

### 1 Introduction

This document describes various capabilities and features of the FRWY-LS1046A board through a graphical user interface (GUI) based demo. These capabilities/features include CPU performance benchmarking, data analytics (cold storage data analytics and sensor data analytics), machine learning / video analytics, and near field communication (NFC).

The document also provides instructions to access the FRWY-LS1046A demo images and flash the images on the FRWY-LS1046A board.

### 2 Acronyms and abbreviations

The table below lists and explains the acronyms and abbreviations used in this document.

Table 1. Acronyms and abbreviations

Acronym/abbreviation	Meaning
AI	Artificial intelligence
CPU	Central processing unit
CRC	Cyclic redundancy check
DIP	Dual inline package
DTS	Device tree syntax — the textual representation of device trees
DUT	Device under test
GUI	Graphical user interface
IP	Internet protocol
LTS	Long Term Support
ML	Machine learning
NFC	Near field communication
RCW	Reset configuration word
TPU	Tensor processing unit
USB	Universal serial bus

### 3 Prerequisites

This section describes the system requirements for FRWY-LS1046A board demo. It also explains the dual inline package (DIP) switch settings of the FRWY-LS1046A board.

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## System requirements

The table below lists the hardware and software requirements for running the FRWY-LS1046A board demo.

**Table 2. System requirements**

Item	Description	Quantity
<b>Hardware requirements</b>		
DUT	FRWY-LS1046A board	1
Linux machine	x86 machine with Ubuntu 18.04.4 <sup>1</sup>	1
M.2 cards	Google Coral Edge TPU module	1
	Wi-Fi card based on Qualcomm Atheros QCA6174 chipset (for example, SparkLAN WNFQ-255ACN(BT))	1
Wi-Fi antenna	Wi-Fi antenna with mini-SMA connector	1
Click boards	ADXL345 accelerometer module	1
	Near field communication (NFC) click board with NXP PN547 NFC controller	1
NFC card	NFC tag	1
USB camera		1
SD card	32 GB SD card	1
Console cable	USB Type A to micro-B cable	1
Ethernet cable	Cat-6 Ethernet cable	1
<b>Software requirements</b>		
Console	Minicom for Linux	

1. Use Ubuntu 18.04.4 LTS as host operating system while preparing SD card.

## FRWY-LS1046A switch settings

The figure below explains the FRWY-LS1046A DIP switch settings.

Switch	Supported function	Settings
SW1[1:9]	RCW fetch location CFG_RCW_SRC[0:8]	<ul style="list-style-type: none"> <li>0_0100_0100: QSPI NOR flash (default setting)</li> <li>0_0100_0000: Micro-SD card</li> <li>1_0000_01xx: NAND flash (8-bit bus, 2 KB page, 64 pages/block) (LS1043A only)<sup>1</sup></li> <li>0_1001_1110: Hard-coded RCW</li> </ul>
SW1[10]	System clock source CFG_ENG_USE0	<ul style="list-style-type: none"> <li>0: DIFF_SYSCLK/DIFF_SYSCLK_B (differential clock) - 100 MHz (fixed) (default setting)</li> <li>1: SYSCLK (single-ended clock) - 100 MHz (fixed)</li> </ul>

