iCE40 UltraPlus Hand Gesture Recognition Demo

User Guide

FPGA-UG-02119-1.0

December 2020

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Acronyms in This Document

A list of acronyms used in this document.

Acronym	Definition
FPGA	Field-Programmable Gate Array
LSB	Least Significant Bit
ML	Machine Learning
MSB	Most Significant Bit
SPI	Serial Peripheral Interface
USB	Universal Serial Bus

1. Introduction

This document provides technical information and instructions on setting up and running the EVDK Based Human Counting Demo.

Refer to the following documents for detailed information on Lattice development boards and kit:

- iCE40 UltraPlus UPduino Shield Board with IR Camera

2. Functional Description

Figure 2.1 shows the diagram of the hand gesture demo. The microphone captures the audio and sends it to the iCE40 UltraPlus™ device. The iCE40 UltraPlus device then uses the audio data with the firmware file from the external SPI Flash to determine the outcome.

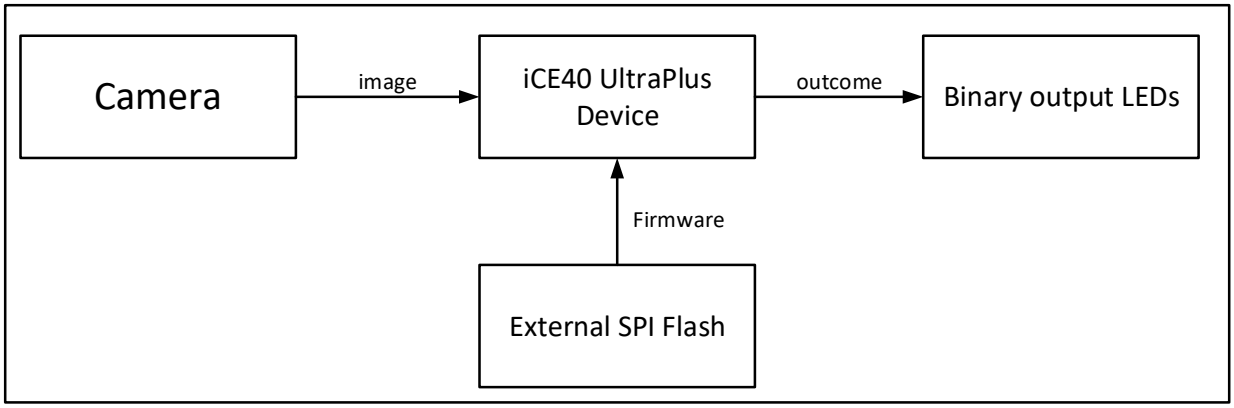

Figure 2.1. iCE40 UltraPlus Hand Gesture Demo Diagram

3. Demo Setup

This section describes the demo setup.

3.1. Hardware Requirements

- Lattice HM01B0 UPduino Shield Board
  - Micro-USB Cable
  - Micro-B USB Cable

3.2. Software Requirements

- Lattice Diamond® Programmer (refer to http://www.latticesemi.com/programmer)
- Display software such as AMCap or VLC Player

4. Programming the Demo

4.1. Programming the Hand Gesture Recognition on iCE40 UltraPlus SPI Flash

This section provides the procedure for programming the SPI Flash on the Himax HM01B0 UPduino Shield board.

There are two different files that should be programmed into the SPI Flash. These files are programmed to the same SPI Flash, but at different addresses:

- Bitstream
- Firmware

To program the SPI Flash in Lattice Radiant™ Programmer:

1. Connect the Himax HM01B0 UPduino Shield board to the PC using a micro USB cable. Please note that the USB connector onboard is delicate so handle it with care.
2. Start Radiant Programmer. In the **Getting Started** dialog box, select **Create a new blank project**.

