

MCU VIZNAS Solution User's Guide



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1 Introduction

NXP's MCU-based SLN-VIZNAS-IOT development kit provides OEMs with a fully integrated, self-contained, software and hardware solution. This includes the i.MX RT106F run-time library and pre-integrated machine learning face recognition algorithms, as well as all required drivers for peripherals, such as camera and memories.

This cost-effective, easy-to-use face recognition implementation facilitates the demand for a face-based "Friction Free Interface" that can be embedded in a variety of products across home, commercial and industrial applications, thus eliminating the need to use hard to learn and time-consuming mechanisms to identify users.

TARGET APPLICATIONS

- **Safety/Security/Alarm devices:** E-locks, Alarm panels, remote sensors, and automated access
- **Smart appliances:** Washing machines, dryers, ovens, refrigerators, stoves, and dishwashers
- **Home comfort devices:** Thermostats, remote temperature sensors, and lighting
- **Counter-top appliances:** Microwaves, coffee machines, rice cookers, and blenders
- **Smart industrial devices:** Power tools, ergonomic stations, machine access and authorization

1.1 RT106F VISION CROSSOVER PROCESSOR OVERVIEW

The i.MX RT106F is an EdgeReady member of the i.MX RT1060 family of crossover processors, targeting low cost embedded face recognition applications. It features NXP's advanced implementation of the Arm® Cortex®-M7 core, which operates at speeds up to 600 MHz to provide high CPU performance and best real-time responses. This i.MX RT106F-based solution enables system designers to easily and inexpensively add face recognition capabilities to a wide variety of smart appliances, smart homes, and smart industrial devices. The i.MX RT106F processor is licensed to run NXP's i.MX RT run-time library for face recognition which may include:

- Camera drivers
- Image capture
- Image pre-processing
- Face alignment
- Face tracking
- Face detection
- Face recognition
- Liveness Detection
- Emotion recognition

1.2 Additional Peripherals

In addition to the i.MX RT106F, included in the kit are many additional peripherals essential to experiencing everything the SLN-VIZNAS-IOT kit has to offer. Many of these peripherals are shown in the figure below.

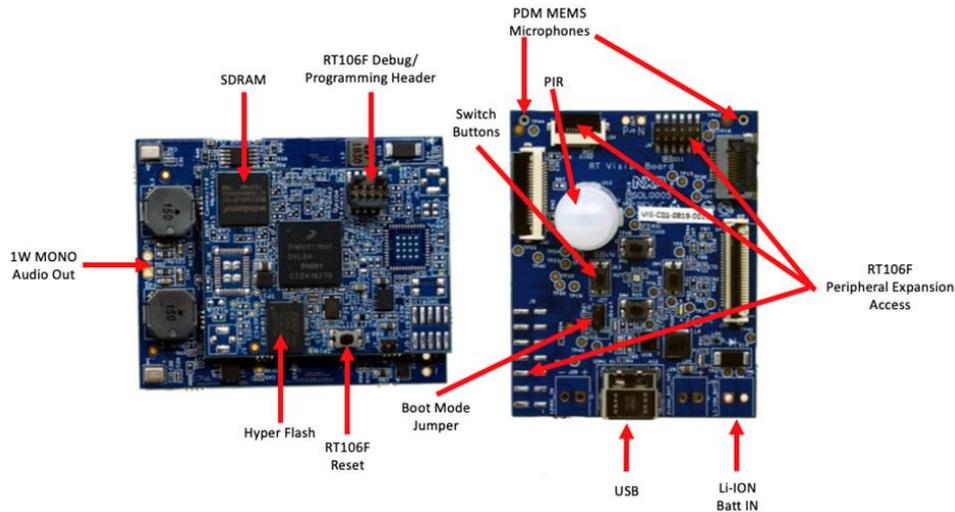


Figure 1: SLN-VIZNAS-IOT Additional Peripherals

Additionally, the SLN-VIZNAS-IOT kit comes with an IR+RGB **Dual Camera Adapter** like that shown below for use in secure applications.



Figure 2: Dual Camera Adapter Kit Configuration

Depending on the mode of operation, devices using the Dual Camera Adapter can emit highly concentrated non-visible infrared light which can be hazardous to the human eye. Products which incorporate these devices must follow the safety precautions given in IEC 60825-1 and IEC 62471.

Recommended Computer Configuration

The MCU SLN-VIZNAS-IOT SDK requires an up-to-date computer which runs the MCUXpresso IDE version 11.2. It also requires a terminal program to communicate with the device via USB.

<https://www.nxp.com/support/developer-resources/software-development-tools/mcuxpresso-software-and-tools/mcuxpresso-integrated-development-environment-ide:MCUXpresso-IDE>

Computer type	OS version	Terminal
Apple	Mac OS	PuTTY
PC	Windows 7 / 10	PuTTY/Tera Term
PC	Linux	PuTTY

Table 1: Supported Computer Configurations

Usage Condition

The following information is provided per Article 10.8 of the Radio Equipment Directive 2014/53/EU:

- (a) Frequency bands in which the equipment operates.
- (b) The maximum RF power transmitted.

PN	RF Technology	(a) Freq Range	(b) Max Transmitted Power
SLN-VIZNAS-IOT	Wi-Fi	2412MHz-2472MHz	17.9dBm

Table 2: Wi-Fi Frequency & Power

EUROPEAN DECLARATION OF CONFORMITY (Simplified DoC per Article 10.9 of the Radio Equipment Directive 2014/53/EU)

This apparatus, namely SLN-VIZNAS-IOT, conforms to the Radio Equipment Directive 2014/53/EU. The full EU Declaration of Conformity for this apparatus can be found at this location: <https://www.nxp.com/mcu-vision>

To maintain EMC Compliance, the `CLOCK_DRIVE_STRENGTH_LOW` preprocessor macro* must remain set to 1

****NOTE:** See SLN-VIZNAS-IOT Developer's Guide for information on changing preprocessor macros

2 Get Started with SLN-VIZNAS-IOT

2.1 Box Contents

The SLN-VIZNAS-IOT kit arrives in a box alongside a printed Quick Start Guide and a USB-C Cable.



Figure 3: SLN-VIZNAS-IOT Box Contents

Please check your kit for damage or marks, and, if seen, please contact your NXP representative.

2.2 Running the Demo

To get started, take the USB-C cable provided inside the kit and plug the USB-A end into your computer and the USB-C end into your kit.

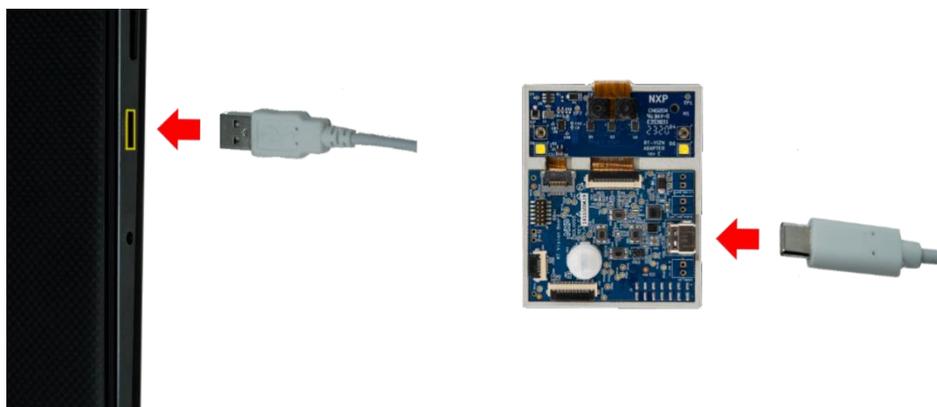


Figure 4: Plugging in SLN-VIZNAS-IOT Kit

Once connected, a green LED (D1) will light up to indicate the kit is powered on.

2.2.1 Access the Camera

NOTE: Camera enumeration is currently supported on Windows and Ubuntu.

With the kit powered on and connected to your computer, the SLN-VIZNAS-IOT kit will automatically enumerate as both a serial device and USB camera device. To access the kit's camera, open **Camera** if using Windows, or **Cheese**, if using Ubuntu. In this guide, we'll be using Windows and the Windows camera app.

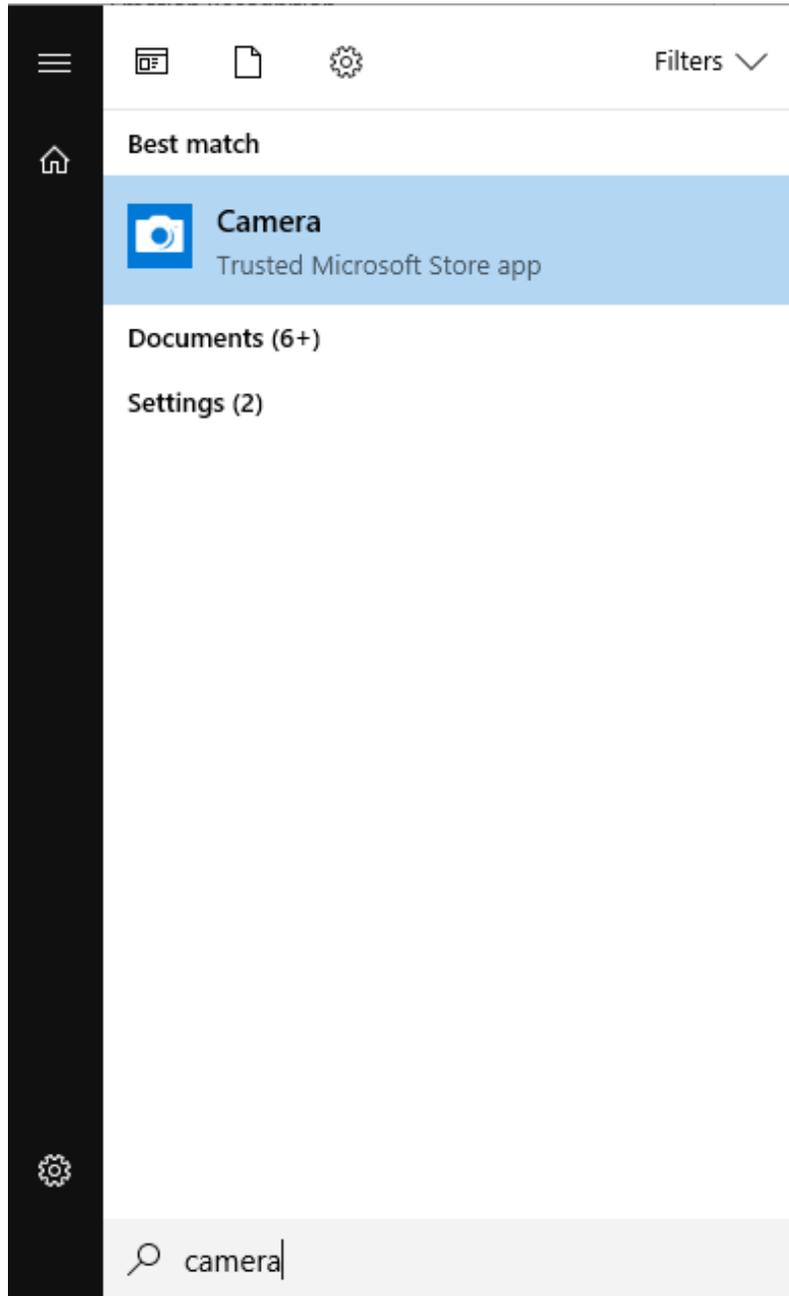


Figure 5: Windows Camera App

After opening the camera app, video coming directly from the kit will be shown in the app's camera window:



Figure 6: SLN-VIZNAS-IOT Camera Output in Camera App

NOTE: The Windows Camera app has a “face finder” feature of its own, shown by the smaller blue box around the face in the above screenshot.

If you have multiple cameras connected to your computer, you may need to change which camera is being shown. In the Windows Camera app, this can be done by using the “Change Camera” button located in the top right-hand corner of the app.

