CrossLink-NX ROI Face ID using VVML Board Demonstration

User Guide

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Acronyms in This Document

A list of acronyms used in this document.

Acronym	Definition
FPGA	Field-Programmable Gate Array
SPI	Serial Peripheral Interface
SRAM	Static Random-Access Memory
USB	Universal Serial Bus
VVML	Voice and Vision Machine Learning

1. Introduction

This document describes the Face ID demo using the CrossLink™-NX Voice and Vision Machine Learning (VVML) platform.

2. Functional Description

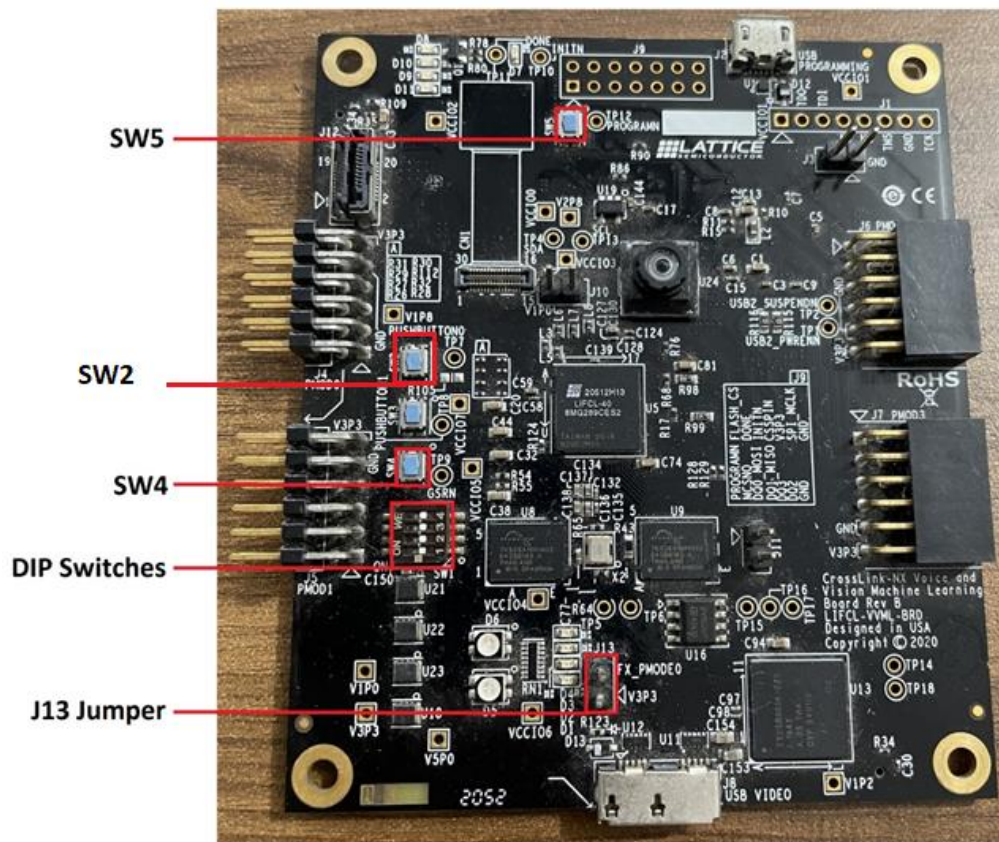Figure 2.1 shows the top view of the VVML board used in this demonstration.

Figure 2.1. VVML Rev-B board - Top View

3. Demo Setup

This section describes the demo setup.

3.1. Hardware Requirements

- CrossLink-NX Voice and Vision Machine Learning Board, Rev. B
- USB 3.0 A to Micro B cable (To load firmware in FX3 and to run demo using video visualizing tool), USB 2.0 A to Micro B cable (to program Crosslink-NX VVML board)
- Personal computer

3.2. Software Requirements

- Lattice Radiant™ Programmer version 3 (Refer to http://www.latticesemi.com/programmer)
- Cypress - EZ-USB FX3 Software Development Kit (Refer to https://www.cypress.com/documentation/software-and-drivers/ez-usb-fx3-software-development-kit)
- Video visualizing tool to see output, user can use one of below tool:

1. VLC Media Player: https://www.videolan.org/vlc/download-windows.html

2. Windows Camera APP: To use windows camera app user must change default webcam if other camera device is connected to system. For more info user can follow steps mentioned in link: https://answers.microsoft.com/en-us/windows/forum/all/how-to-change-default-webcam-in-windows-10/1e8377c8-4fd5-4e9c-8ab6-67913c5c8e0c.

3. AMCap: http://noeld.com/programs.asp?cat=video.

FPGA-UG-02159-1.0

4.   Programming the Demo

This document describes the FaceID Demo running process using the Crosslink-NX™ Voice and Vision platform.

To Run the demo user will need prebuilt '.mcs' and '.bit' file to program the Crosslink-NX VnV board.

4.1.   Package Folder Structure

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

```
▼ ROI_FaceID
    ▼ bitfiles
        vvml_sf_face_id_96x96_atss_faceid_th38_facebox_option.bit
    ▼ firmwares
        lattice_fx3_16bit_480p_60fps_with_usb2.img
    ▼ mcs
        Untitled.xcf
        prog_facecls_0929_1320_OPT_LREG_96x96.mcs
        prog_facedet_c1_0715_0959_OPT_LREG_read.mcs
        prog_model_20211008_150404_OPT_LREG.mcs
```

Figure 4.1. Demo Package Folder Structure

4.2. Load Firmware in FX3 I2C EEPROM

To load the firmware:

1.   Connect jumper J13, user refer to section Functional Description for location of jumper on VVML Board.

2.   Connect the USB3 port of the CrossLink-NX VVML Board (Rev B) to the PC using the USB3 cable.

3.   Open the USB Control Centre application. The Cypress FX3 SDK should be installed.

4.   Press the SW2 button to reset the FX3 chip. Figure 4.2 shows the boot loader device screen.
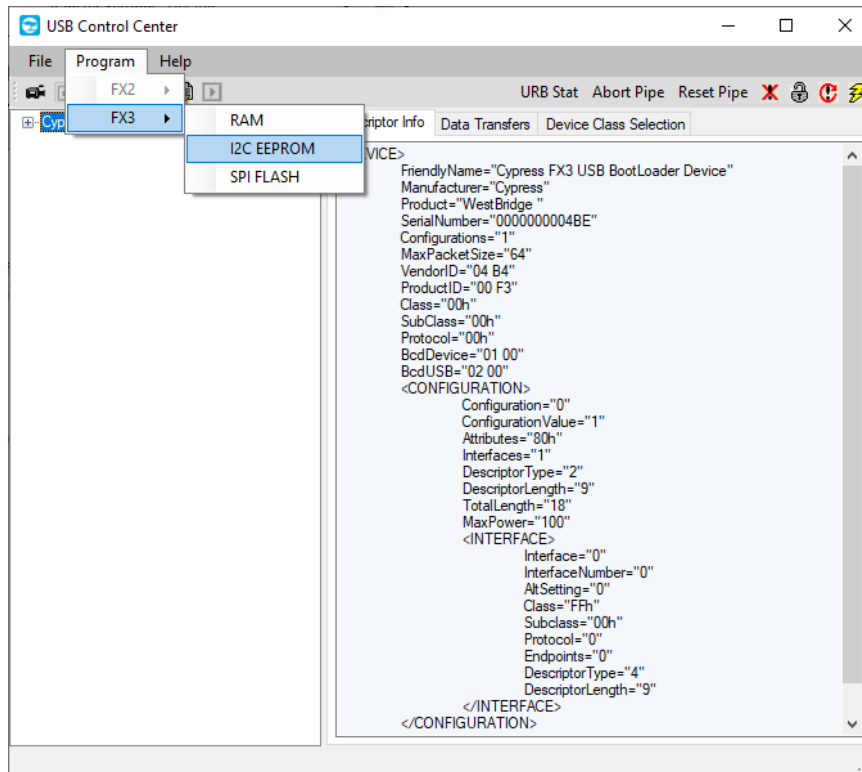
Figure 4.2. Selecting FX3 I2C EEPROM in USB Control Centre

5. Select Cypress USB Bootloader.

6. Click Program > FX3 > I2C E2PROM.

7. Locate and select the FX3 image file for the 640 × 480p 60 Hz 16 bit configuration.

8. The Firmware is programmed in the I^{2}C E2PROM.

9. After the operation is completed, a message acknowledging successful programming is shown at the bottom taskbar.

10. Remove jumper J13.

11. Power OFF and then power ON the board.

12. The FX3 boots from I^{2}C 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 reprogramming 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.

FPGA-UG-02159-1.0
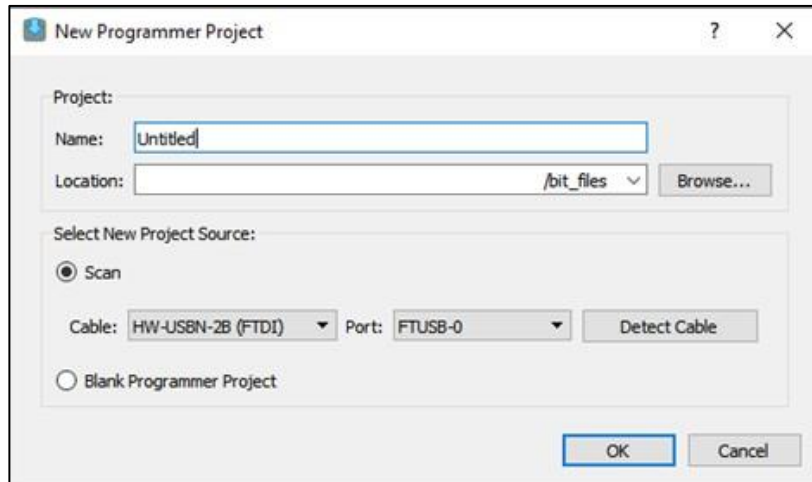
Figure 4.3. Lattice Radiant Programmer Default Screen

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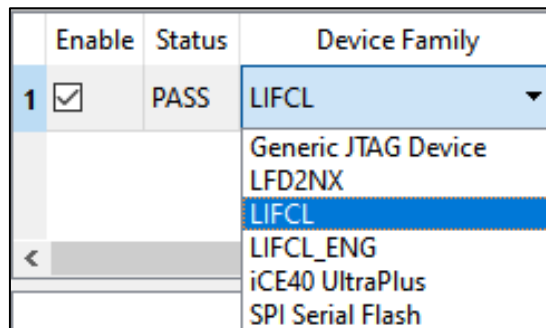
Figure 4.4. Lattice Radiant Programmer- Device Selection

5. Right-click and select Device Properties.
6. Select JTAG for Port Interface, Direct Programming for Access Mode, and Erase Only for Operation, as shown in Figure 4.5.
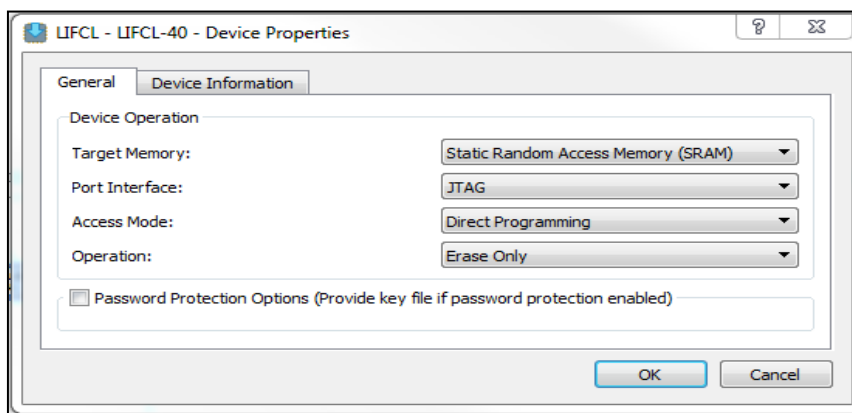
Figure 4.5. Lattice Radiant Programmer – Device Operation

7. Click OK to close the Device Properties dialog box.

8. Press and hold SW5 until you see the Successful message in the Lattice Radiant log window.

9. In the Radiant Programmer main interface, click the Program   button to start the erase operation.

4.3.2. Programming the CrossLink-NX Voice and Vision 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 Operation and select Device Properties.