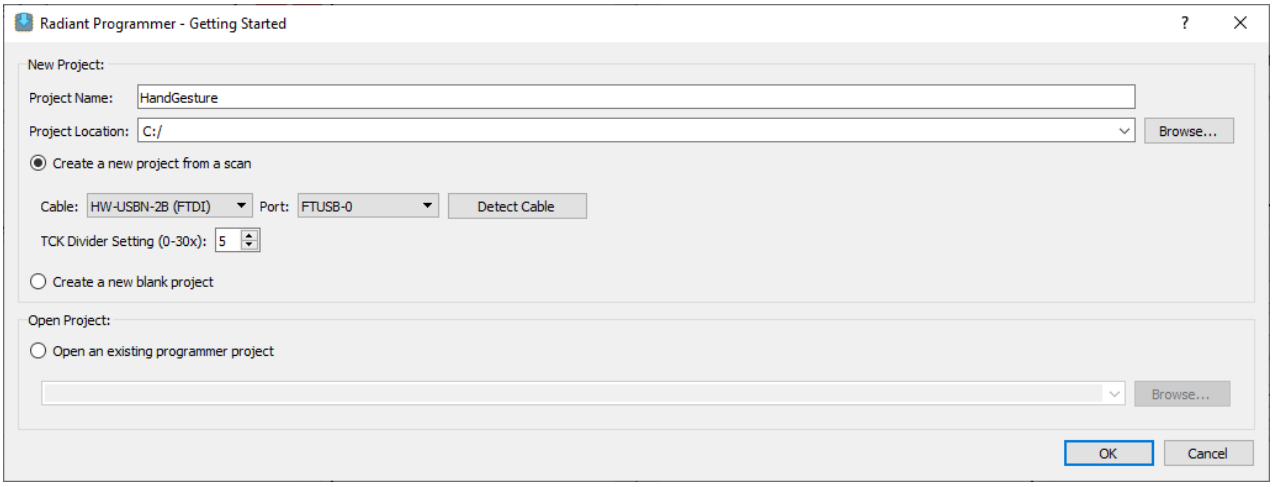

Figure 4.1. Radiant Programmer – Default Screen

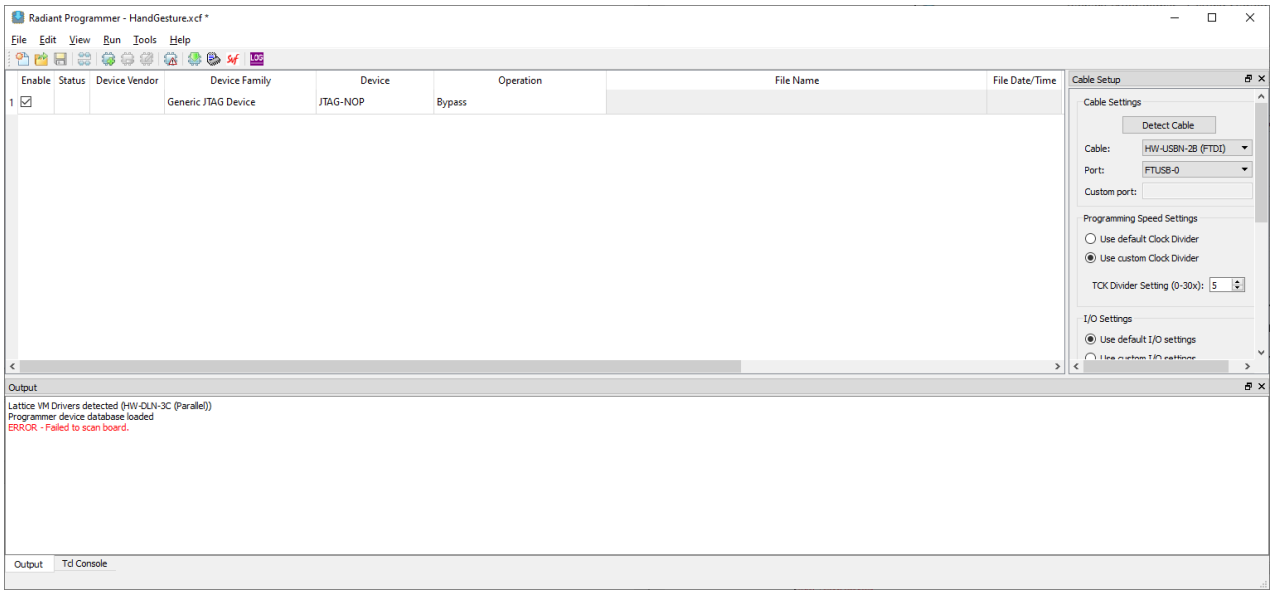

Figure 4.2. Radiant Programmer – Initial Project Window

3. Click **OK**.
4. In the Radiant Programmer main interface, select **iCE40 UltraPlus** for **Device Family** and **iCE40UP5K** for **Device** as shown in Figure 4.3.