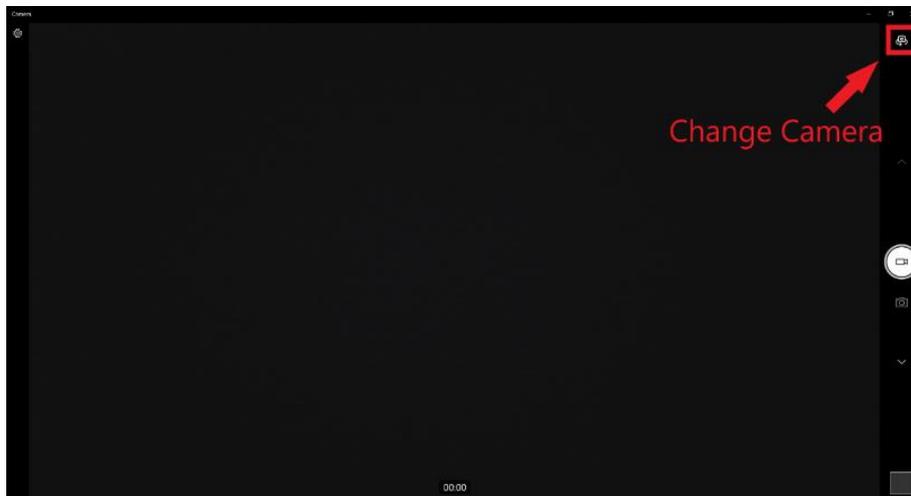


Figure 7: Change Camera Button in Windows Camera App

2.2.2 Register a Face

To make full use of the face detection and recognition features of the SLN-VIZNAS-IOT, you must register a face. To begin registering a new face, press the **Manual Registration** button on the kit (SW4).

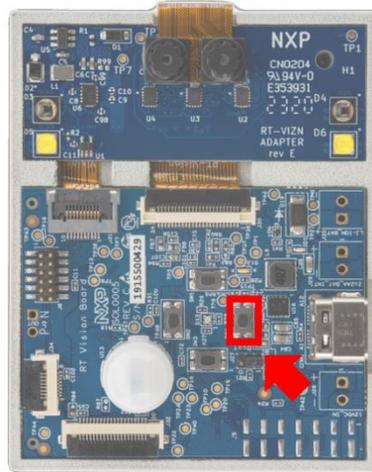


Figure 8: SLN-VIZNAS-IOT Manual Registration Button

Once pressed, a message indicating registration is taking place will appear at the top of the screen, and the bounding box around the user's face will turn from blue to green. To register your face, stare straight-on at the camera while aligning your face inside the bounding box. While registration is taking place, a "Registering" message will be shown.



Figure 9: Registration in Progress

NOTE: If pressing the button does not produce a "Registering" message, ensure that the "base" board and "expansion" board are properly connected inside of the enclosure.

To cancel registration, simply press the **registration** button again, or, wait for the registration process to timeout (~5s).

Once successfully registered:

- A “**USERNAME** Added” message will be displayed
- The number of registered users will increase by one
- A username will be assigned to the registered face (usernames can be specified through the CLI interface discussed in the following section)



Figure 10: Successful Registration

Should your face fail to register properly, either due to the registration being canceled or timing out, a message like the following will be displayed:



Figure 11: Registration Failed

To retry, simply press the manual registration button again.

NOTE: If you are having trouble successfully registering a face, try adjusting proximity to the camera (either closer or further away), slowly moving your head left-right and up-down so that the camera can get a better view of different angles of your face, and ensure that the face being registered is sufficiently well lit for both the IR and RGB cameras by adjusting the pwm values for the IR and white LEDs. For more information, check out the *Troubleshooting* section near the end of this guide.

Once registered, recognition of your face will prompt a “Welcome Home” message, indicating the kit has detected a recognized face.



Figure 12: "Welcome Home" Message

Your face will continue to be recognized so long as the system is running. By default, however, faces will be erased upon reset and must be explicitly saved into flash using the “save” command if they should be retained (see **Save Users Through Resets**).

2.2.3 Liveness Detection and Anti-Spoofing

The SLN-VIZNAS-IOT comes with **Liveness Detection** and **Anti-Spoofing** turned ON by default, meaning that the system can discern between your actual face and a print-out/phone display picture of your face.

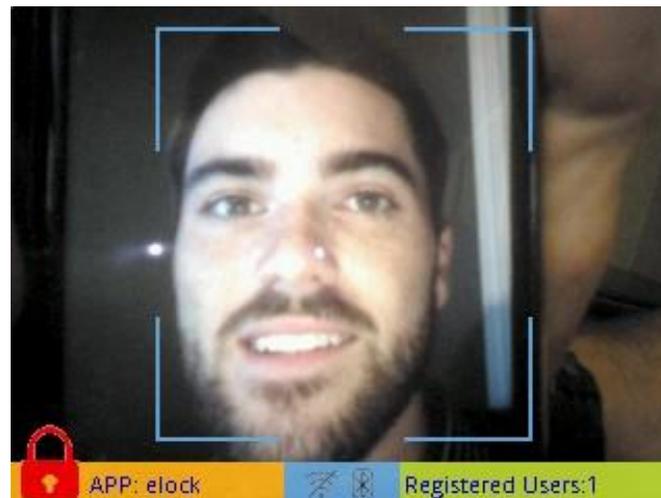


Figure 13: Phone Display Spoof Attack

By requiring a user’s actual face to be able to unlock the system, as opposed to a simple picture of the user’s face, this feature helps to protect against some of the most common

face recognition “spooF” attacks wherein a malicious actor will use a picture of someone to gain access to their face-protected materials.



Figure 14: Printed Picture SpooF Attack

As shown in the screenshots above, using neither a phone display nor a printed picture of a face triggers the “Welcome Home” message. In fact, if we enable verbose mode (see **2.2.5 Enable Verbose Mode**) while attempting to recognize the printed picture in Figure 14, we can see that the inference engine detects a face, but recognizes that the image captured by the IR camera is a “fake”/“spooFed” face.

```
[ 336.974] [L1] Face detected - dt = 160 ms  
[ 337.154] [L1] [OASIS]:quality chk res:6  
[ 337.154] [L2] [EVT]: IR Fake Face!
```

Figure 15: Fake Face Detected

2.2.4 Connect to Serial CLI

Using serial commands will give users access to the full suite of features the SLN-VIZNAS-IOT has to offer. Issuing serial commands can be done via a serial terminal emulator like PuTTY or Tera Term.

To connect to the serial CLI of the kit, identify the **COM** port associated with the kit and connect using the [115200, 8, 1, N, XON/XOFF] serial settings shown below.

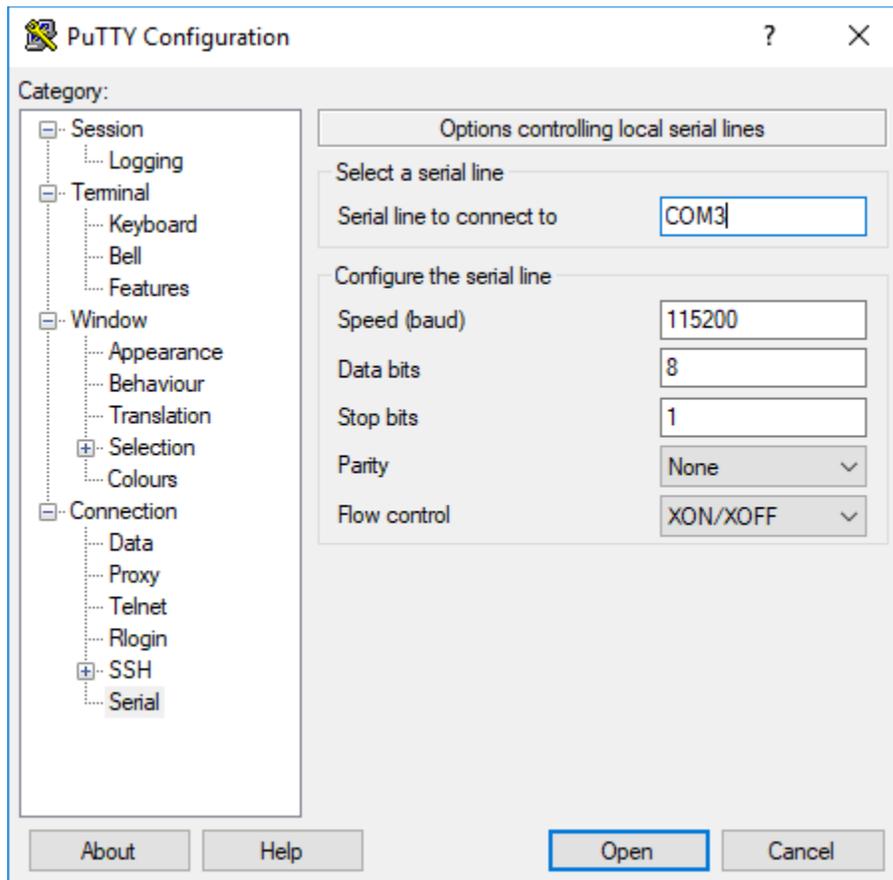


Figure 16: Serial Connection Settings

After connecting to the kit's serial interface, you will encounter a blank terminal screen that echoes any characters that you type. Use the **“help”** command to display a list of all the available serial commands and their usage. We will be discussing a few of these commands in the upcoming sections.

```
SHELL>> help
"help": List all the registered commands
"exit": Exit program
"list": List all registered users
"add username": Add user
"add -s": Stop the former add command issued
"del username": Delete user
"del -a": Delete all users
"rename oldusername newusername": Rename user
"verbose <0|1|2|3> (none-all)": Debug message detail level setting
"camera ir_pwm <value>": PWM pulse width for IR led, value should be between 0 (inactive) to 100
"camera white_pwm <value>": PWM pulse width for white led, value should be between 0 (inactive) to 100
"version": The version information
"save n": Save database into flash memory
"updateotw": Reboot the board and start the OTW firmware update
"reset": Reset the MCU
"emotion <0|2|4|7>"
"liveness <on|off>"
"detection resolution <qvga|vga>": Set detection resolution and reset
"display output_mode <rgb|ir>"
"display output_device <usb|riverdi>"
"display interface <loopback|infobar>"
"wifi <on|off>": Turn the Wi-Fi connection on|off
"wifi reset": Reset wifi to re-link.
"wifi credentials": Get the credentials.
"wifi credentials SSID [PASSWORD]": Set Wi-Fi credentials.
"wifi ip": Get the ip address.
"wifi erase": Erase the Wi-Fi credentials from flash
"app_type <0|1|2|3|4>":
 0 - Elock(light)
 1 - Elock(heavy)
 2 - Door access(light)
 3 - Door access(heavy)
 4 - Userid
"low_power <on|off>": Turn low power mode on|off
```

Figure 17: Serial Commands "Help" Menu

2.2.5 Enable Verbose Mode

The SLN-VIZNAS-IOT kit supports debug message logging which provides important inference performance information, for example, the time it took to detect a user. Serial debug messages are disabled by default but can be enabled via a serial command.

To enable serial debug output, type the serial command “**verbose 0**”, “**verbose 1**”, “**verbose 2**”, or “**verbose 3.**”

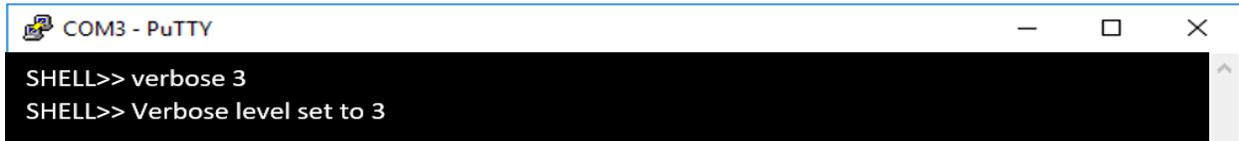


Figure 18: "verbose 0"

Using the verbose command will enable logging of the debug information indicated in the table below.

Message Type	Importance	"verbose 0"	"verbose 1"	"verbose 2"	"verbose 3"
Critical	High		X	X	X
Detailed	Medium			X	X
Misc.	Low				X
On-screen Debug Info	N/A				X

Table 3: Verbose Mode Configuration Table

The following is an example of a debug message a user might receive after a face detection and recognition event.