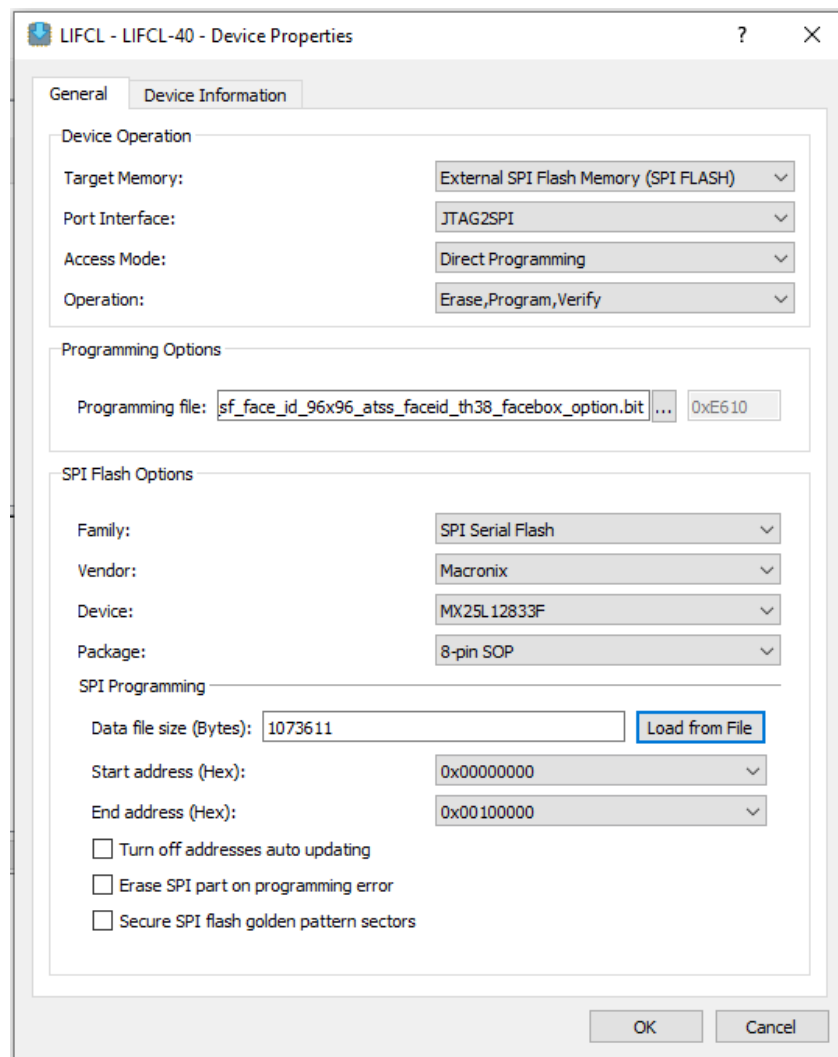3. In the Device Properties dialog box, apply the settings shown in Figure 4.6.

Figure 4.6. 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) – 0x00100000

4. Click OK.

5. Now press SW5 push button switch before clicking program button in below step and keep it pressed till you see Successful message in 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 4.7.