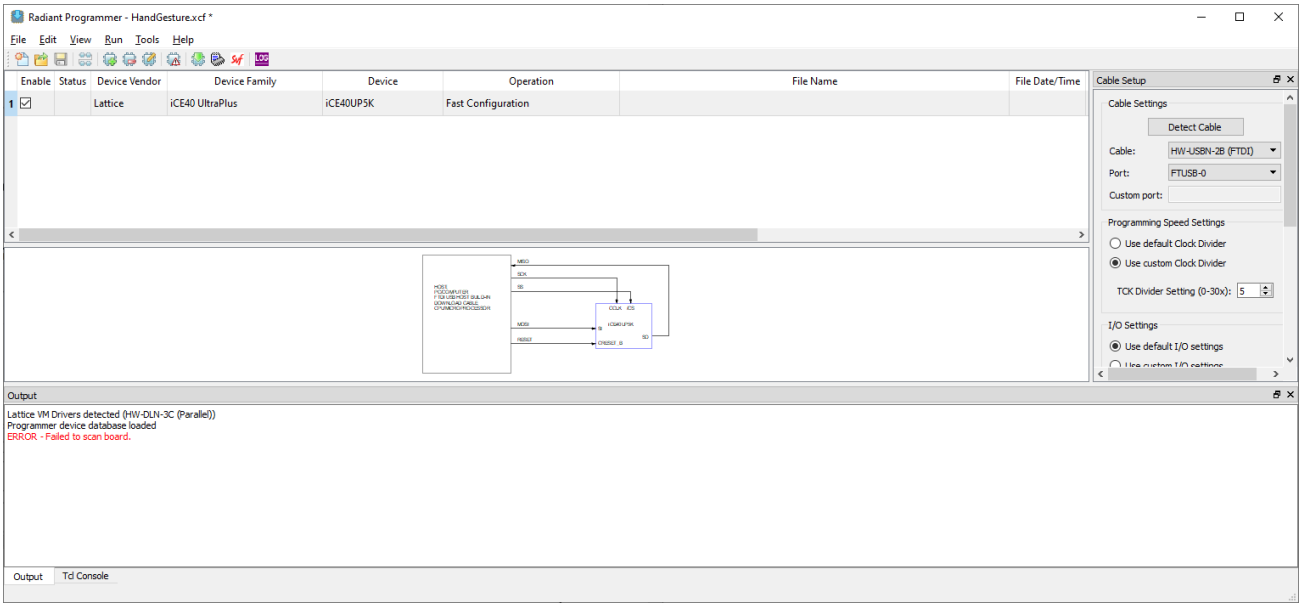

Figure 4.3. Radiant Programmer – Device Selection

5. Right-click and select **Device Properties**.

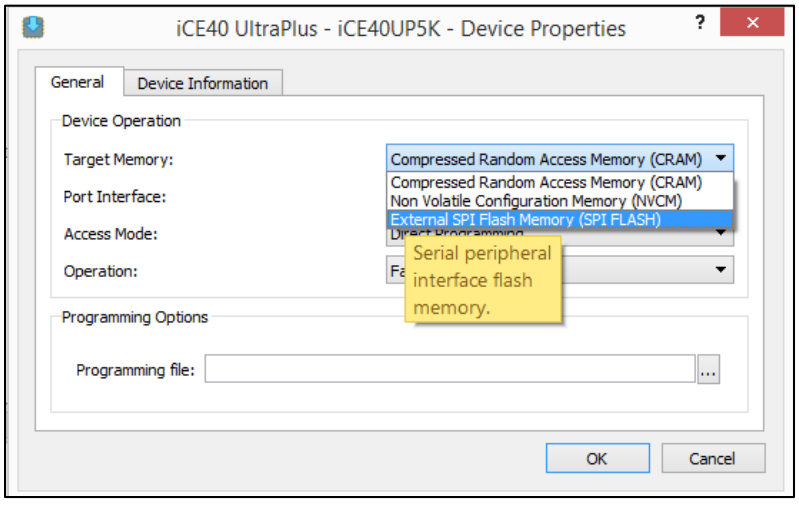

Figure 4.4. Radiant Programmer – Device Operation

6. Apply the settings below:
   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 – Winbond**
      - **Device – W25Q32**
      - **Package – 8-pin SOIC**
7. To program the bitstream file, select the options as shown in Figure 4.5.
   a. Under **Programming Options**, select the *Hand Gesture RTL* bitstream file 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**
8. Click **OK**.