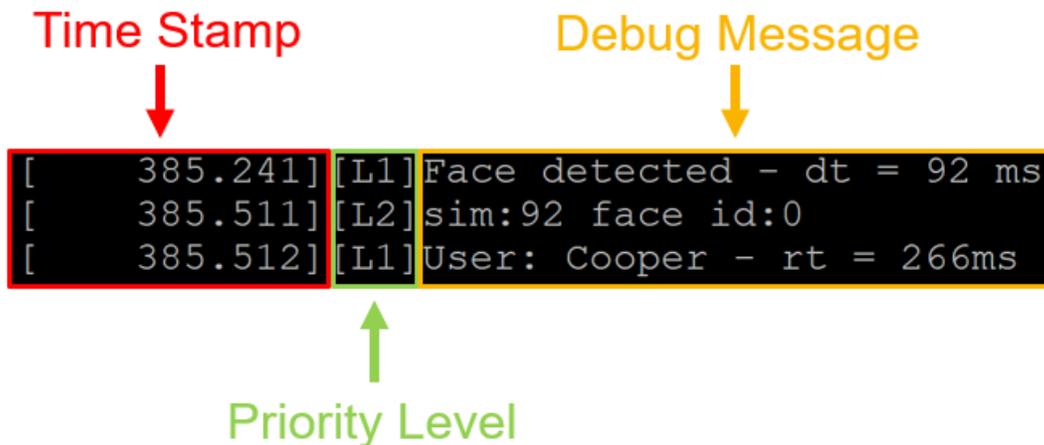


Figure 19: Example Verbose Mode Debug Message

The following table describes the different messages and the associated descriptions.

Abbreviation	Definition
dt	Time taken to detect face
rt	Time taken to recognize face
sim	Predictive accuracy/confidence value of face rec
face_id	Internal face database identifier

Table 4: Verbose Mode Abbreviation Table

In addition to debug logging over serial, enabling “**verbose 3**” will also display some useful on-screen information as well that can be helpful when troubleshooting registration/recognition issues. An example can be seen in the images below:

NOTE: Without any registered users, the on-screen debug info will not update until a registration has been triggered. This is because the inference engine does not attempt to recognize any faces if they are none currently registered.



Figure 20: On-screen Info for Registering Face

In the above example, registration is taking place, but according to the on-screen debugging info, although the face has passed the blurriness check (hence “**blur: 0**”), the “front face check” has passed (hence “**front: 1**”), and the RGB liveness check has passed (hence “**rgbLive: 1**”), the IR liveness check has not passed (hence “**irLive: 0**”). This would suggest that there may be an issue with the IR camera – likely a lighting issue.



Figure 21: On-screen Info for Recognized Face

In this example, the on-screen info reflects information about the face being recognized. As shown in the screenshot, the face has been recognized with 95% similarity to the matching face in the internal database (hence “**sim: 95**”) and has passed both the RGB and IR liveness checks (hence “**rgbLive: 1**” and “**irLive: 1**”).

NOTE: The “front face check” is only performed by the inference engine for faces being registered to ensure that no face gets registered that it is improperly angled towards the camera. For this reason, the “front” value will not change unless a registration is being performed.

2.2.6 (Optional) Enable Low Power Mode

For many use cases, managing power consumption is critical. Fortunately, the SLN-VIZNAS-IOT supports low power features out-of-the-box. Low power mode functionality can be enabled or disabled through the use of the serial commands.

Use the command “**low_power on**” or “**low_power off**” to enable or disable the low power mode feature supported on the SLN-VIZNAS-IOT.

```
COM3 - PuTTY
SHELL>> low_power on
SHELL>> Low power mode enabled.
```

When low power mode is enabled, the SLN-VIZNAS-IOT will automatically sleep/hibernate in a state of much lower power consumption than normal, when no registration/deregistration is taking place and no activity is detected by the camera for ~20s. A “recognition timeout” message like the one shown in Figure 22 will be displayed on screen as a warning that the SLN-VIZNAS-IOT will be entering sleep mode within the next 5 seconds.



Figure 22: "Recognition Timeout" Message

During hibernation, nearly everything but a select few peripherals is disabled in order to conserve power. As a result, the video output from the kit as well as the shell interface will not be active and will not be accessible until the board has woken up again.

NOTE: When low power mode is activated and the board enters sleep/hibernation, after the SLN-VIZNAS-IOT wakes up, your computer's camera app (Windows Camera app, Cheese, etc.) may need to be restarted before you can begin seeing camera output once again. This may also apply to your serial terminal emulator of choice as well (PuTTY, Tera Term, etc.)

Because only select peripherals are enabled during sleep mode, the SLN-VIZNAS-IOT will only wake up in response to a specific trigger(s), which by default, is the SW3 push button shown in the following figure:



Figure 23: Hibernation Wake-up Trigger (SW3)

Upon detecting the trigger, the SLN-VIZNAS-IOT will automatically wake up and begin running as normal.

For more specifics on low power mode, check out **Low Power Mode**.

3 Additional Features

This section will discuss in more detail some of the extra features included in the kit that may not have been discussed in the previous sections. Included in this feature discussion are the **Push Buttons** and their functionality, each of the supported **Serial Commands** and how to use them, Remote (Wireless) Registration, App Configurations, Low Power Mode, Audio Feedback, and the Configurable Display settings.

Button	Function	Description
SW1	Toggle GUI	<i>Toggles the GUI on or off.</i>
SW2	Manual Deregister	<i>Triggers the deletion of the next registered face encountered by the kit.</i>
SW3	Toggle IR/RGB Output	<i>Toggles whether output from the RGB or IR camera is shown. Does not affect which cameras are in use.</i>
SW4	Manual Register	<i>Triggers registration of the next face encountered by the kit.</i>

Table 5: Push Buttons Functionality

3.1 Push Buttons

The SLN-VIZNAS-IOT kit makes use of on-board push buttons in order to give users easy access to some of the kit's most useful features, like face registering and deregistering, and the ability to change between manual and automatic enrollment mode.

In this section, we will discuss these buttons and their functions in more depth.

3.1.1 SW1 – Toggle GUI

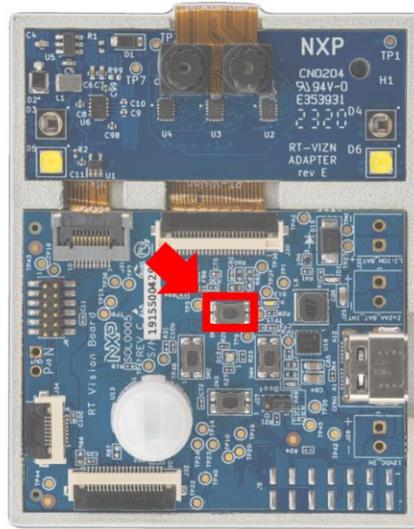


Figure 24: SW1

The SW1 push button toggles the GUI ON or OFF. When the GUI is deactivated, only video from the kit's camera will be shown and no other on-screen information.



Figure 25: GUI Toggled Off

NOTE: The behavior of this button is identical to that of the “display interface” serial command.

3.1.2 SW2 – Manual Deregistration

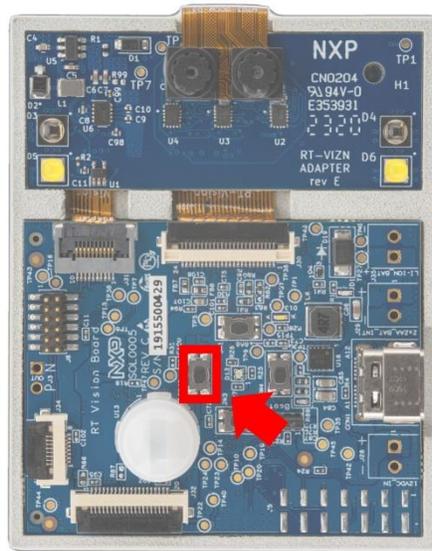


Figure 26: SW2

Working similarly to SW4, pressing SW2 will trigger a manual “deregistration” command, which will remove the next recognized face from the kit’s internal face database.

When this button is pressed, an indicator message will be displayed at the top of the screen which lets the user know that the process of deregistering a face is taking place.



Figure 27: Deregistration in Progress

To deregister a face, simply stare straight-on at the camera while aligning the face inside the bounding box for ~1-3 seconds and wait for a message confirming the removal of the user. Once deregistered, the number of registered users will be decremented by one.



Figure 28: "USERNAME Removed" Message

Should the deregistration process fail, a "Remove Failed" message will be displayed. Simply press the SW2 push button again to retry.



Figure 29: "Remove Failed"

To cancel a deregistration, simply press the **deregistration** button again, or, wait for the deregistration process to timeout (~5s).

NOTE: The behavior of this button is identical to specifying the name of the user whose face is being captured by the camera as the argument to the "del USERNAME" command.

3.1.3 SW3 – Toggle IR/RGB Output

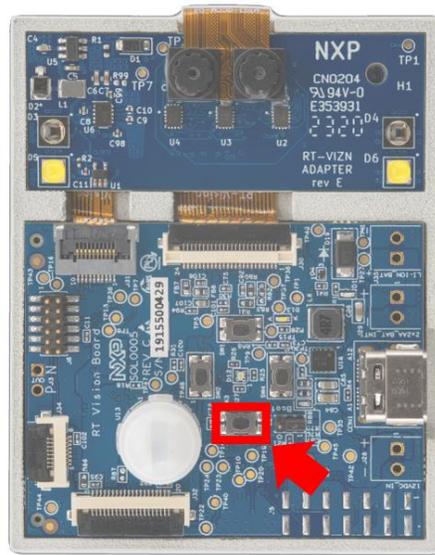


Figure 30: SW3

When using all but the **userid** app type (see **App Configurations**), both cameras are always active, however only the output from one camera can be displayed at a time. The SW3 push button can be used to toggle between the output coming from the IR and RGB cameras as shown in the following figure.



Figure 31: SW3

The behavior of SW3 is identical to that of the “**display output_mode <rgb|ir>**” command.

3.1.4 SW4 – Manual Registration

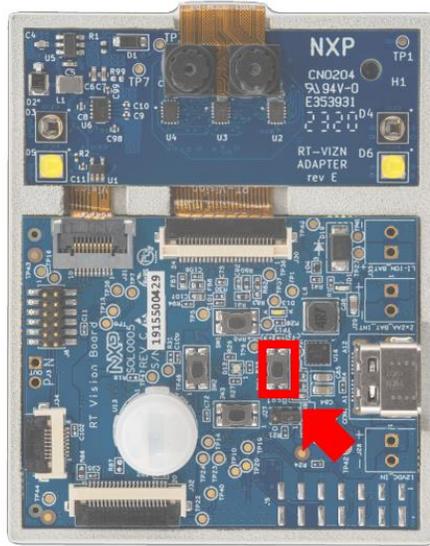


Figure 32: SW4

As mentioned previously, the SW4 push button can be used to trigger the manual registration process.

Once pressed, a message indicating registration is taking place will appear at the top of the screen, and the bounding box around the user's face will turn from blue to green. To register your face, stare straight-on at the camera while aligning your face inside the bounding box. While registration is taking place, a "Registering" message will be shown.



Figure 33: Registration in Progress

NOTE: If pressing the button does not produce a 'Registering' message, ensure that the "base" board and "expansion" board are properly connected inside of the enclosure.

To cancel registration, simply press the **registration** button again, or, wait for the registration process to timeout (~5s).

Once successfully registered:

- A “**USERNAME** Added” message will be displayed
- The number of registered users will increase by one
- A username will be assigned to the registered face (usernames can be specified through the CLI interface discussed in the following section)



Figure 34: Successful Registration

Should your face fail to register properly, either due to the registration being canceled or timing out, a message like the following will be displayed:

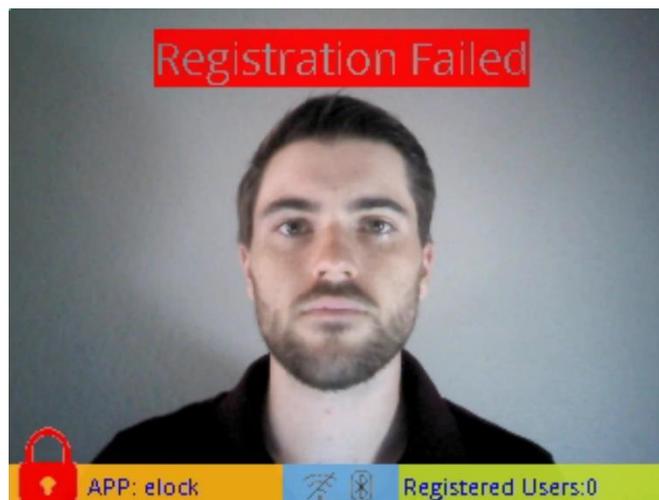


Figure 35: Registration Failed

To retry, simply press the manual registration button again.

Once registered, recognition of your face (done simply by placing your face in front of the camera for a brief moment) will prompt a “Welcome Home” message, indicating the kit has detected a recognized face.



Figure 36: "Welcome Home" Message

Simply follow the same procedure to add additional faces into the system.