1. The LS1046A processor does not support booting from NAND flash.

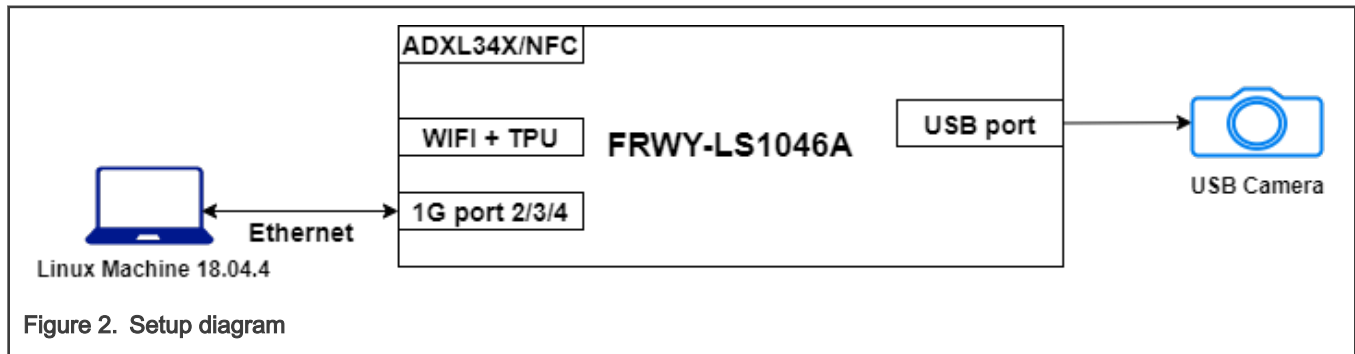
**Figure 1. Switch settings**

**NOTE**

To have QSPI NOR flash memory as the booting device, use default switch settings. To have SD card as the booting device, use switch settings corresponding to micro-SD card.

## 4 Demo setup diagram

The figure below shows the setup diagram for running the FRWY-LS1046A board demo.



## 5 Preparing demo setup

Preparing demo setup involves the following major steps:

1. [Download demo images](#)
2. [Copy low-level firmware to SD card](#)
3. [Flash low-level firmware to boot device](#)
4. [Launch demo GUI](#)

### 5.1 Download demo images

Perform these steps to download FRWY-LS1046A demo images:

1. Click the following [nxp.com](https://www.nxp.com/webapp/swlicensing/sso/downloadSoftware.sp?catid=FRWYLS1046A-DEMO) link:  
<https://www.nxp.com/webapp/swlicensing/sso/downloadSoftware.sp?catid=FRWYLS1046A-DEMO>

You are redirected to the **Sign In** page, as shown in the figure below.

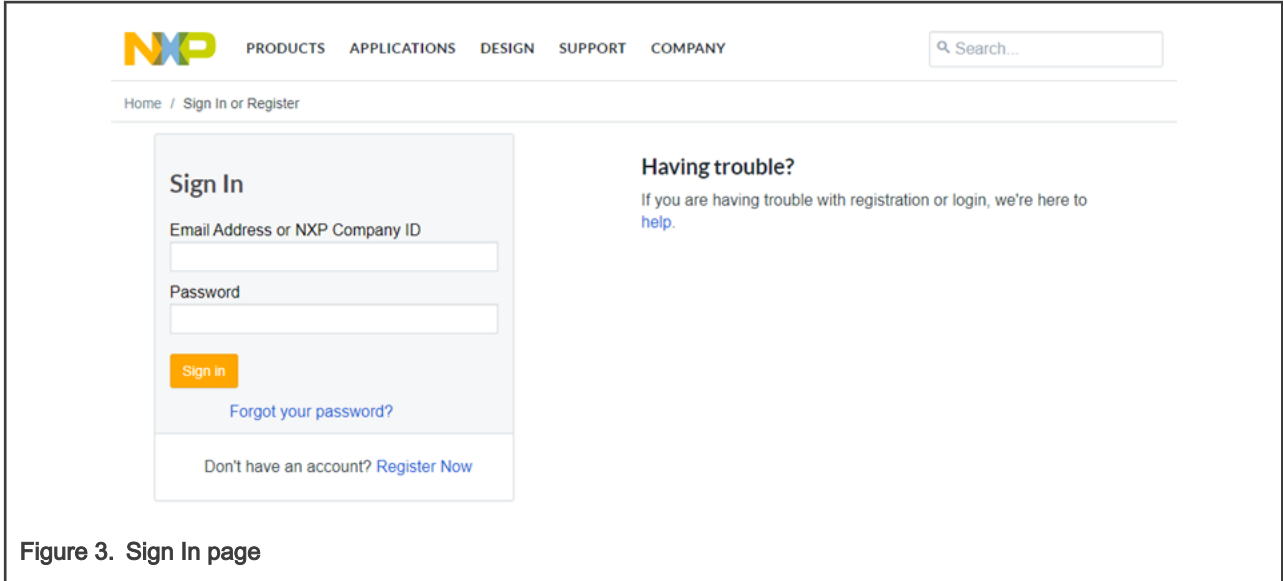


Figure 3. Sign In page

2. Sign in to NXP website. If you are not registered already, then register yourself first. After sign in, you are redirected to the **Product Information** page, as shown in the figure below.