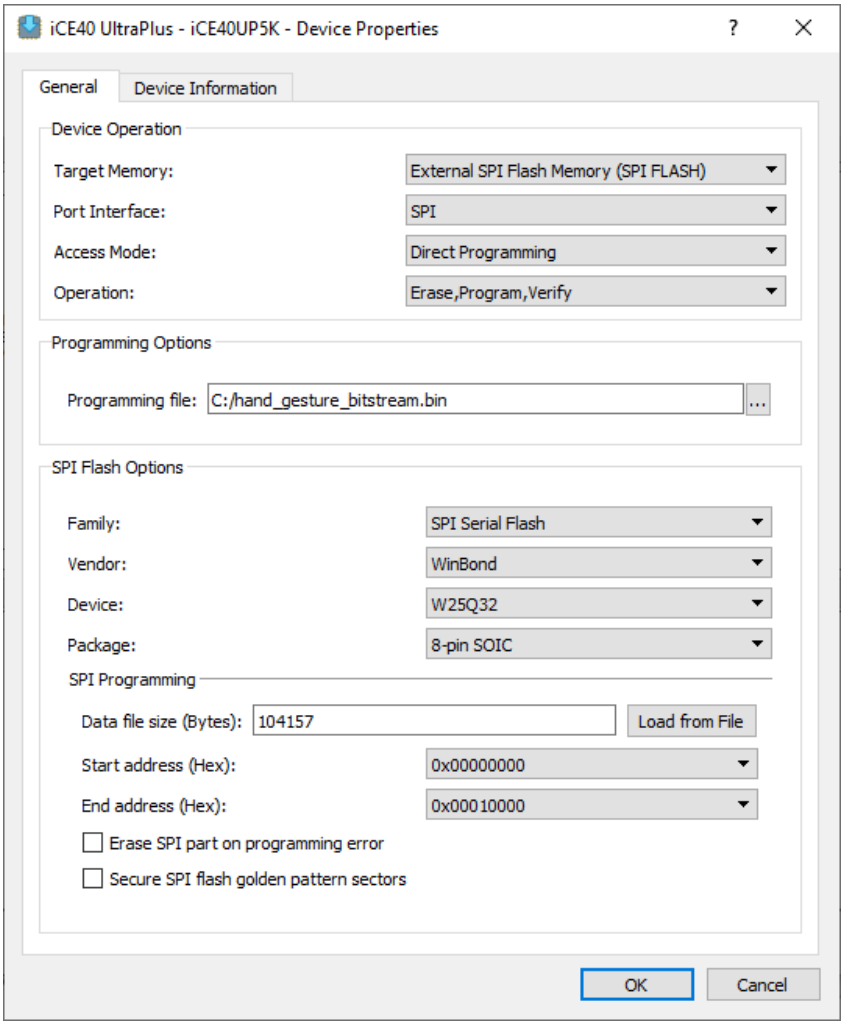

Figure 4.5. Radiant Programmer – Bitstream Flashing Settings

9. Initially, the .xcf file only has one option to add bin file. In order to run the Hand Gesture demo, you need to program the bitstream file as well as firmware file. In order to add another file to program, press  in the toolbar. Set **Device Family** to **iCE40 UltraPlus** and Device to **iCE40UP5K**.
10. To program the firmware, select the options as shown in Figure 4.6.
    a. Under **Programming Options**, select the hand gesture firmware generated by the SensAI tool.
    b. Ensure that the following addresses are correct:
       - **Start Address (Hex) – 0x00020000**
       - End Address (Hex) – 0x00030000
11. Click **OK**.