NOTE: If you are having trouble successfully registering a face, try adjusting your proximity to the camera (either closer or further away), and additionally try slowly moving your head left-right and up-down so that the camera can get a better view of different angles of your face. If after following these instructions you are still experiencing trouble, ensure that the face being registered is sufficiently well lit for both the IR and RGB cameras by adjusting the pwm values for the IR and white LEDs. For more information, check out the **Troubleshooting** section near the end of this guide.

3.2 Serial Commands

In order to access the full suite of features that the SLN-VIZNAS-IOT has to offer, communication via serial is needed. Using serial, users can be added and deleted, the camera's detection resolution can be configured, as well as several additional capabilities.

In this section, we will show a full list of available serial commands and cover them in-depth.

3.2.1 List Available Commands

To display a list of all available commands you can run, type the command “**help**.” This command will output a list similar to that shown below which details all available commands and their arguments:

Command	Arguments	Description
help		Display a list of all available serial commands along with a brief description of their function
exit		Exit program; closes serial terminal until reset
list		List all registered users
add	USERNAME	Add new user with specified username
add	-s	Stops attempting to add a new user
del	USERNAME	Deletes specified user
del	-a	Deletes all registered users
rename	Old new	Renames face associated with old name to new name
verbose	< 0 1 2 3 >	Configures verbose mode debug logging with the specified verbosity
camera ir_pwm	< 0 – 100 >	Configures the camera adapter's IR LEDs to use the specified intensity
camera white_pwm	< 0 – 100 >	Configures the camera adapter's white LEDs to use the specified intensity
version		Displays version information regarding inference engine
save		Saves face database in flash memory
updateotw		Reboots the board and sets up OTW firmware update mode
reset		Reset the MCU
emotion	< 0 2 4 7 >	Configures emotion recognition to use the specified mode (0, 2, 4, or 7 emotion recognition mode)
liveness	< on off >	Enables or disables liveness detection
detection resolution	< qvga vga >	Configures the detection resolution to use the resolution specified and resets the board
display output_mode	< rgb ir >	Configures whether output from the rgb camera or the ir camera is shown
display output_device	< usb riverdi >	Configures the display output device to use either video over USB or the Riverdi display. (Requires Riverdi display)

display interface	< loopback info bar >	Configures whether the info bar/GUI is displayed or not
wifi	<on off>	Turn the Wi-Fi connection on or off
wifi reset		Reset Wi-Fi to reestablish connection
wifi credentials		Get the current Wi-Fi credentials (SSID and password)
wifi credentials	[SSID] [PASSWORD]	Set Wi-Fi credentials
wifi ip		Return the current ip address.
wifi erase		Erase the Wi-Fi credentials from flash
app_type	< 0 1 2 3 > 0-Elock(light) 1-Elock(heavy) 2-Door access(light) 3-Door access(heavy)	Determines the inference engine model to use. For descriptions of these models see
low_power	< on off >	Enables or disables low power mode

Table 6: Serial Command Table

3.2.2 List All Registered Users

Using the “list” command will list all the users currently registered into the system.

```
SHELL>> Registered users count:2
Cooper
Chris
```

Figure 37: "list" Command

3.2.3 Manually Add Users

While running in manual mode, in order to register a new face, use the command “**add USER_NAME.**” After a few seconds, should the demo find a face, it will begin recording and saving a face, with success indicated by a green border around the newly registered face.

```
SHELL>> add Cooper
SHELL>> Start registering 'Cooper'
```

Figure 38: "add Cooper" Command

To cancel an “**add**” command issued via serial or the SW4 push button, issue an “**add**” command with the “**-s**” argument.

```
SHELL>> add Cooper
SHELL>> Start registering 'Cooper'
SHELL>> add -s
SHELL>> Stopped adding
```

Figure 39: "add -s" Command

3.2.4 Manually Delete Users

In cases where you want to delete a previously registered user, running the command “**del USER_NAME**” will delete the specified user.

```
SHELL>> del Cooper
SHELL>> User 'Cooper' successfully deleted
```

Figure 40: "del Cooper" Command

Alternatively, running the command “**del -a**” will delete all users from the database.

```
SHELL>> del -a
SHELL>> All users successfully deleted
```

Figure 41: "del -a" Command

3.2.5 Rename Users

The “**rename**” command can be used to rename a user who is currently registered into the database. To do so, simply use the command “**rename oldusername newusername.**” Below is an example of the command being used.

```
SHELL>> rename user_0 Cooper
SHELL>> User 'user_0' successfully renamed
```

Figure 42: "rename user_0 Cooper" Command

3.2.6 Verbose Mode

The SLN-VIZNAS-IOT kit supports debug message logging which provides important inference performance information, for example, the time it took to detect a user. Serial debug messages are disabled by default but can be enabled via a serial command.

To enable serial debug output, type the serial command “**verbose 0**”, “**verbose 1**”, “**verbose 2**”, or “**verbose 3.**”

```
SHELL>> verbose 3
SHELL>> Verbose level set to 3
```

Figure 43: "verbose 0"

Using the verbose command will enable logging of the debug information indicated in the table below:

Message Type	Importance	"verbose 0"	"verbose 1"	"verbose 2"	"verbose 3"
Critical	High		X	X	X
Detailed	Medium			X	X
Misc.	Low				X
On-screen Debug Info	N/A				X

Table 7: Verbose Mode Configuration Table

The following is an example of a debug message a user might receive after a face detection and recognition event.

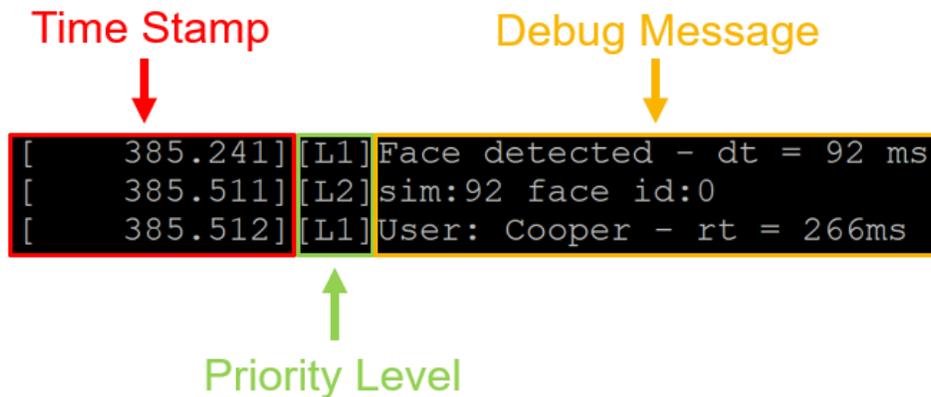


Figure 44: Example Verbose Mode Debug Message

The following table describes the different messages and the associated descriptions.

Abbreviation	Definition
dt	Time taken to detect face
rt	Time taken to recognize face
sim	Predictive accuracy/confidence value of face rec
face_id	Internal face database identifier

Table 8: Verbose Mode Abbreviation Table

In addition to debug logging over serial, enabling "**verbose 3**" will also display some useful on-screen information as well that can be helpful when troubleshooting registration/recognition issues. An example can be seen in the images below:



Figure 45: On-screen Info for Registering Face

NOTE: Without any registered users, the on-screen debug info will not update until a registration has been triggered. This is because the inference engine does attempt to recognize any faces if they are none currently registered.

In the above example, registration is taking place, but according to the on-screen debugging info, although the face has passed the blurriness check (hence “**blur: 0**”), the “front face check” has passed (hence “**front: 1**”), and the RGB liveness check has passed (hence “**rgbLive: 1**”), the IR liveness check has not passed (hence “**irLive: 0**”). This would suggest that there may be an issue with the IR camera – likely a lighting issue.



Figure 46: On-screen Info for Recognized Face

In the above example, the on-screen info reflects information about the face being recognized. As shown in the screenshot, the face has been recognized with 95% similarity to the matching face in the internal database (hence “**sim: 95**”) and has passed both the RGB and IR liveness checks (hence “**rgbLive: 1**” and “**irLive: 1**”).

NOTE: The “front face check” is only performed by the inference engine for faces being registered to ensure that no face gets registered that it is improperly angled towards the camera.

3.2.7 Configure IR LED Brightness

The dual camera adapter has two IR LEDs which can be configured to control their brightness as appropriate for the environment they are being used in. To control the brightness, these IR LED's use PWM signals which have configurable duty cycles that can be set using serial commands.

To control the brightness of the LED, use the command **“ir_pwm 0-100”** to set the percentage brightness of the LEDs. An example of this command being run is shown below.

```
SHELL>> ir_pwm 60
SHELL>> Camera IR duty cycle 60%
```

Figure 47: "ir_pwm 60" Command

NOTE: If not using a camera which supports configurable IR LEDs, you will receive a message like the following:

```
SHELL>> ir_pwm 60
SHELL>> Camera IR PWM not supported
```

Figure 48: "Camera IR PWM not supported" Message

3.2.8 Configure White LED Brightness

The dual camera adapter has two white LEDs which can be configured to control their brightness as appropriate for the environment they are being used in. To control the brightness, these white LEDs use PWM signals which have configurable duty cycles that can be set using serial commands.

To control the brightness of the LED, use the command **“white_pwm 0-100”** to set the percentage brightness of the LEDs. An example of this command being run is shown below.

```
SHELL>> white_pwm 60
SHELL>> Camera white duty cycle 60%
```

Figure 49: "white_pwm 60" Command

3.2.9 Print Version Information

It can be useful to know which version of the SLN-VIZNAS-IOT inference engine is being run in order to know which features are currently supported. To determine the version number of the Oasis Lite inference engine being used by your kit, use the **“version”** command.

```
SHELL>> version
SHELL>> Engine:v3.4
```

Figure 50: "version" Command

3.2.10 Save Users Through Resets

When low power mode is disabled, faces are not automatically saved into flash, meaning that when the board is reset, any registered faces not explicitly saved into flash will be removed. To save a face into flash, use the command “**save N**”, where “N” is the number of users you want to save. Users are saved in the order that they were added, so if the command “save 3” was used, the first 3 users registered into the database would be saved.

```
SHELL>> save 3
SHELL>> 3 list will be saved into flash database
Database save success. Time taken in ms 0
```

Figure 51: "save 3" Command

Alternatively, the command “**save**” with no arguments will save all registered users into flash.

```
SHELL>> save
SHELL>> all sdram database will save into flash database
Database save success. Time taken in ms 0
```

Figure 52: "save" Command

The “**save**” command returns a success message along with the time taken in milliseconds to save all the faces into flash.

3.2.11 Enable OTW (Over-the-Wire) Update Mode

OTW updates and enabling OTW Update Mode are discussed in the **SLN-VIZNAS-IOT Developer’s Guide**.

3.2.12 Reset the SLN-VIZNAS-IOT

Situations can arise in which it is useful to reset the kit without needing to physically power cycle the kit. This can be done through use of the “**reset**” command. This command performs a soft reset of the kit, going through the entire bootstrapping and bootloading process (see SLN-VIZNAS-IOT-Developer’s Guide) again.

```
SHELL>> reset
SHELL>> System will reset
```

Figure 53: "reset" Command

As with any reset of the kit, serial communication will need to be reestablished to begin issuing serial commands to the board again and you may also need to restart the camera application you are using (Windows Camera App, Cheese, etc..)

3.2.13 Configure Emotion Recognition

The SLN-VIZNAS-IOT kit supports emotion recognition in addition to face recognition. This feature comes disabled by default and needs to be enabled via serial commands.

Once connected to the kit via serial, use the command “emotion 0”, “emotion 2”, “emotion 4”, or “emotion 7.”

```
SHELL>> emotion 4
SHELL>> 4 types emotion recognition is set, system will reset
```

Figure 54: “emotion 4” Command Success Output

Running the “emotion” command will enable the recognition of the emotions shown in the table below.

Emotion	“emotion 2”	“emotion 4”	“emotion 7”
Neutral	X	X	X
Happy	X	X	X
Angry		X	X
Surprised		X	X
Sad			X
Fear			X
Disgust			X
Accuracy	92%	81%	62%

Table 9: Emotion Recognition Configuration Table

When a user’s emotion is recognized, the kit will display a message which will indicate the detected emotion. If a user smiles, the text “Happy” will be shown in the upper right-hand corner of the bounding box*.