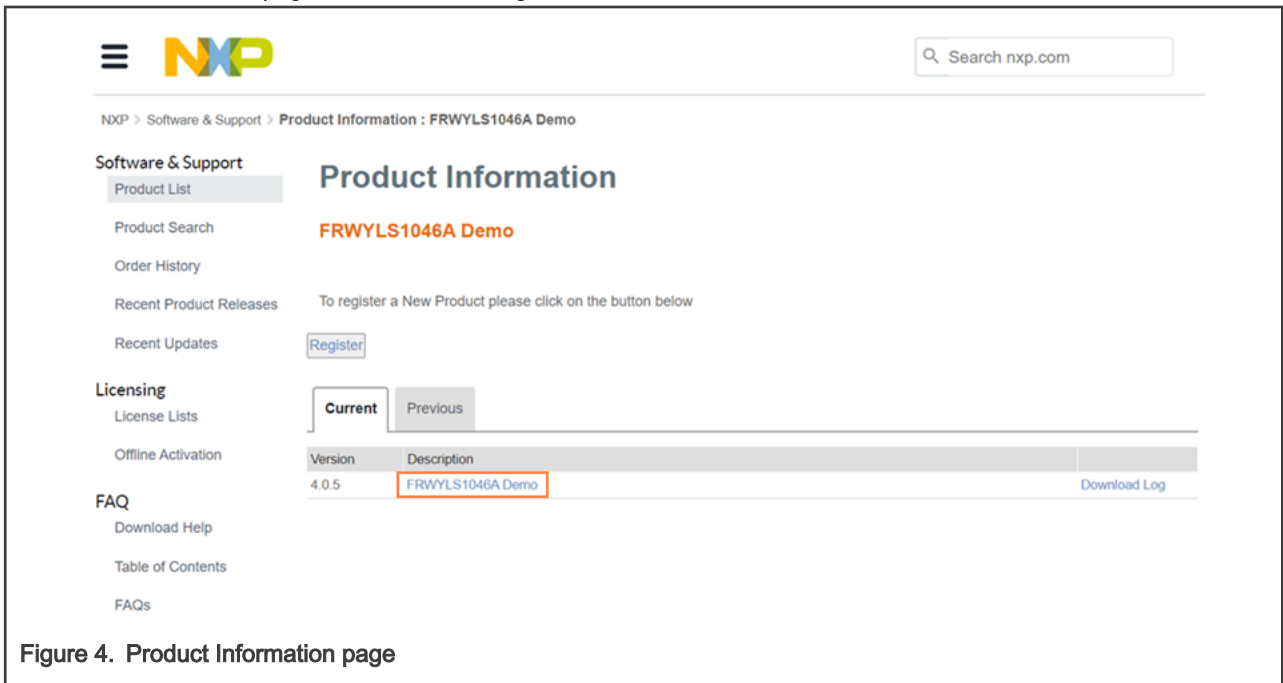


Figure 4. Product Information page

3. Click the **FRWYLS1046A Demo** link (highlighted in the figure above). You are redirected to the **Software Terms and Conditions** page.
4. Read NXP Software License Agreement and if you agree, then click **I Agree**. The **Product Download** page appears, as shown in the figure below.