Figure 4.7. CrossLink-NX Voice and Vision Flashing Switch – SW5 Push Button

4.3.3. Programming SensAI Firmware Binary to the CrossLink-NX Voice and Vision SPI Flash

4.3.3.1. Flash SensAI Firmware Hex for Face Detection 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 4.8.
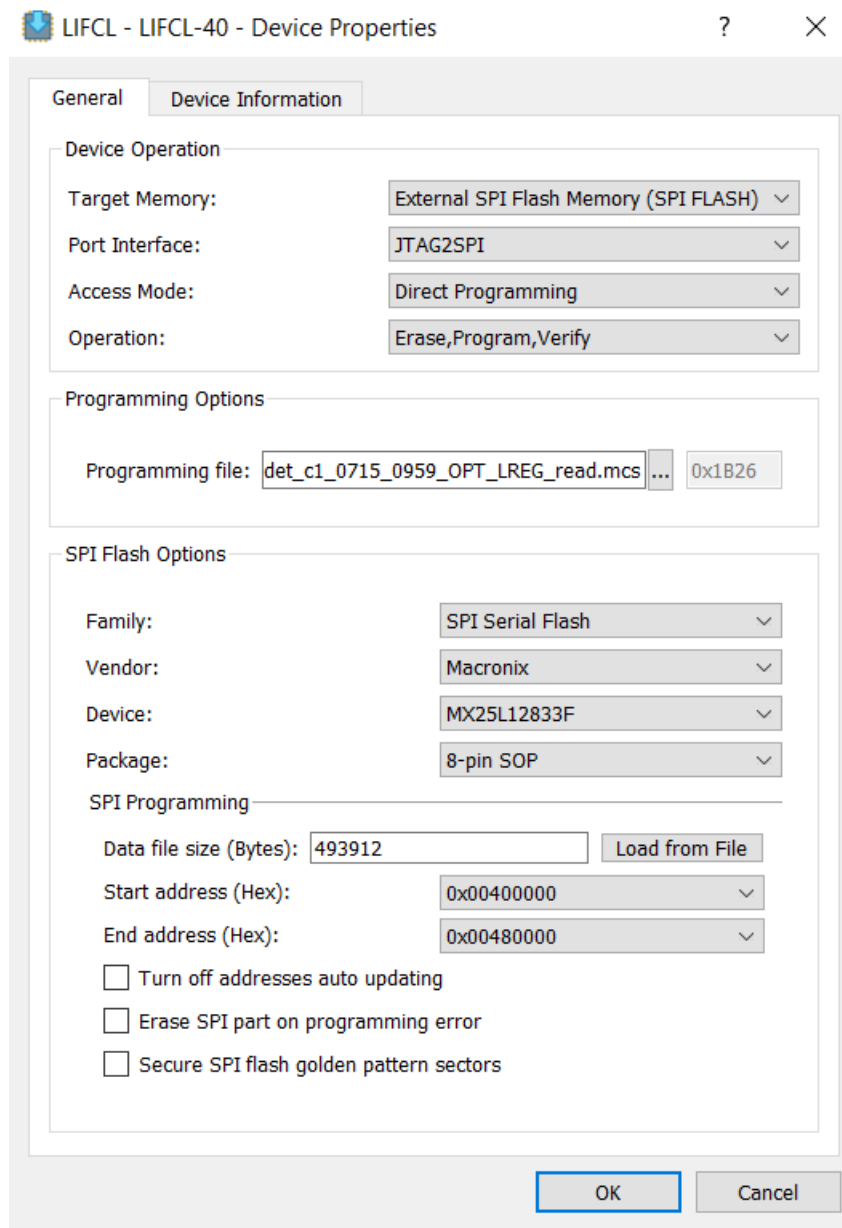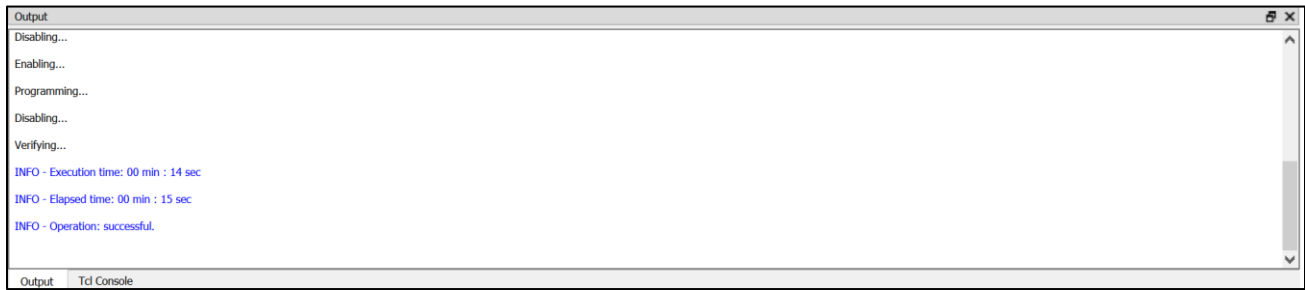
Figure 4.8. Radiant Programmer – Selecting Device Properties Options for CrossLink-NX Flashing

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) – 0x00400000
    - End Address (Hex) – 0x00480000
4. Click OK.
5. Now press SW5 push button switch before clicking program button in below step and keep it pressed till you see Successful message in 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 4.9.


Figure 4.9. Radiant Programmer – Output Console

4.3.3.2. Flash SensAI Firmware Hex for AT-SS Classification 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 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 4.10.
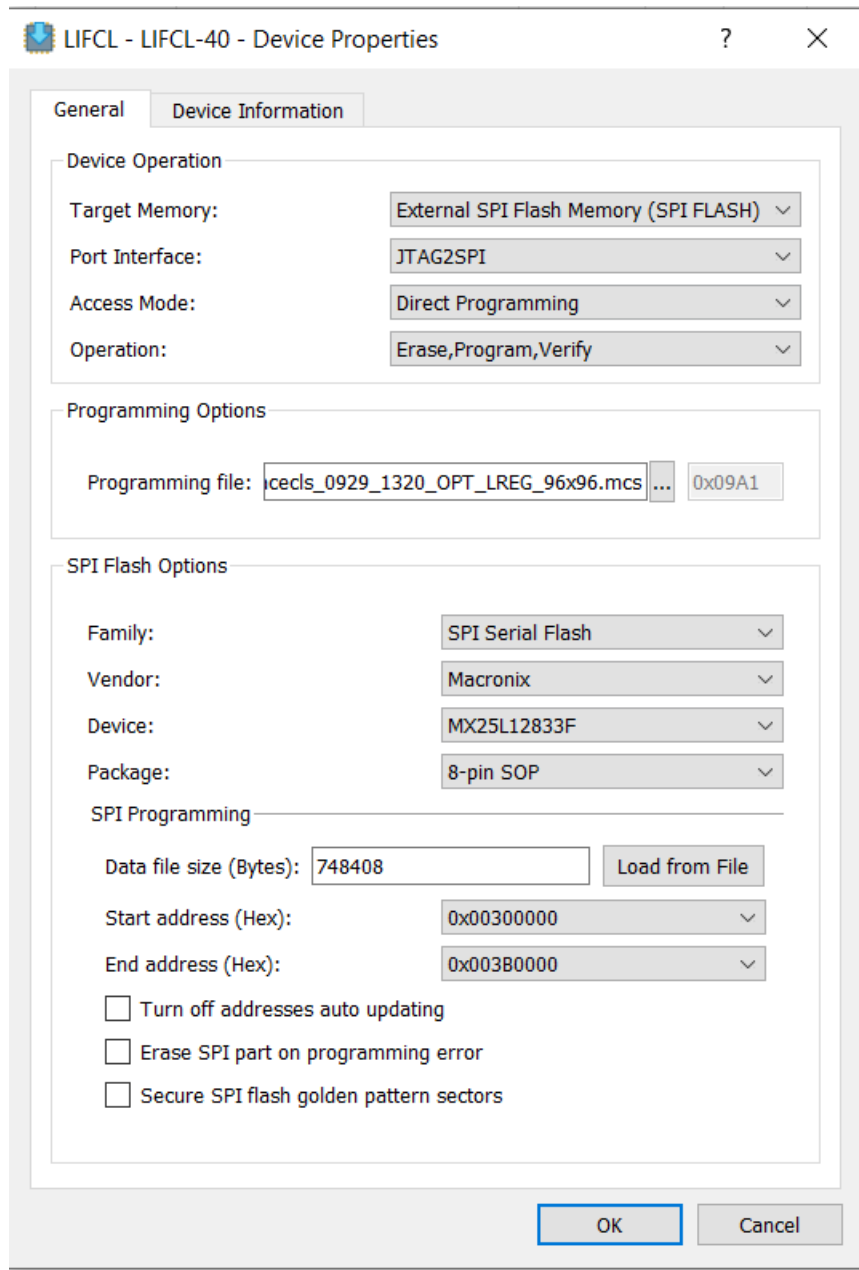
Figure 4.10. Radiant Programmer – Selecting Device Properties Options for CrossLink-NX Flashing