***Note: Detected emotion will only be shown through verbose mode when the app type is not the UserID app type. For more info on app types/configurations see App Configurations.**

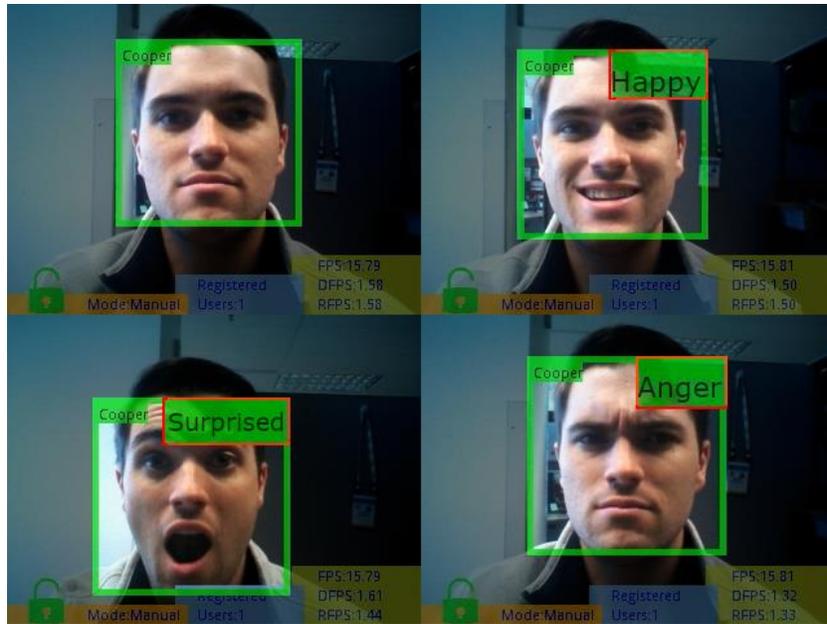


Figure 55: "emotion 4"

The more emotions that are being actively recognized, the lower the emotion accuracy. For this reason, we recommend using two or four emotions.

Please note the **“Neutral”** emotion is a standard state and is not displayed.

3.2.14 Configure Liveness Detection

Kits equipped with the dual camera adapter come with the ability to perform liveness/anti-spoofing detection as an added level of security for those using the kit. This feature comes enabled by default.

Using the command **“liveness <off|on>”** can be used to toggle this feature off or on. For the command to take effect, the board will automatically reset itself, so make sure you have any faces you want to retain saved in flash.

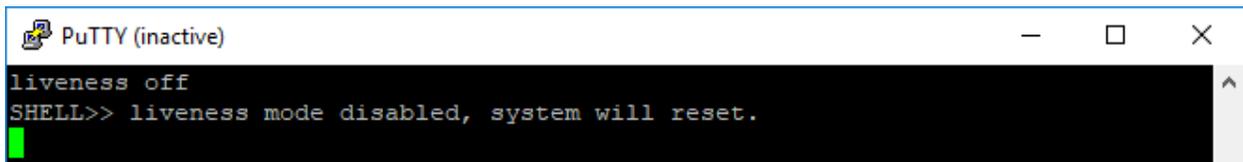


Figure 56: "liveness off" command

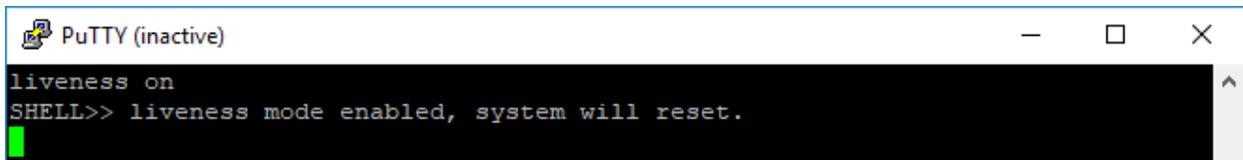


Figure 57: "liveness on" Command

3.2.15 Configure Detection Resolution

The SLN-VIZNAS-IOT kit comes with both VGA and QVGA **detection resolution settings***. By default, the kit runs in VGA mode. Although VGA takes more processing power which can slightly affect detection times, the higher resolution provided by VGA mode also allows for further roughly double detection/recognition range compared to using QVGA. An overview of the differences can be seen in the chart below.

NOTE: As the name would suggest, changing the detection resolution does not affect the resolution of the video output, just the resolution of the image passed to the inference engine.

Mode	Resolution	Detection & Recognition Range	Detection Speed
VGA (default)	640x480	.3m ~1.4m	100ms
QVGA	320x240	.3m ~ .7m	80ms

Table 10: VGA vs. QVGA

A visual example of the difference in max range between the two resolutions can be seen in the following figure:



Figure 58: VGA vs. QVGA Detection Resolution Max Range

In order to switch between the two modes, the command “**detection resolution <VGA|QVGA>**” can be used to enable VGA or QVGA detection resolution mode. For the command to take effect, the board will automatically restart itself, so make sure to have any faces you want to retain saved in flash (see **Saving Users Through Resets**).

```
SHELL>> detection resolution vga
SHELL>> Detection resolution VGA mode selected, reset system
```

Figure 59: "detection resolution vga" Command

```
SHELL>> detection resolution qvga
SHELL>> Detection resolution QVGA mode selected, reset system
```

Figure 60: "detection resolution qvga" Command

NOTE: Due to the minimal benefits in detection performance, VGA is recommended for most use-cases.

3.2.16 Display IR Output

The camera whose output gets displayed can be configured via the “display <rgb|ir>” command which will configure the display to output from whichever camera is specified. The functionality of this command is identical to that of the SW3 push button.

```
SHELL>> display output_mode ir
SHELL>> display ir frame
```

Figure 61: "display output_mode ir" Command



Figure 62: IR Display Output

```
SHELL>> display output_mode rgb
SHELL>> display rgb frame
```

Figure 63: "display mode not supported" Message

NOTE: This command will only change the camera being shown, not the camera(s) being used for detection and recognition.

3.2.17 Configure Display Output Device (Requires Riverdi Display)

Kits enabled with a Riverdi display like that shown below can use the “**display output_device <usb|riverdi>**” command to configure whether video will be output through USB to a computer or through the Riverdi display connected to the kit.



Figure 64: Riverdi Display

```
SHELL>> display output_device riverdi
SHELL>> Display output mode set to riverdi, system will reset
```

Figure 65: "display output_device riverdi" Command

For more information on supported display peripherals, see **Display Configurations**

3.2.18 Toggle GUI

The “**display interface <loopback|infobar>**” command can be used to toggle the GUI on or off, leaving only the face bounding box. The behavior of this command is identical to that of the SW1 push button.

```
SHELL>> display interface loopback
SHELL>> Interface changed with success
```

Figure 66: "display interface loopback" Command



Figure 67: GUI Toggled Off

3.2.19 Toggle Wi-Fi Enablement

The command “**wifi <on|off>**” can be used to turn Wi-Fi functionality either on or off.

The output of this command is based on the connection status of the Wi-Fi.

For example, if Wi-Fi was off before issued the “**wifi on**”, you will get output like the following:

```
SHELL>> wifi on
SHELL>> Wi-Fi will start
```

Figure 68: "Wi-Fi will start" Message

Alternatively, if this command is used while the Wi-Fi is already attempting to connect, you will get the following message:

```
SHELL>> wifi on
SHELL>> Wi-Fi driver is connecting, wait...
```

Figure 69: "Wi-Fi driver is connecting" Message

If the Wi-Fi is already turned on and connected, you will receive the following message:

```
SHELL>> wifi on
SHELL>> Wi-Fi driver is on
```

Figure 70: "Wi-Fi driver is on" Message

Finally, if the Wi-Fi was already on and had attempted to connect but failed because the credentials given were bad, etc., you will receive the following message:

```
SHELL>> wifi on
SHELL>> Wi-Fi is in provisioning mode
```

Figure 71: "wifi on" Command

The “**wifi off**” command will display a message like the following if Wi-Fi is currently on

```
SHELL>> wifi off
SHELL>> Wi-Fi will stop
```

Figure 72: "Wi-Fi will stop" Message

or a message indicating that the Wi-Fi is already off:

```
SHELL>> wifi off
SHELL>> Wi-Fi driver is off
```

Figure 73: "Wi-Fi driver is off" Message

3.2.20 Reset Wi-Fi

The command **“wifi reset”** can be used to reset the kit’s connection to the network. Resetting the network can be useful in scenarios where the kit has lost connection to its network, but performing a Wi-Fi reset is also necessary any time the Wi-Fi credentials are updated.

```
SHELL>> wifi reset
SHELL>> Wi-Fi will reset
```

Figure 74: "wifi reset" Command

3.2.21 Retrieve Wi-Fi Credentials

If Wi-Fi credentials have already been configured on the kit either through the CLI interface or through the remote provisioning application, using the command **“wifi credentials”** will retrieve both the SSID and password credentials which are currently in use.

```
SHELL>> wifi credentials
SHELL>> SSID is test_ssid with password 123456.
```

Figure 75: "wifi credentials" command

If no credentials are currently in use, the output of the command will look like the following:

```
SHELL>> wifi credentials
SHELL>> Wi-Fi Credentials not found
```

Figure 76: "Wi-Fi Credentials not found" Message

NOTE: While useful during development, exposing sensitive password information is not recommended, and it is advised that this command be disabled.

3.2.22 Configure Wi-Fi Credentials

The **“wifi credentials SSID PASSWORD”** command can be used to configure the Wi-Fi settings being used by the kit.

```
SHELL>> wifi credentials test_ssid 123456
SHELL>> Wi-Fi credentials set. New network will be available after Wi-Fi reset
```

Figure 77: "wifi credentials" w/ Args

To begin using the newly configured Wi-Fi settings, a Wi-Fi reset must be issued either through a reset of the board or via the **“wifi reset”** CLI command discussed previously.

Failure to properly specify both an SSID and password will result in output like the following:

```
SHELL>> wifi credentials test_ssid
SHELL>> Wrong command for wi-fi credentials
```

Figure 78: "wifi credentials" w/ Bad Arg

3.2.23 Retrieve IP Address

Once the Wi-Fi credentials have been set, the IP address associated with the kit's Wi-Fi connection can be discovered using the “**wifi ip**” command. Assuming the board is connected to a network, the command should display output similar to the following:

```
SHELL>> wifi ip
IPv4 Address: 192.168.0.165
```

Figure 79: "wifi ip" Command Successful

If no connection to a network has been made, the IP address returned by the command will be “0.0.0.0”

```
SHELL>> wifi ip
IPv4 Address: 0.0.0.0
```

Figure 80: "wifi ip" Command Unsuccessful

3.2.24 Erase Wi-Fi Credentials

In order to completely erase the existing Wi-Fi credentials, use the “**wifi erase**” command.

```
SHELL>> wifi erase
SHELL>> Wi-Fi credentials removed
```

Figure 81: "wifi erase" Command

NOTE: Once issued, the Wi-Fi credentials will be wiped from flash and cannot be retrieved.

3.2.25 Configure Application Type

The “**app_type <0|1|2|3|4>**” CLI command can be used to configure the “App Type” used by the inference engine. The arguments in the command correspond to the following app types:

Number/Argument	Corresponding App Type
0	E-Lock (Light)
1	E-Lock (Heavy)
2	Door Access (Light)
3	Door Access (Heavy)
4	Userid

Table 11: App Type Arguments

```
SHELL>> app_type 0
SHELL>> Set app type 0, system will remove existing db & reset.
```

Figure 82: "app_type" Command

NOTE: As the output of the command shown in the figure above would suggest, the current database of registered faces is erased whenever the app type is configured. This is due to the incompatibility of data from one model/app type with another.

More information about App Types can be found in the **App Configurations** section.

3.2.26 Configure Low Power Mode

As discussed in an earlier section, the command “**low_power <on|off>**” can be used to configure whether low power/the ability to enter sleep mode is enabled or disabled.

```
SHELL>> low_power on
SHELL>> low_power enabled
```

Figure 83: "low_power on" Command

More information about low power mode can be found in the **Low Power Mode** section.

3.3 Remote (Wireless) Registration

The SLN-VIZNAS-IOT supports the ability to register faces both locally by using either CLI commands or the on-board push buttons as described in earlier sections, but it also supports remote registration via BLE using an Android phone/tablet application. The companion remote registration Android app, also known as the “**FaceRec Manager**” application, sports a relatively simple interface where a user is able to register faces remotely and manage the users stored in the SLN-VIZNAS-IOT’s local database. This section will discuss some of the major features provided by this application.

A download link for the FaceRec Manager Android APK + full source code can be found under the **Software and Tools** section of [the homepage for the SLN-VIZNAS-IOT](#).

NOTE: The FaceRec Manager application is intended for use as an evaluation tool, and as a reference/boiler plate upon which a customized smartphone/tablet companion application can be built on top of.