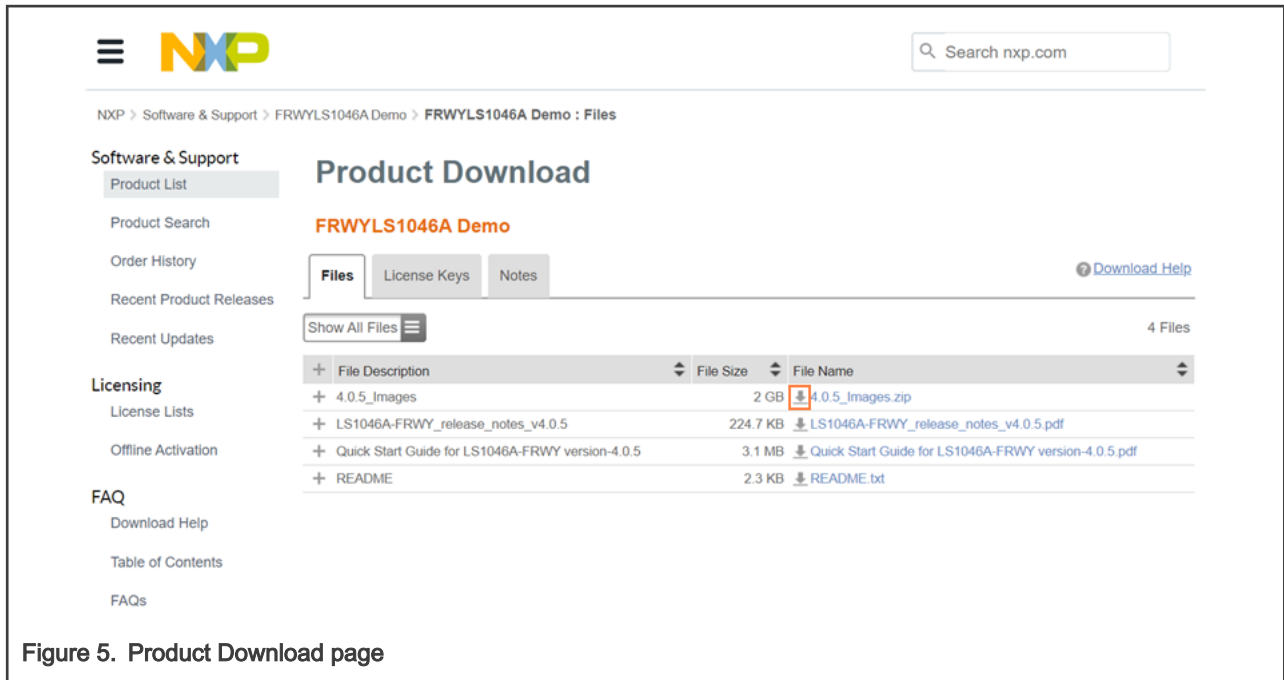


Figure 5. Product Download page

- Click the download link for 4.0.5\_images.zip file (highlighted in the figure above) to download the ZIP file containing FRWY-LS1046A demo images.
- Unzip the downloaded ZIP file to extract the following demo images:
  - firmware\_ls1046afrawy\_uboot\_qspiboot.img (low-level firmware)
  - firmware\_ls1046afrawy\_uboot\_sdboot.img (low-level firmware)
  - bootpartition\_LS\_arm64\_edgescale\_lts\_4.19\_202002251408.tgz (boot partition containing kernel and DTS modifications for Wi-Fi, accelerometer, TPU, and docker)
  - rootfs\_v4.0.5.2.tgz (root file system that enables different parts of the FRWY-LS1046A demo)
  - flex-installer (flex-installer tool, which helps to quickly deploy images)

## 5.2 Copy low-level firmware to SD card

Follow these steps to copy low-level firmware to SD card:

- Insert the SD card into the Linux machine.
- Run the following commands on the Linux machine to flash boot partition and rootfs to SD card:

```
$ sudo su
$ chmod 0777 flex-installer
$ sudo ./flex-installer -b bootpartition_LS_arm64_edgescale_lts_4.19_202002251408.tgz -r
rootfs_v4.0.5.2.tgz -m ls1046afrawy -d /dev/mmcblk0
```

### NOTE

"/dev/mmcblk0" may change to "/dev/sdx", where x (may be 'b', 'c') is the ID assigned while inserting the adapter.