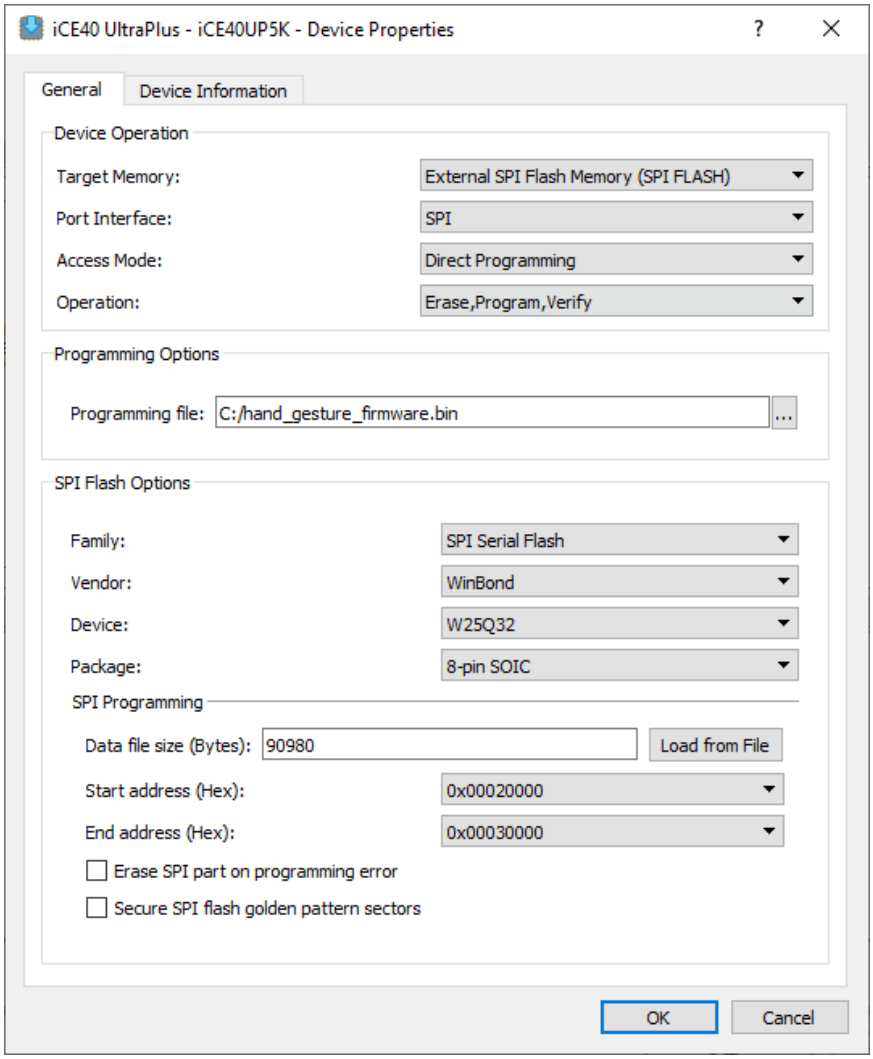

Figure 4.6. Radiant Programmer – Firmware Bin File Flashing Setting

12. In the main interface, click **Program Device** to program the binary file.

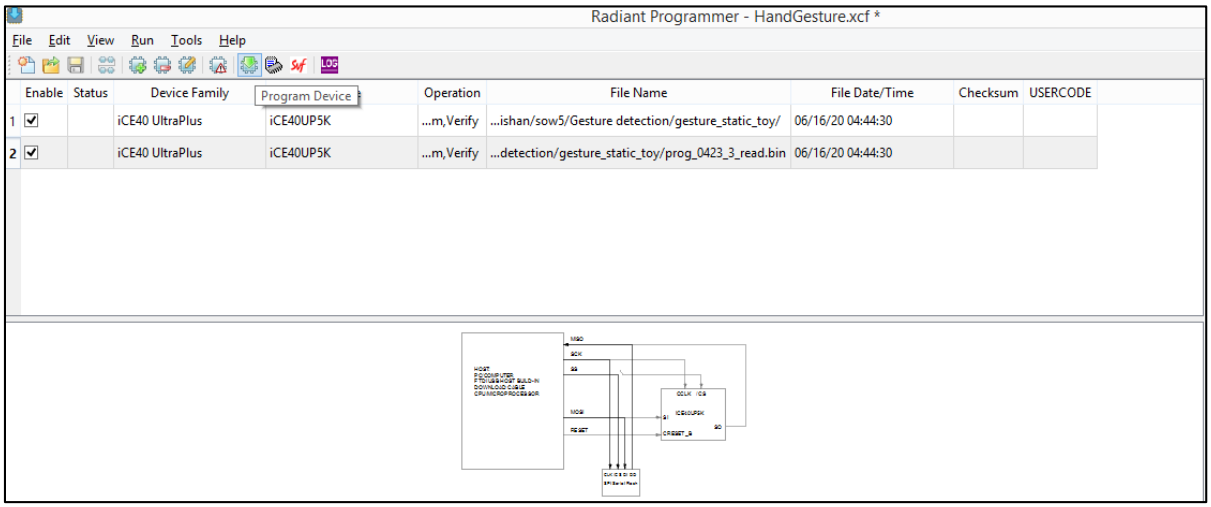

Figure 4.7. Radiant Programmer – Program Device

13. After successful programming, the **Output** console displays the result as shown in Figure 4.8.

```
INFO - Check configuration setup: Start.
INFO - Check configuration setup: Successful (Ignored JTAG Connection Checking).
INFO - Device1 iCE40UP5K: W25Q32: Erase,Program,Verify
Initializing...
IDCode Checking...
Enabling...
Erasing...
Disabling...
Enabling...
Programming...
Disabling...
Verifying...
Finalizing...
INFO - Execution time: 00 min : 04 sec
INFO - Elapsed time: 00 min : 04 sec
INFO - Device2 iCE40UP5K: W25Q32: Erase,Program,Verify
Initializing...
IDCode Checking...
Enabling...
Erasing...
Disabling...
Enabling...
Programming...
Disabling...
Verifying...
Finalizing...
INFO - Execution time: 00 min : 04 sec
INFO - Elapsed time: 00 min : 04 sec
INFO - Operation: successful.
```

Figure 4.8. Radiant Programmer – Output Console