3.3.1 Select Wireless Configuration

The FaceRec Manager application gives the option for remote registration over BLE or a Network* (Wi-Fi) connection. To select the desired configuration, simply choose your preferred option from the app’s home screen, which will look similar to the screen shown below:

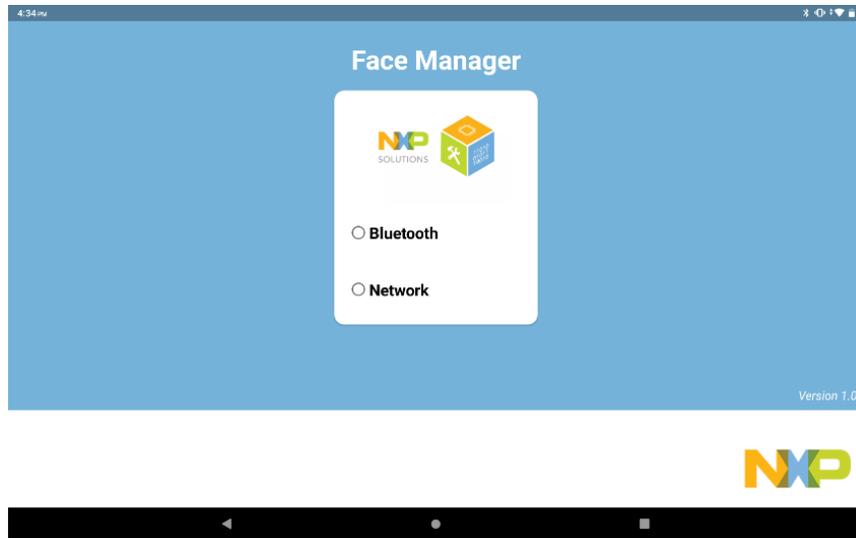


Figure 84: FaceRec Manager Home Screen

****NOTE: Currently only remote registration via BLE is supported**

3.3.2 Connect Kits

Through the FaceRec Manager application, users are able to add kits they own by simply pressing a button to scan for remote devices that are within Bluetooth range of the phone/tablet being used.

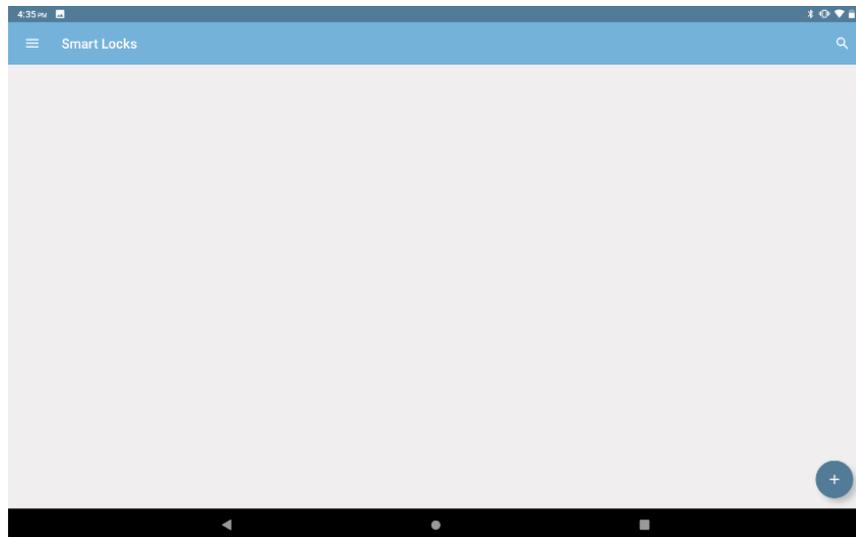


Figure 85: "Smart Locks" Management Page

Once scanning has begun, any devices in the area will automatically be detected and show up in the app as a potential connection. Simply press "Connect" next to the device you want to add in order to register the VIZNAS kit to your list of kits being managed.



Figure 86: BLE Connections in Range

After connecting with the device, a unique name and passcode can be associated with the kit to demonstrate how an end-device could be identified and management of that device could be restricted via password protection.

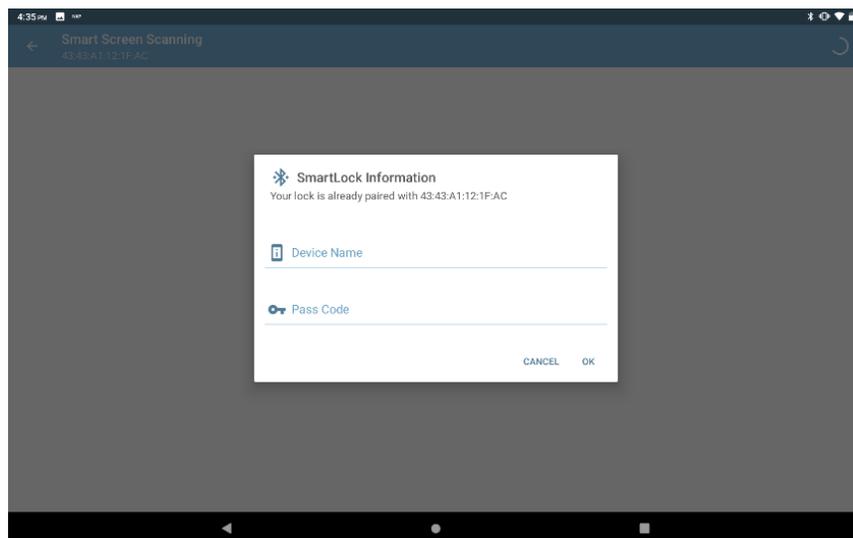


Figure 87: Configure SmartLock Information

Finally, your registered locks will show up under the “Manage Smart Locks” tab inside the Android app, and the kit your phone/tablet is currently connected to will display a BLE icon indicating a connection is currently established with that SLN-VIZNAS-IOT kit. Additionally, users can connect/disconnect from a device using the BLE icon in the upper right-hand corner of the screen, and using a simple swipe gesture, an individual lock can be renamed or deleted entirely.

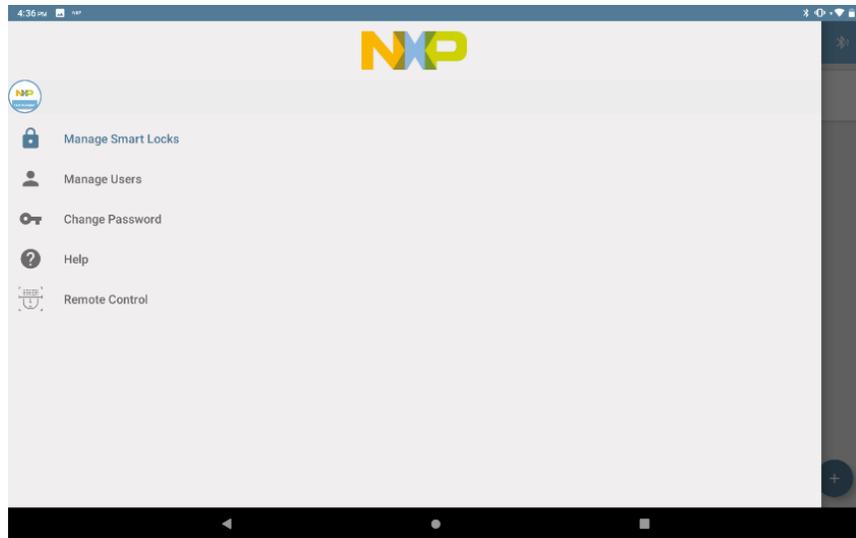


Figure 88: "Manage Smart Locks" Tab

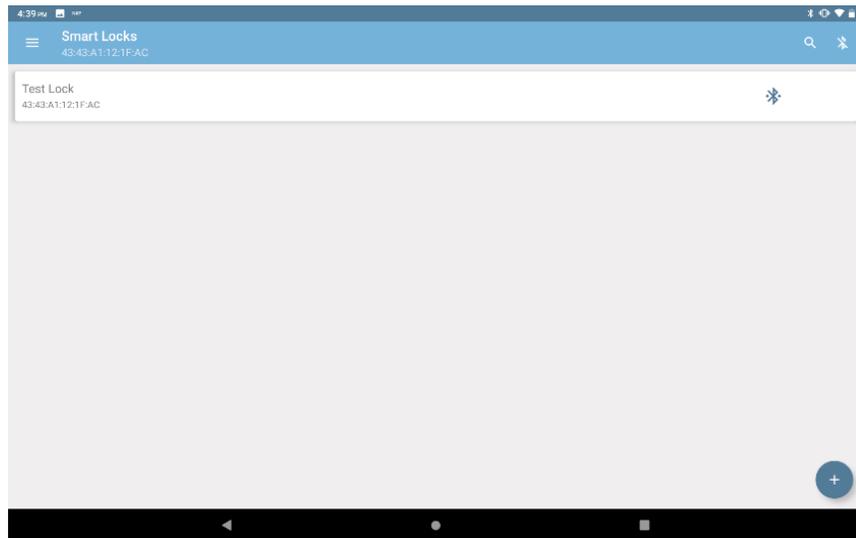


Figure 89: Connected Locks

NOTE: Currently, only one device can be "managed"/connected to at any given time.

3.3.3 Manage Users

The FaceRec Manager app, as the name would imply, allows users to manage the users stored on an SLN-VIZNAS-IOT kit using an Android application. This includes the ability to add, list, and delete users from the SLN-VIZNAS-IOT's local face database by providing 2-way synchronization. This section will give an overview of each of these features.

3.3.3.1 Add Users

One of the highlights of FaceRec Manager application is the ability to remotely register faces via Wi-Fi* or BLE. The application provides a simple interface for adding faces which can be accessed under the “**Manage Users**” tab.

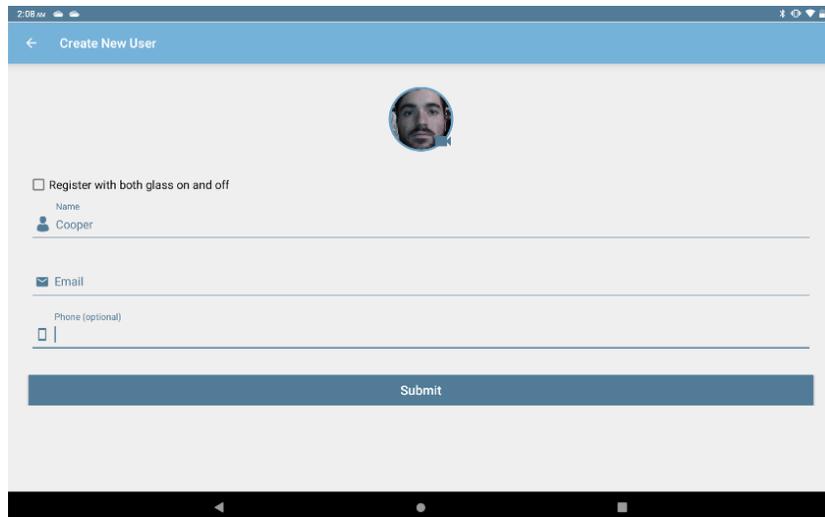


Figure 90: Remote Registration Screen

To register your face, click on the icon of silhouette in upper-middle part of the screen. Once pressed, a screen like the following will be shown and you must enable face capture by using the camera icon at the bottom of the screen:

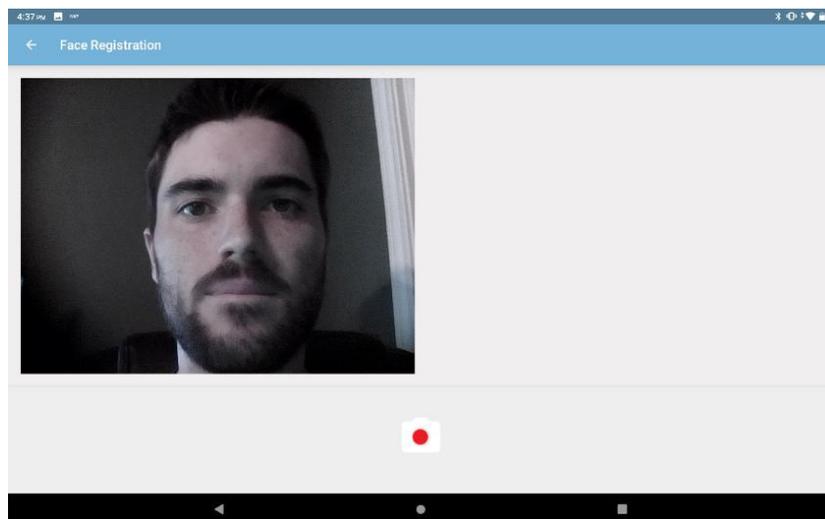


Figure 91: Remote Face Capture Screen

The “face capture” screen may provide instructional cues to help you properly align your face, etc. and will automatically return to the previous screen once your face has successfully been registered.