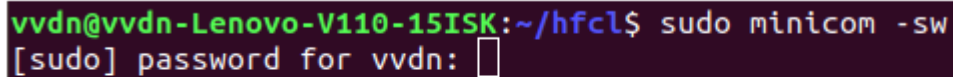
- After the SD card is prepared, copy the low-level firmware on mmcblk0p3 partition:

```
$ sudo mkdir -p /mnt/demo
$ sudo mount /dev/mmcblk0p3 /mnt/demo
$ sudo cp firmware_ls1046afrawy_uboot_qspiboot.img /mnt/demo
$ sudo umount /dev/mmcblk0p1
```

```
$ sudo umount /dev/mmcblk0p2
$ sudo umount /dev/mmcblk0p3
```

4. Make a console connection between the board and Linux machine using the USB Type A to micro-B cable.
5. Open Minicom using the following command (as shown in the figure below):

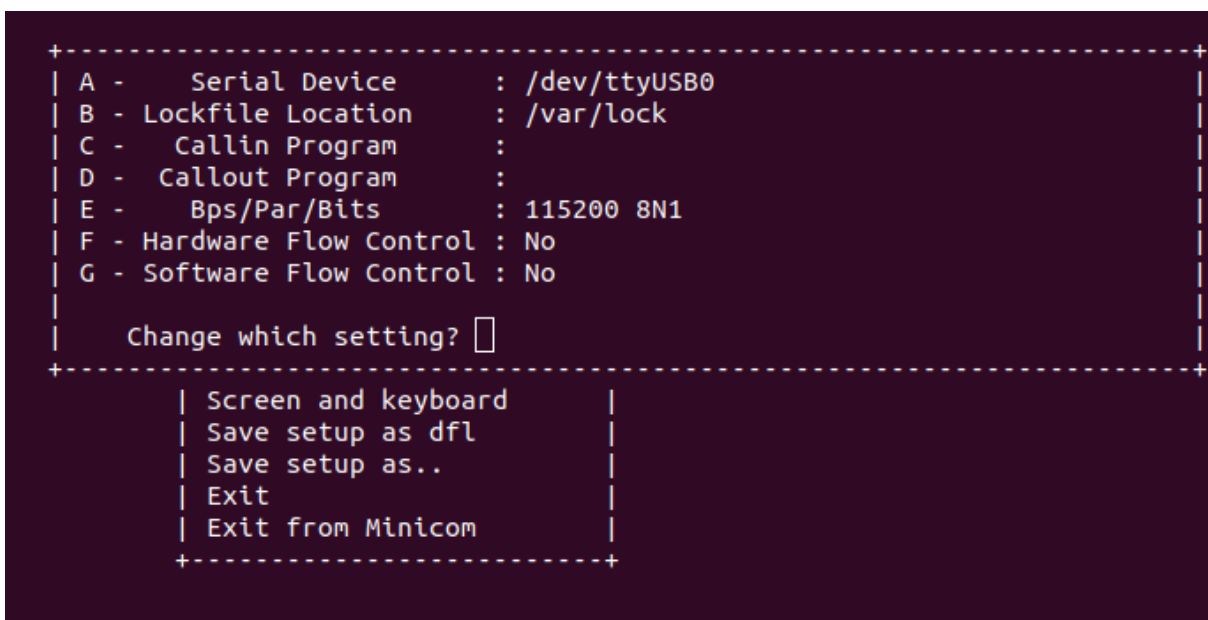
```
$ sudo minicom -sw
```



```
vvdn@vvdn-Lenovo-V110-15ISK:~/hfcl$ sudo minicom -sw
[sudo] password for vvdn: █
```

Figure 6. Opening Minicom

6. Ensure that the Minicom settings are as follows (also shown in the figure below):
  - A - Serial Device: /dev/ttyUSB0
  - B - Lockfile Location: /var/lock
  - C - Callin Program:
  - D - Callout Program:
  - E - Bps/Par/Bits: 115200 8N1
  - F - Hardware Flow Control: No
  - G - Software Flow Control: No



```
+-----+
| A -   Serial Device       : /dev/ttyUSB0
| B -   Lockfile Location   : /var/lock
| C -   Callin Program      :
| D -   Callout Program     :
| E -   Bps/Par/Bits        : 115200 8N1
| F -   Hardware Flow Control : No
| G -   Software Flow Control : No
|
| Change which setting? █
+-----+
|
| Screen and keyboard
| Save setup as dfl
| Save setup as..
| Exit
| Exit from Minicom
|
+-----+
```

Figure 7. Minicom settings

7. Save Minicom settings using the **Save setup as dfl** option.
8. Exit Minicom using the **Exit from Minicom** option.

### 5.3 Flash low-level firmware to boot device

Follow these steps to flash low-level firmware (QSPI firmware / SD card firmware) to boot device (QSPI NOR flash memory / SD card) on the FRWY-LS1046A board:

1. Remove the SD card from the Linux machine and insert it into the board.
2. Boot the board and stop at U-Boot by pressing **Enter**.
3. Run the following commands to flash QSPI firmware to QSPI NOR flash memory:

```
$ ext2load mmc 0:3 0xa0000000 firmware_ls1046afrawy_uboot_qspiboot.img
$ sf probe
$ sf erase 0x0 +$filesize
$ sf write 0xa0000000 0x0 $filesize
$ reset
```

4. Run the following commands to flash SD card firmware to SD card:

```
$ sudo su
$ chmod 0777 flex-installer
$ sudo ./flex-installer -b bootpartition_LS_arm64_edgescale_lts_4.19_202002251408.tgz
-f firmware_ls1046afrawy_uboot_sdboot.img -r rootfs_v4.0.5.2.tgz -m ls1046afrawy -d /dev/
mmcblk0
```

#### NOTE

"/dev/mmcblk0" may change to "/dev/sdx", where x (may be 'b', 'c') is the ID assigned while inserting the adapter.

### 5.4 Launch demo GUI

Follow these steps to launch FRWY-LS1046A demo GUI:

1. Plug the USB camera to the board and power ON the board. The board boots to U-Boot initially and then to Linux kernel.
2. Use the following credentials to log into the board:
  - User name: root
  - Password: root

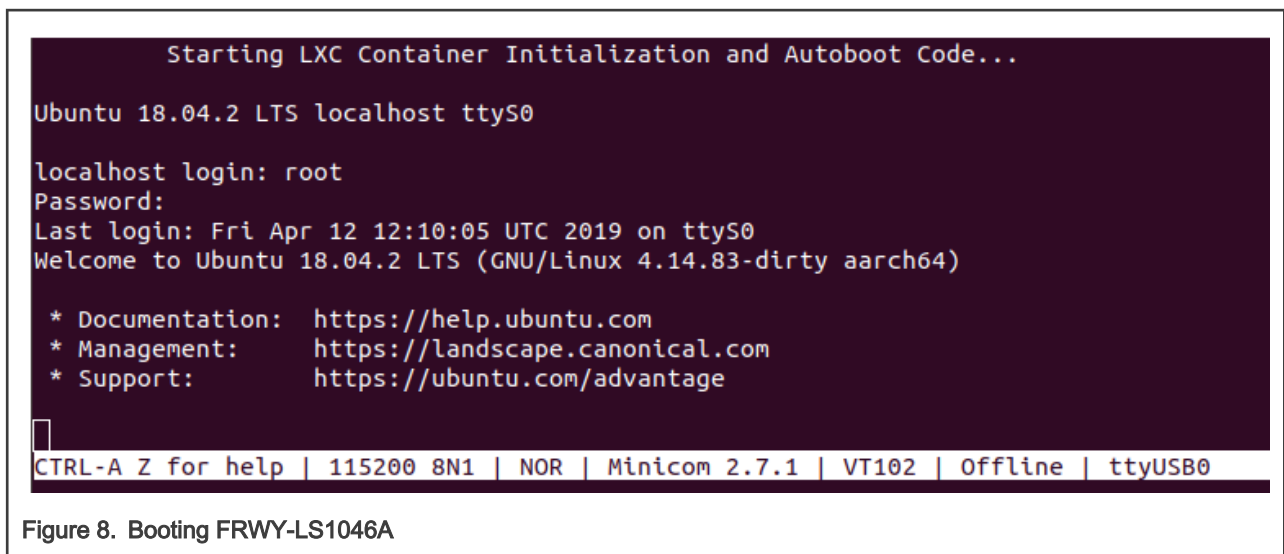


Figure 8. Booting FRWY-LS1046A

3. Set up a client-server connection to access the board (server) from the Linux machine (client):

- **Using Wi-Fi:**

- a. Approximately 1 minute after the board completes booting, an SSID with name “FRWY-LS1046A-<last two digits of Ethernet MAC address>” starts showing in the list of available connections on Wi-Fi client. Connect to the board through the SSID using “frwyls1046a” as wpa\_passphrase.

