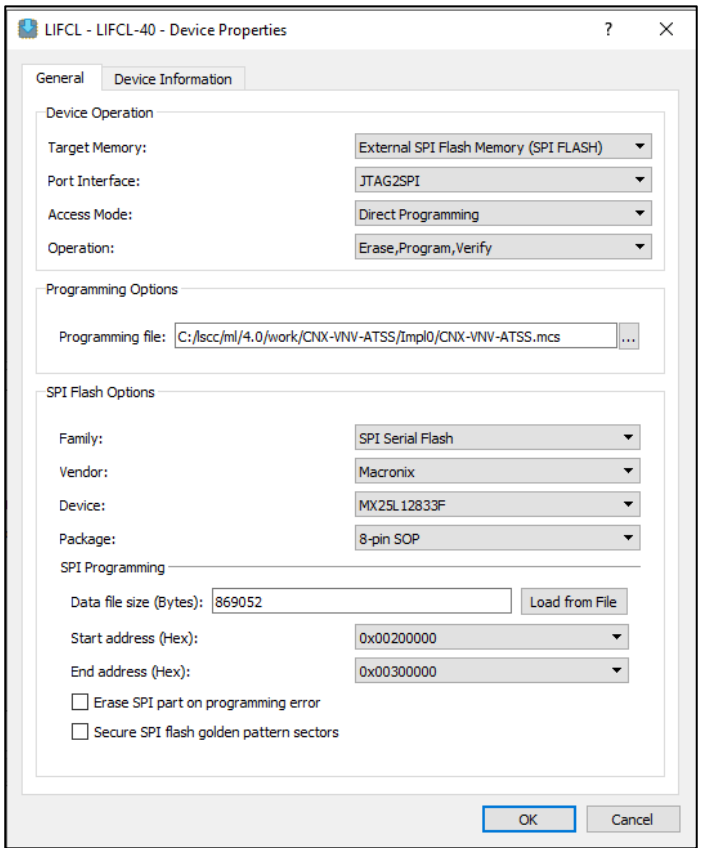

Figure 4.9. Lattice Radiant Programmer – Selecting Device Properties Options for CrossLink-NX Flashing

Notes:

- In **Programming file**, browse and select the CrossLink-NX sensAI firmware binary file after converting it to hex (*.mcs).
- Click **Load from File** to update the Data file size (bytes) value.
- Ensure that the following addresses are correct:
  - Start Address (Hex) – 0x00300000
  - End Address (Hex) – 0x00400000

4. Click **OK**.
5. Press and hold SW5 until you see the *Successful* message in the Lattice Radiant log window.
6. Click the **Program** button to start the programming operation.

7. After successful programming, the **Output** console displays the result, as shown in Figure 4.10.

Figure 4.10. Lattice Radiant Programmer – Output Console

5. Setting up Dip Switch and Running the Demo

5.1. Setting up Dip Switch

The Dip Switch should be set as shown in Figure 5.1.

- Switch 1: ON
- Switch 2: OFF
- Switch 3: ON
- Switch 4: OFF

Note: ON is AWAY from the *1 2 3 4* markings on DIP switch.

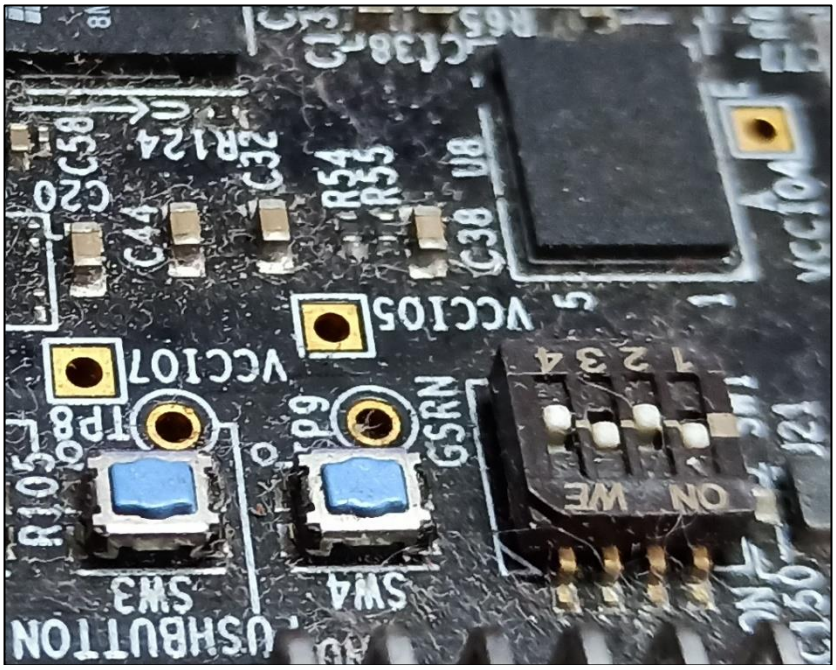

Figure 5.1. DIP Switch Setup

5.2. Running the Demo

To run the demo:

1. Power on the VVML board.
2. Connect the VVML board to the PC through the USB3 port.
3. Open the Windows utility and select the FX3 Device as source and set the USB port to the maximum number ports available.
4. The camera image is displayed on monitors shown in Figure 5.2.

Figure 5.2. Demo Camera Image 1

5. At-SS output, four colored boxes indicate the different user states.
   - Green – Front Facing User
   - Blue – Not Front Facing User
   - Red – Front Facing Non-user
   - Purple – Not Front Facing Non-user

Figure 5.3. Demo Camera Image 2

Figure 5.4. Demo Camera Image 3

5.3. Ideal Conditions for Testing the Demo

- Distance – The user should be in the range of 1.5 feet to 5 feet away from the camera.
  The demo may not be able to distinguish between a front facing user and a non-front facing user when they are more than four feet away.
- Lighting – Proper lighting is needed to efficiently run demo. Too low and direct light from a source may reduce the performance quality of the demo.

References

- User Tracking and Onlooker Detection Demonstration web page
- CrossLink-NX User Tracking and Onlooker Detection on VVML Board Demo – Bitstream
- Lattice Radiant FPGA design software
- Lattice Radiant Programmer version 3
- Lattice Radiant Software User Guide
- Lattice Insights for Lattice Semiconductor training courses and learning plans

Technical Support Assistance

Submit a technical support case through www.latticesemi.com/techsupport.

For frequently asked questions, please refer to the Lattice Answer Database at www.latticesemi.com/Support/AnswerDatabase.

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Revision History

Revision 1.1, August 2024

Section	Change Summary
All	Minor editorial fixes.
Disclaimers	Updated this section.
Abbreviation in This Document	Updated the section title from *Acronyms* to *Abbreviations* in This Document.
Programming the Demo	Added the CrossLink-NX User Tracking and Onlooker Detection on VVML Board Demo – Bitstream link to the reference design in the Package Folder Structure subsection.
References	Added this section.
Technical Support Assistance	Added reference to the Lattice Answer Database on the Lattice website.

Revision 1.0, November 2021

Section	Change Summary
All	Initial release

www.latticesemi.com