3.3.3.2 List Users

In addition to adding users, a full list of users registered to a device can be seen under the “**Manage Users**” tab in the FaceRec Manager Android application.

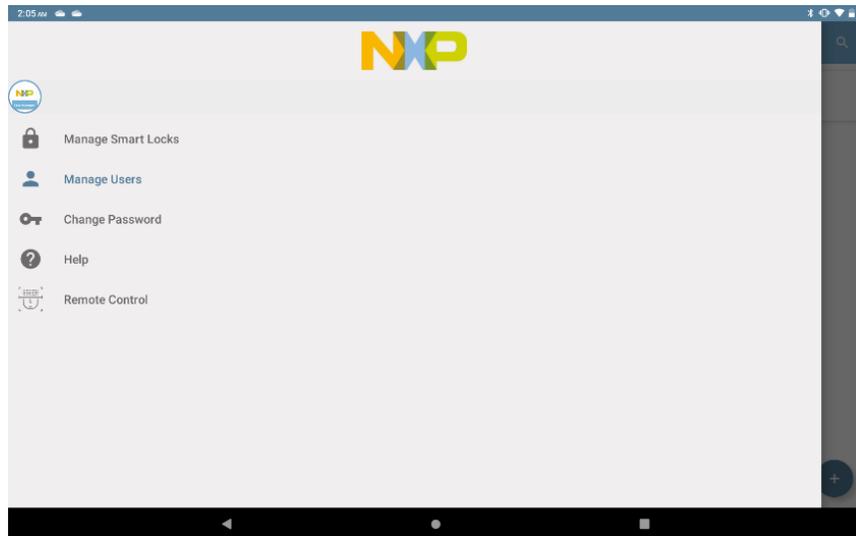


Figure 92: "Manage Users" Tab

From here, pulling down from the middle of the page will perform a sync between the device and the application. Alternatively, individual users registered remotely but not yet synced with the kit can be synced by clicking the “sync icon” next to a user’s name.

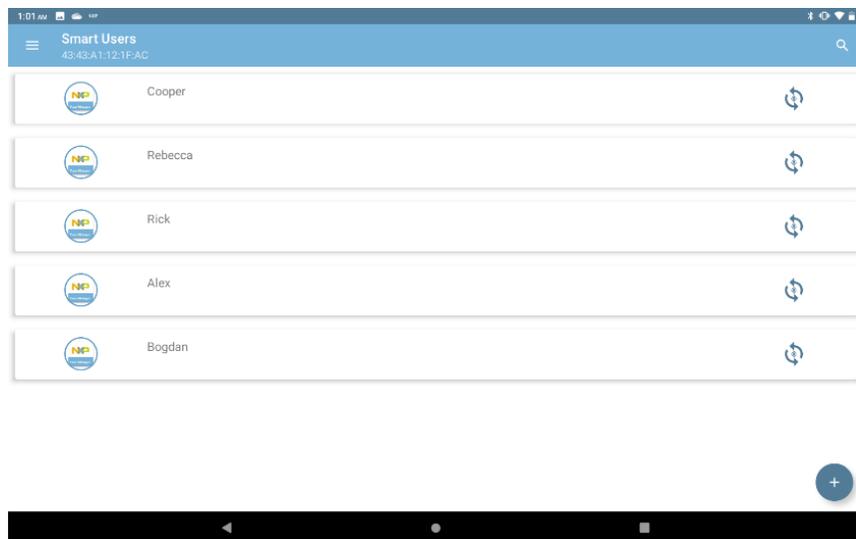


Figure 93: User List Screen

3.3.3.3 Delete Users

In addition to adding and listing users, the FaceRec Manager application also allows for the deletion of registered users as well. From the “Manage Users” tab, swiping left on the name of the user who is to be deleted will reveal an icon which allows for the deletion of the user.



Figure 94: Remote Deletion Screen

3.4 Remote Credential Provisioning

In addition to the **FaceRec Manager App**, the SLN-VIZNAS-IOT also comes with a reference application for remote credential provisioning over Wi-Fi and BLE call the **VIZN Companion App**. This application allows users to remotely provide Wi-Fi credentials using an existing Wi-Fi connection or via BLE. Similar to the FaceRec Manager App, the APK + full source code for this Android application can be downloaded from [the official webpage for the SLN-VIZNAS-IOT](#) under the **Software and Tools** section. While the functionality for this application is limited, it is intended to be used as a reference for developers seeking to create their own smartphone/tablet companion applications.

3.5 App Configurations

The below table shows a list of the different available app types and their corresponding feature sets. In this section, each of these app types will be looked at in more depth to highlight the advantages and disadvantages of each.

App Type	Max # of Faces	Detection Speed	Recognition Speed	Liveness Detection & Anti-Spoofing
E-Lock (Light)	50	~80ms	~200 ms	Yes
E-Lock (Heavy)	100	~80ms	~700 ms	Yes
Door Access (Light)	1000	~80ms	~200 ms	Yes
Door Access (Heavy)	3000	~80ms	~700 ms	Yes
Userid	1000	~80ms	~200 ms	No

Table 12: App Configurations

As shown in the table above, the various app type configurations greatly affect the recognition speed, number of faces, and security functionality of the kit. Each app type has its own advantages and disadvantages.

3.5.1 Light vs. Heavy

As shown in **Table 12: App Configurations**, E-Lock (Light) is roughly 500ms faster at recognizing a face when compared to the E-Lock (Heavy) app type. However, the heavy configuration is capable of recognizing roughly double the number of faces as the “light” app type. A similar tradeoff between recognition speed and max # of faces can be seen in the Door Access (Light) vs. Door Access (Heavy) models.

The disparity between the two comes down to the difference in the AI model which is used to perform the recognition stage of the inferencing pipeline. The light models are designed to recognize faces more quickly, but are more limited in the total number of faces that can be recognized, whereas the heavy models are optimized for the max number of faces that can be recognized, resulting in slower recognition speed than the light models.

Choosing between the heavy and light model configurations comes down to a question of performance vs. # of users, and that is generally determined by the use-case.

3.5.2 E-Lock vs. Door Access vs. UserID

Both the E-Lock and Door Access and app types have liveness detection and anti-spoofing capabilities, however, the main difference between the two is a tradeoff between max # of recognizable faces and power consumption.

Compared to the “Door Access” app type, the equivalent heavy/light E-Lock app can recognize far fewer faces, but the advantage of using the E-Lock app type is that E-Lock utilizes the IR camera for face recognition as opposed to the RGB camera. While the RGB camera provides more feature data, thereby allowing recognition of a far greater number of faces, RGB struggles in lower-light conditions where an IR camera has a much easier time. Because of this fact, the IR camera has less reliance on power-hungry illuminator LEDs that an RGB camera would require for the recognition process. As a result, generally, the E-Lock app type is recommended in battery-powered use-cases where continually running power-hungry LEDs could prove to be an issue, draining a significant portion of the battery life.

The UserID app type, unlike the E-Lock and Door Access app types, does not have any liveness detection/anti-spoofing features. The UserID app type is meant to replicate the original SLN-VIZN-IOT kit which is no longer in active circulation. Unlike the original SLN-VIZN-IOT kit, however, the remote registration and low power mode features of the SLN-VIZNAS-IOT are fully functioning in this version of the UserID application. For more information on the UserID app type, check out the [User Guide for the SLN-VIZN-IOT](#).

3.6 Low Power Mode

Low power mode demonstrates the power saving capabilities of the RT106F chip, which can be useful in battery-powered applications like a battery-powered door lock. While low power mode is enabled, the SLN-VIZNAS-IOT kit will automatically go to sleep according to the rules in the following diagram:

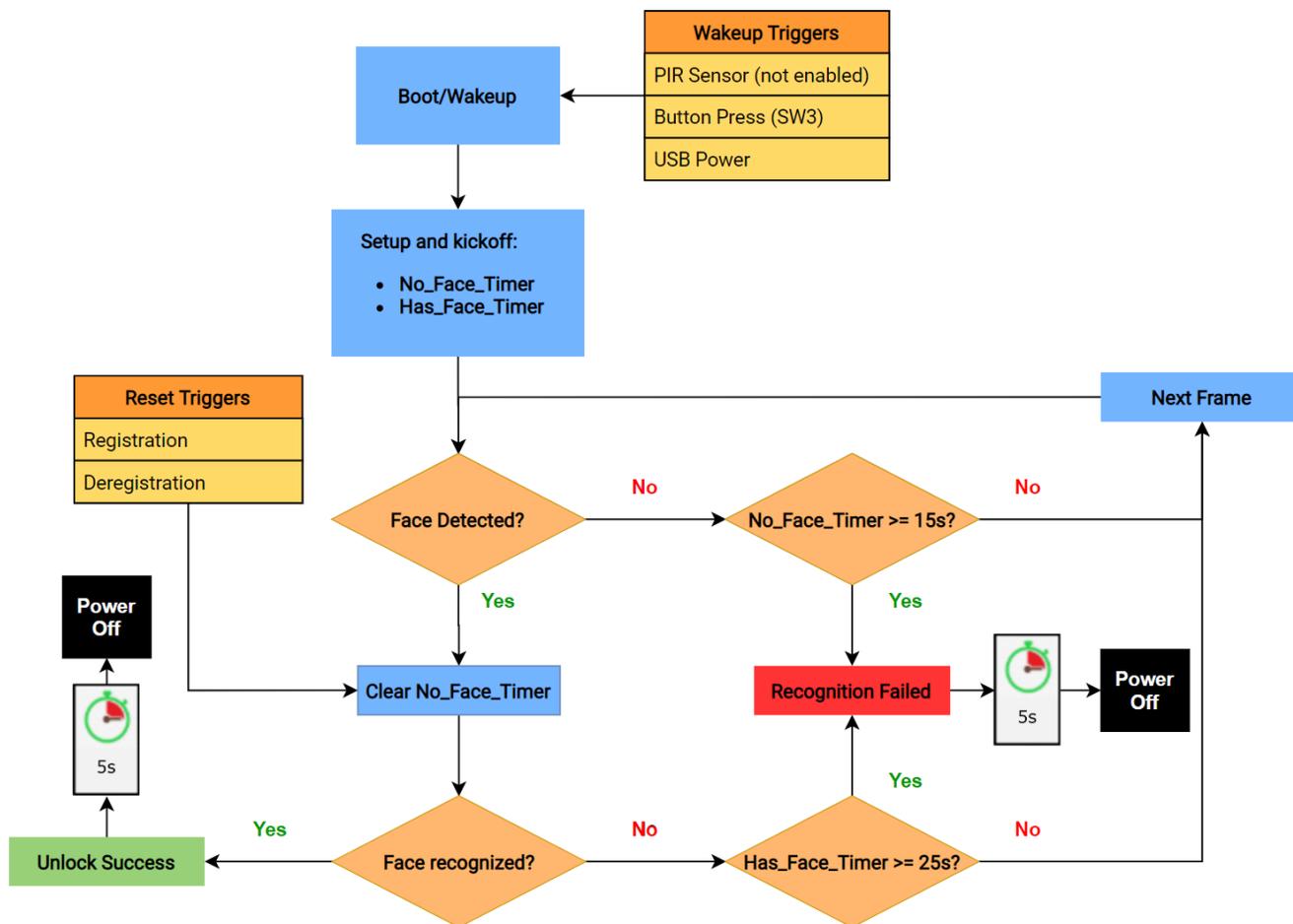


Figure 95: Low Power Timeout Flow

As shown above, when the kit boots and low power mode is enabled, two timers are kicked off which are used to determine when the kit should fall asleep. One timer is used only when a face is detected but not recognized, and the other timer is used when no face is detected at all.

By default, the “No_Face_Timer,” which is used when no face is detected, will cause a timeout and power down once 15 seconds have passed with no face detected. The “Has_Face_Timer” is used when a face has been detected but is not recognized, and, by

default, will timeout and power down after 25 seconds have passed with an unrecognized face in frame.

Triggering a registration or deregistration will reset the “No_Face_Timer” and pause it during the registration/deregistration so that neither of those processes will not be interrupted by the system trying to go to sleep.