5. Running the Demo

5.1. Running the Demo in LEDs

To run the demo and observe results on the board:

1. Power ON the Himax HM01B0 UPduino Shield board.
2. Show the gesture in front of the board, which results to the LEDs to turn on. Refer to Figure 5.1 for the LED information.

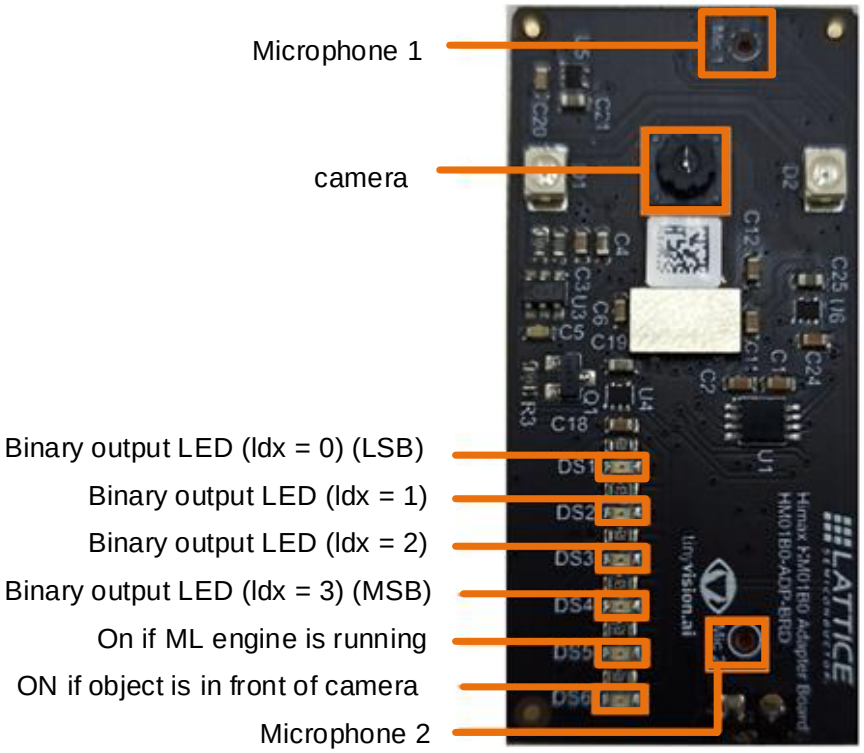

Figure 5.1. Camera and LED Location

- **DS1- DS4 –** Binary output LEDs, where DS1 is LSB (Least Significant Bit) and DS4 is MSB (Most Significant Bit).
- **DS5 –** If this LED is on, ML engine is running.
- **DS6 –** If this LED is on, some object is in front of camera.

Table 5.1. Hand Gesture Recognition Classes

Gesture ID	Gesture Image	Detection LEDs state [DS4, DS3, DS2, DS1]
1		[OFF, OFF, OFF, ON]
2		[OFF, OFF, ON, OFF]
3		[OFF, OFF, ON, ON]
4		[OFF, ON, OFF, OFF]
5		[OFF, ON, OFF, ON]
6		[OFF, ON, ON, OFF]
7		[OFF, ON, ON, ON]
8		[ON, OFF, OFF, OFF]
9		[ON, OFF, OFF, ON]
10		[ON, OFF, ON, OFF]

Technical Support Assistance

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

Revision History

Revision 1.0, December 2020

Section	Change Summary
All	Initial release

www.latticesemi.com