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) – 0x003B0000
4. Click OK.
5. Now press SW5 push button switch before clicking program button in below step and keep it pressed till you see Successful message in 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 4.11.

Figure 4.11. Radiant Programmer – Output Console

4.3.3.3. Flash SensAI Firmware Hex for Face Recognition 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 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 4.12.
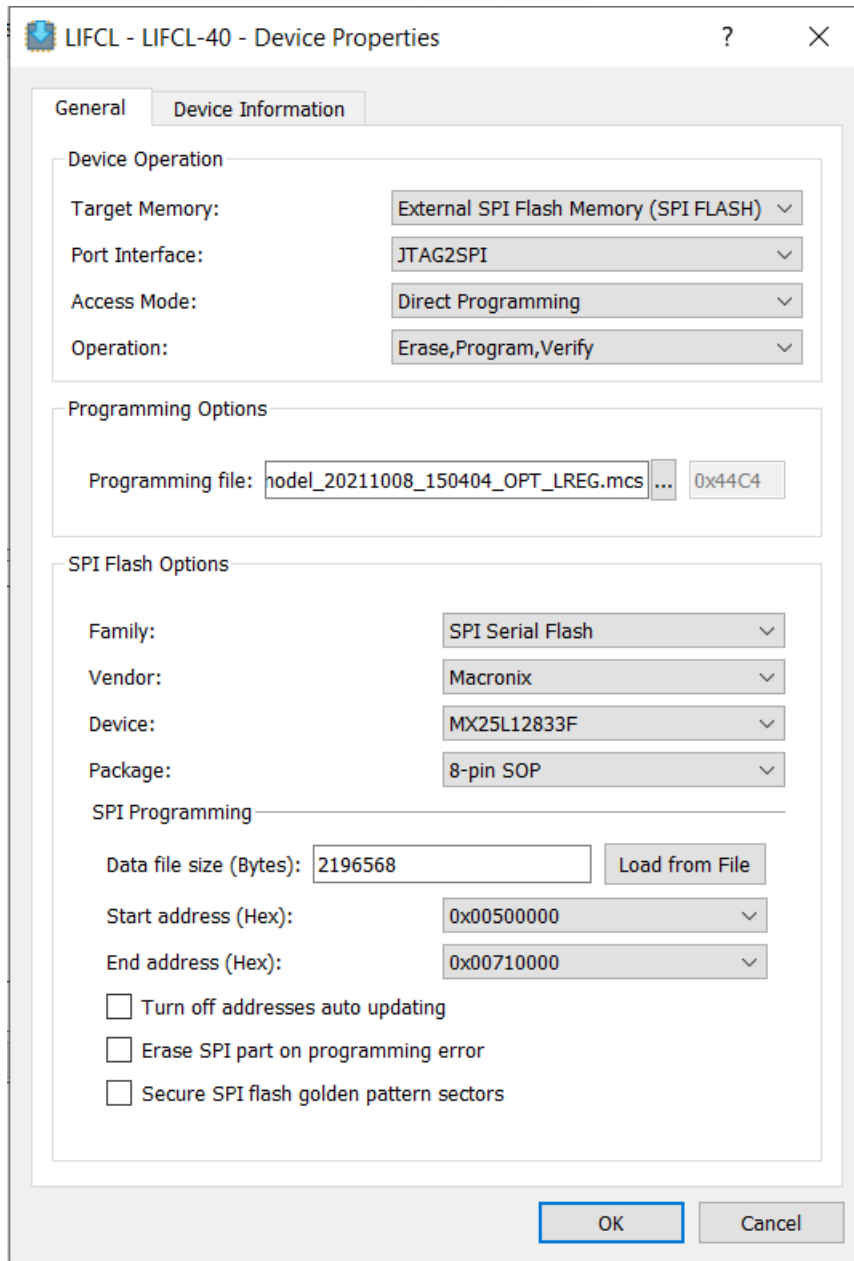
Figure 4.12. Radiant Programmer – Selecting Device Properties Options for CrossLink-NX Flashing

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) – 0x00500000
  - End Address (Hex) – 0x00710000
4. Click OK.

5. Now press SW5 push button switch before clicking program button in below step and keep it pressed till you see Successful message in Radiant log window.