Once the system reaches the “Recognition Failed” state and is 5s from entering low power mode, a “Recognition Timeout” message like the following will be prominently displayed at the top of the screen as a warning that the system is about to power down.



Figure 96: "Recognition Timeout" Message

To prevent the erasure of registered faces when the board powers down, when low power mode is enabled, registered faces are automatically saved into flash, unlike how faces must be explicitly saved into flash upon reset when low power mode is disabled..

NOTE: Faces are not automatically saved to flash when low power mode is disabled.

Once asleep, the board can only be awoken by the triggers mentioned in **Figure 95: Low Power Timeout Flow**: the PIR sensor*, SW3, and USB Power (Power Cycling the kit). Triggering a wakeup will cause the board to return to normal operation.

****NOTE: The PIR sensor as a wakeup trigger is currently disabled on the SLN-VIZNAS-IOT due to a manufacturing issue with the PIR sensor which causes unpredictable behavior when using the PIR sensor as a wakeup source. This should not affect designs which use the PIR layout provided in the SLN-VIZNAS-IOT HW schematic diagrams.**

3.7 Audio Feedback

The SLN-VIZNAS-IOT comes with audio feedback prompts which are used alongside the on-screen messages to provide information to the user. Currently, audio prompts for “Registration Successful”, “Registration Failed”, and “Welcome” (Face Recognized) are supported. To hear the audio prompts, a speaker must be soldered to the J3 connector

which is connected to the TFA9894 audio amplifier on the kit. The location of the J3 connector is shown below:

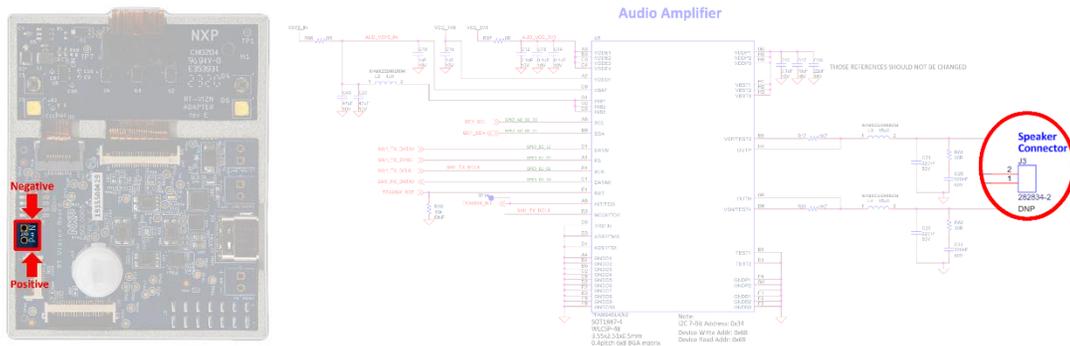


Figure 97: J3 Speaker Connector

To disable audio prompts, the `sln_viznas_iot_elock_oobe` project must be recompiled with the `VOICE_PROMPT` preprocessor macro set to 0. For more information on configuring preprocessor macros see the **SLN-VIZNAS-IOT Developer's Guide**.

3.8 Display Configurations

In addition to supporting video over USB, the SLN-VIZNAS-IOT can also display video to an external display via SPI. Currently, the only officially supported display is the Riverdi **RVT28UEFNWC10 2.8" Capacitive Touch Display**. More information about this display can be found [here](#).



Figure 98: Riverdi RVT28UEFNWC10

NOTE: The SLN-VIZNAS-IOT features a SPI interface to connect a Serial display from Riverdi, which is supported by our Software Package. However, the MIMXRT106F also embeds a parallel display controller which a customer could enable on their own board by leveraging existing NXP drivers from the RT1060/RT1062 EVK package.

In order to make use of the display, 20-pin opposite-side contact ribbon cables like the ones found [here](#) must be used*.

****NOTE:** The picture associated with the item on the website does not accurately reflect the opposite-side nature of the cable.

To configure the display in use, simply specify either “usb” or “riverdi” as the argument to the “**display output_device**” command (see **3.2.17 Configure Display Output Device (Requires Riverdi Display)**).

4 Troubleshooting

4.1 Registering a Face

This section will describe steps that can be taken to help debug potential points of failure when attempting to perform face registration and recognition. If after following these steps you still cannot identify the cause of the issue, head over to the [official NXP forums](#) to reach out for additional assistance.

4.1.1 Turn off Liveness Detection

First, to help identify whether the issue is with the detection/recognition or with the liveness detection/anti-spoofing, turn off liveness detection using the “**liveness off**” CLI command (see **Configure Liveness Detection**) to verify whether or not your face can be registered without the secure features enabled.

If turning liveness detection off allows your face to be able to be registered without any issues, then the problem is likely related to the liveness detection and anti-spoofing feature. **Reenable liveness detection** and skip to **Debug Using Verbose Mode** for steps help identify what specifically is causing liveness detection to fail.

If turning liveness detection off still does not allow your face to be able to be registered, follow the steps in **Change App Type** to help determine why detection/recognition is failing.

4.1.2 Change App Type

As discussed in **App Configurations**, the E-Lock app type makes use of the IR camera for detection/recognition while the Door Access app type makes use of the RGB camera for detection/recognition. To help determine if there is an issue with one specific camera, try changing from E-Lock to Door Access or vice versa depending on which configuration you are currently using.

If after switching to the alternate app type, you are still experiencing an issue, proceed to the next step.

4.1.3 Debug Using Verbose Mode

Verbose mode can provide useful information when debugging registration issues, especially when it comes to debugging issues with liveness detection and anti-spoofing. Follow the steps in the **Enable Verbose Mode** section of this guide and enable “verbose 3” to receive all available debugging information. The on-screen indicators can be particularly helpful in identifying what is going wrong during registration.

For example, in the below screenshots we can see that the IR camera was falsely detecting a fake face. This is likely due to a lighting issue which is covered in the next section **Ensure Lighting is Sufficient**.



Figure 99: "Registration Failed" + Verbose Mode Output

4.1.4 Ensure Lighting is Sufficient

One of the most common issues when registering a face is insufficient lighting for the IR and/or RGB camera. Shown below are a few examples of insufficient lighting for the RGB and IR cameras:



Figure 100: Bad RGB Lighting

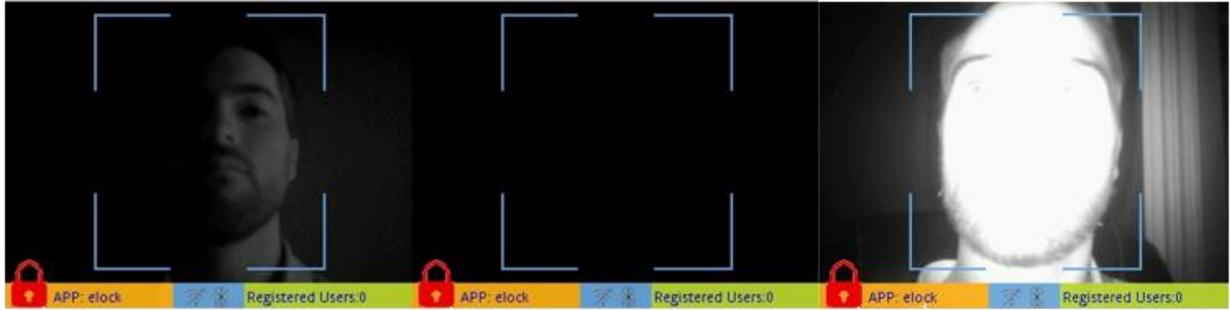


Figure 101: Bad IR Lighting

The “proper” lighting configuration can vary based on the environment in which the product is being used and may therefore require tuning of the LED PWM settings via the CLI commands discussed in **Configure IR LED Brightness 3.2.6** and **Configure White LED Brightness** until a lighting setting which works for your environment is found.

4.1.5 Adjust Face Proximity and Position

Because face recognition makes use of face “identifiers” to determine the face being looked at, it is important that these identifiers can be seen by both cameras. Oftentimes, an improper face angle and/or the proximity to the camera can cause registration to fail. Shown below are a few examples of improper usage.

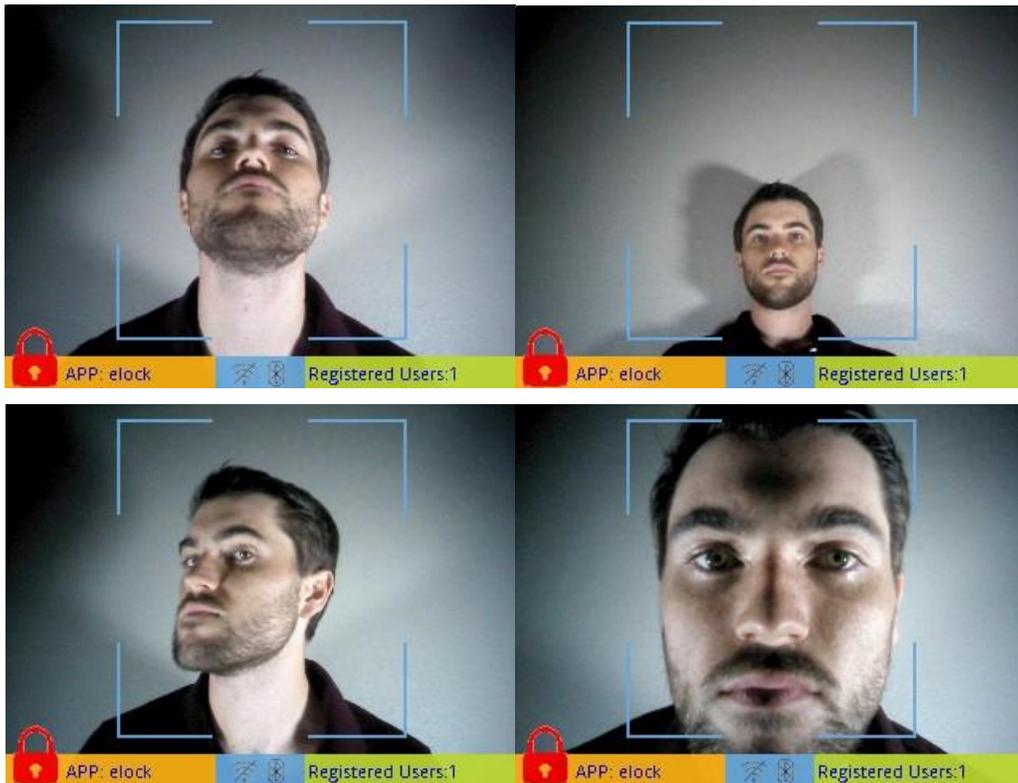


Figure 102: Improper Face Angle & Proximity

When attempting to register a face, the face should ideally take up a majority of the bounding box, be centered inside the bounding box, and staring straight-on at the camera. To help ensure the proper face angle is used, it can be helpful to slowly move the face from left to right and up to down.

5 Document Details

5.1 References

The following references are available to supplement this document:

Document/Link	Remark
http://www.nxp.com/MCUXpresso	MCUXpresso IDE Download
https://www.nxp.com/docs/en/user-guide/MCUXpresso_IDE_User_Guide.pdf	MCUXpresso IDE User Guide
http://nww.preview.nxp.com/docs/en/user-guide/SLN-VIZNAS-IOT-DG.pdf	SLN-VIZNAS-IOT Developer Guide
https://www.nxp.com/mcu-vision2	SLN-VIZNAS-IOT Home Page

Table 13: Reference Documents

5.2 Acronyms, Abbreviations, & Definitions

Acronym	Meaning	(Definition)
FTDI	Future Technology Devices International	
GUI	Graphic User Interface	
IOT	Internet of Things	
IVT	Instruction Vector Table	
JTAG	Joint Test Action Group	
MANF	Manufacturer	
MCU	Microcontroller Unit	
MEMS	Micro-Electro-Mechanical System	
MSD	Mass Storage Device	
OEM	Original Equipment Manufacturer	
OTW	Over the Wire	
OTP	One Time Programmable	
ROM	Read Only Memory	

RTOS	Real-Time Operating System	
SDK	Software Development Kit	
UART	Universal asynchronous receiver-transmitter	

Table 14: Abbreviations and Definitions

5.3 Revision History

Date	Version	Details of Change	Author	Reviewers
10/28/20	Production 1.1	Various Corrections	Cooper Carnahan	NXP
9/29/20	Production 1.0	Initial Version	Cooper Carnahan	NXP

Table 15: Revision History

How to Reach Us:

Home Page:

www.nxp.com

Web Support:

www.nxp.com/support

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