6.   Click the Program button ![button] to start the programming operation.

7.   After successful programming, the Output console displays the result, as shown in Figure 4.13.

Figure 4.13. Radiant Programmer – Output Console

5. Running the Demo

1. To run the demo:
2. Power on the VVML board.
3. Make sure that the position of DIP SWITCH positions as given in the table below

DIP Switch	State
SWITCH 1	OFF
SWITCH 2	OFF
SWITCH 3	OFF
SWITCH 4	ON

4. Flash the .bit and .mcs files.
5. Connect the VVML board to the PC through the USB3 port.
6. Open one of video tool:
7. For AMCap video display application and select the FX3 Device as source from under Devices.
8. For Windows Camera app disable other camera device if any available and set FX3 as default camera device as mentioned in Load Firmware in FX3 I2C EEPROM.
9. For VLC Media player click Media -> Open Capture Device and select video device name as FX3.
10. The camera image with green guide lines enabled is displayed in the output Figure 5.1.
11. AT-SS output can be interpreted as following:
- Green box: Attentive user
- Blue box: Non-Attentive user
- The right bottom corner shows the Region of Interest i.e. cropped detected faces
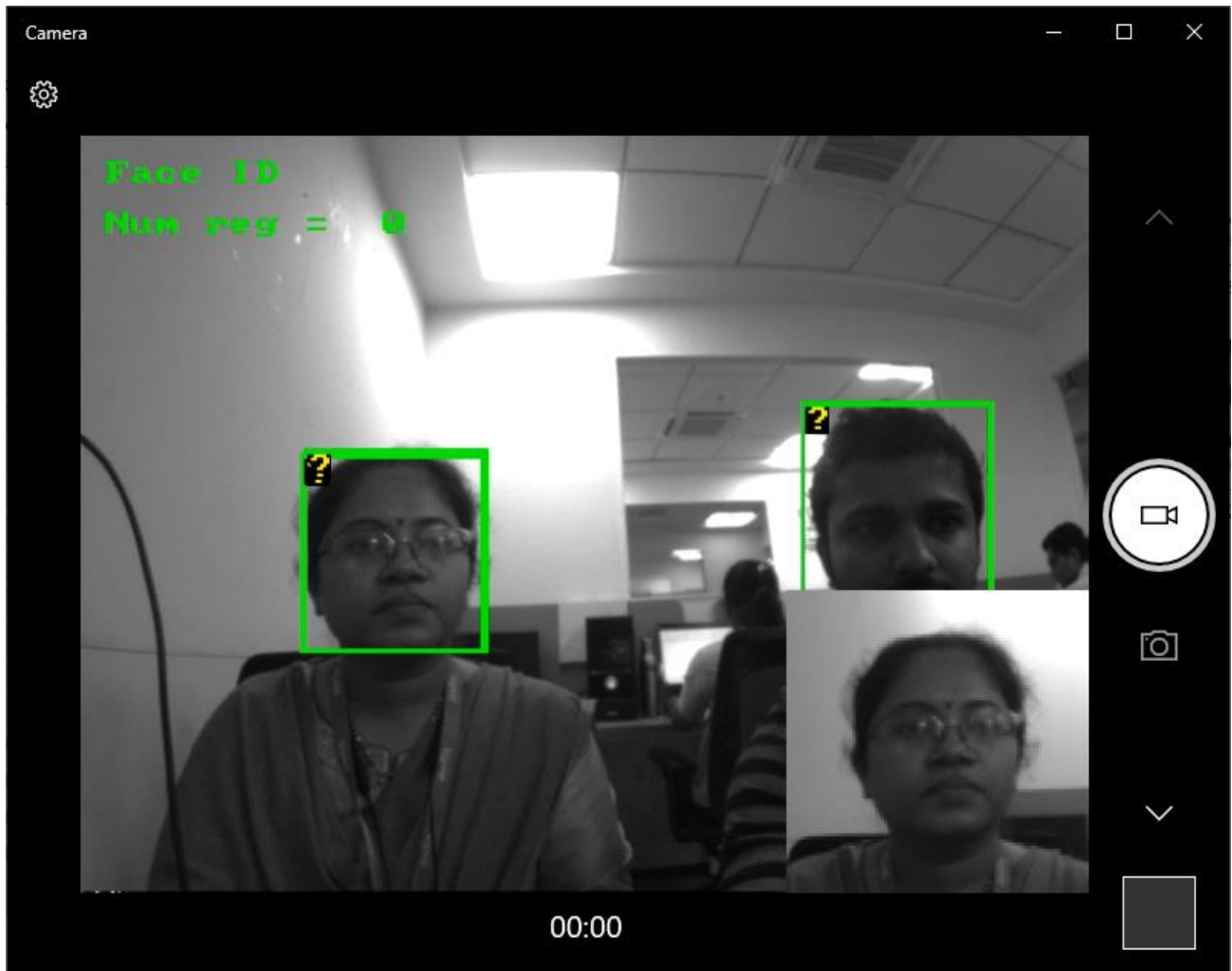
Figure 5.1. Running the Demo

12. FaceID Registration:
- To register a new face, press SW2 button once.
- Please note that only one face must be present in the frame while user registration
- User can register upto 16 faces.
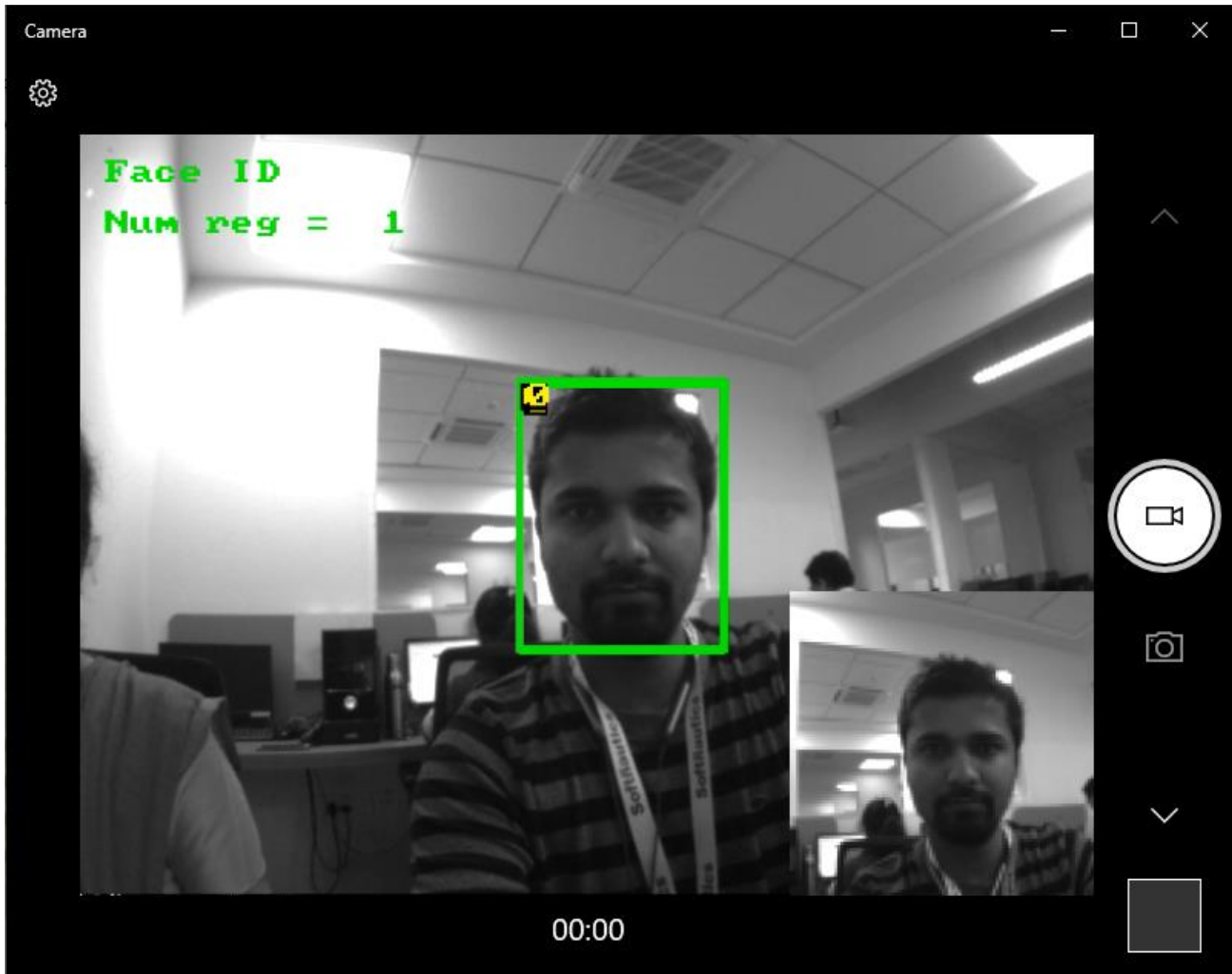- Long press (3 seconds) SW2 button to delete all registered faces.

Figure 5.2. Running the Demo

13. FaceID output will show green box for detected faces.
    - The legend on top left corner shows the number of registered faces
    - The right bottom corner shows the Region of Interest i.e. cropped detected faces
    - The corner of the box shows the id of the face
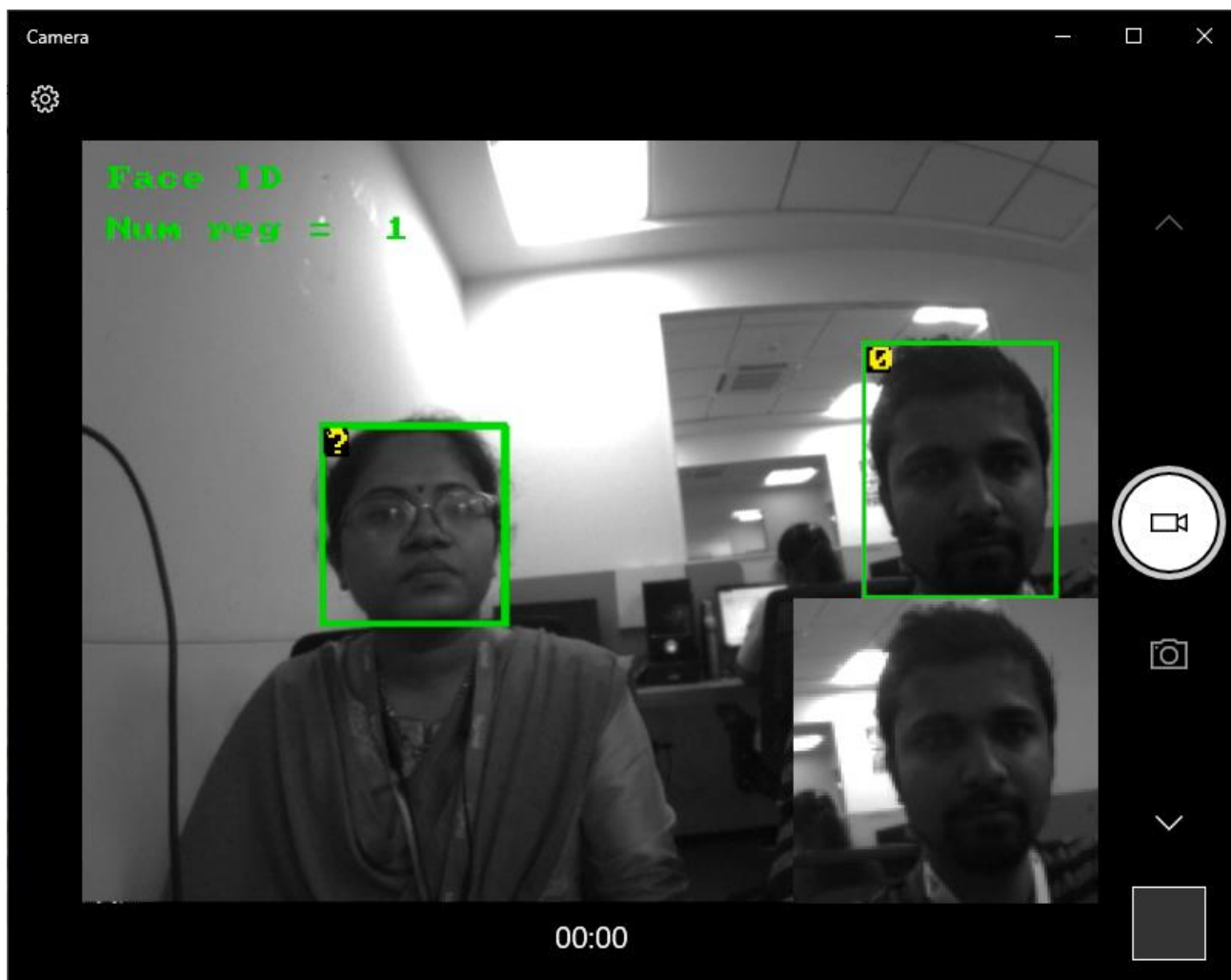   - A "?" symbol is shown for unknown face
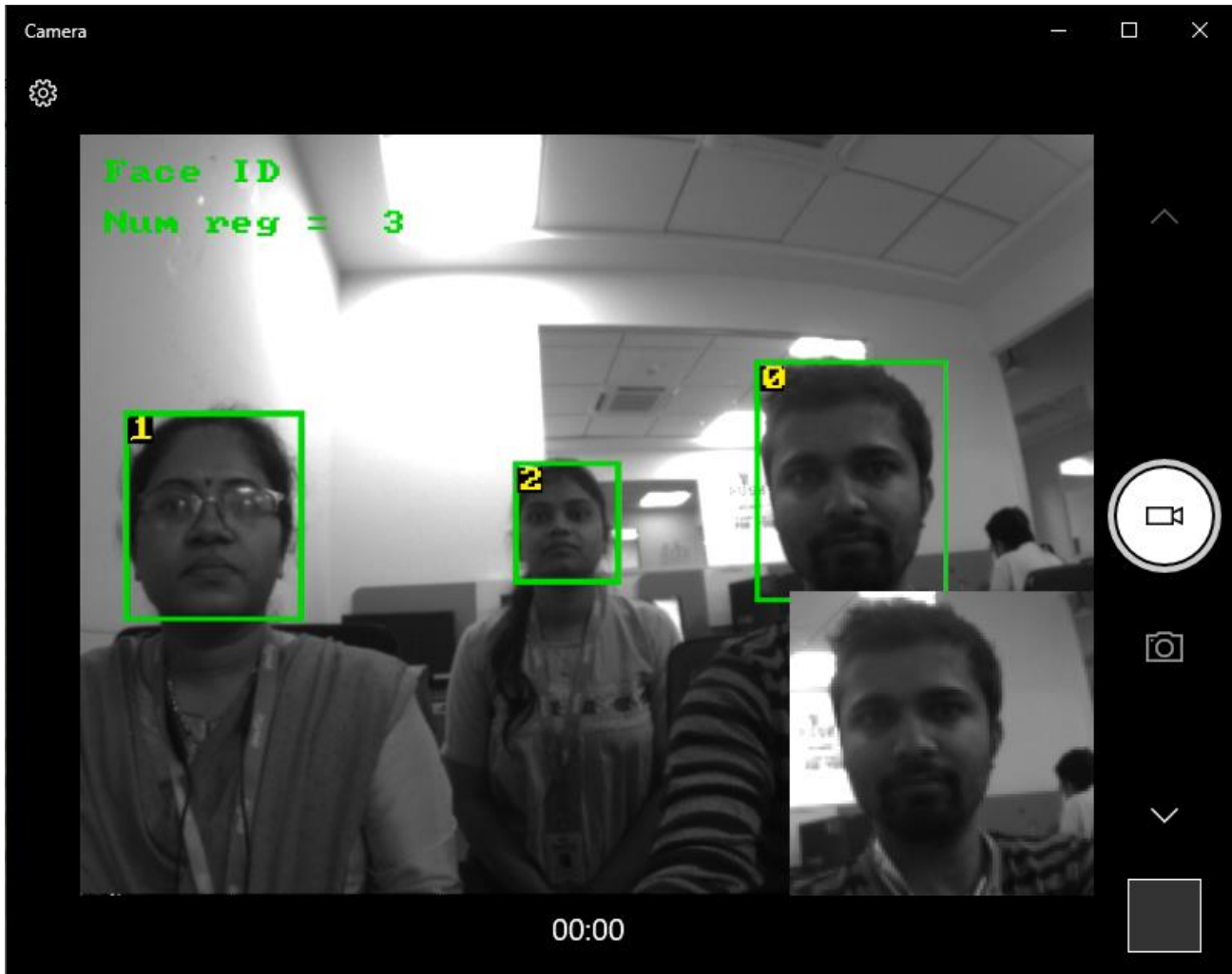
Figure 5.3. Running the Demo

Figure 5.4. Running the Demo

5.1. Ideal Conditions for testing the demo

- Distance: Users should be in range of 1.5 to 5 feet distance.
- Descent light is needed to run demo. Too low and direct light from light source may reduce the performance of demo.
- While user registration, there should be only 1 user in the frame.

Technical Support Assistance

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

Revision History

Revision 1.0, June 2022

Section	Change Summary
All	Initial release.

www.latticesemi.com