- **Using Ethernet:**

- a. Make other board connections as per the demo setup diagram in [Figure 2](#).
- b. Ensure that client's Linux machine is connected to the board (server) only via its Ethernet interface. The board automatically gets an IP address in domain 99 (192.168.99.1), which can be used to access the board from the Linux machine.
- c. Run the following ping command to test server connection from the Linux machine:

```
ping 192.168.99.1
```

4. After setting up a connection, access the following IP address from the Linux machine using a web browser (Google Chrome is recommended as the web browser):

<http://192.168.99.1>

The FRWY-LS1046A demo GUI launches displaying its home page, as shown in the figure below.

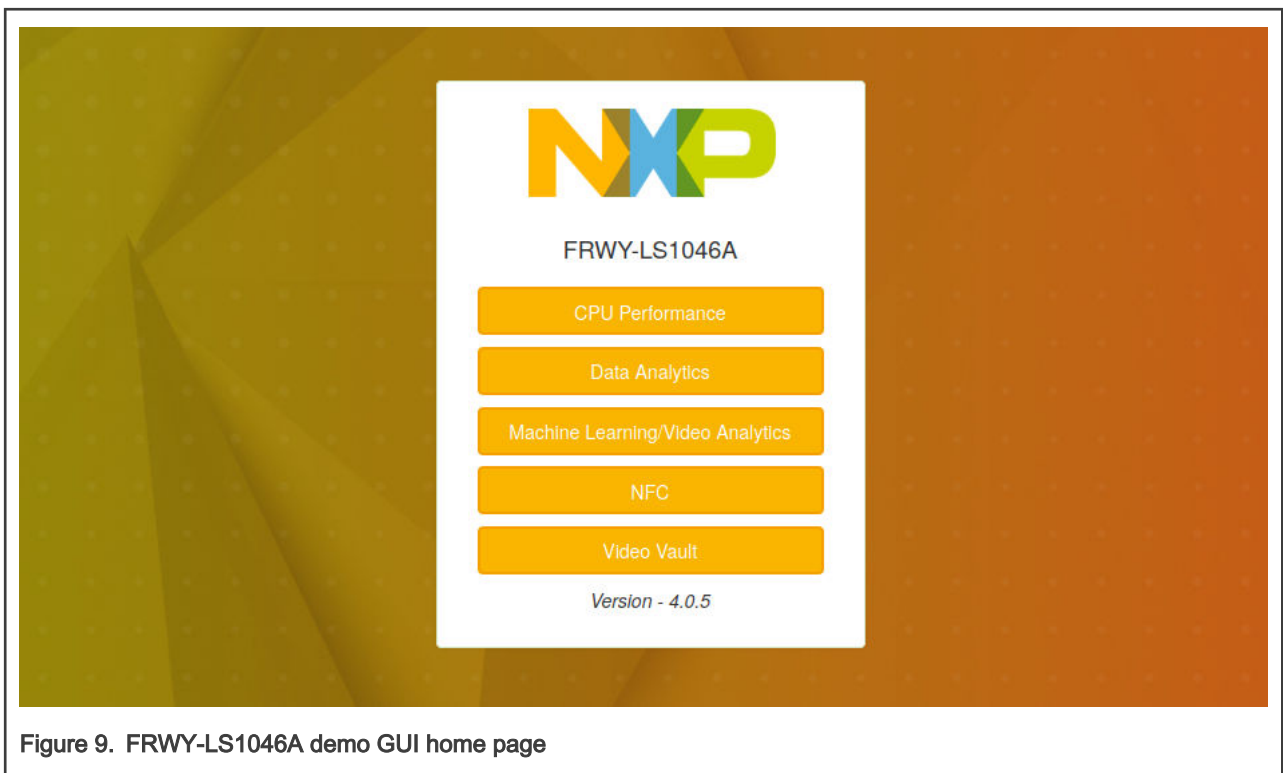


Figure 9. FRWY-LS1046A demo GUI home page

The home page provides options to measure CPU performance, perform data analysis, implement machine learning / video analytics, implement user authentication through NFC feature of the board, and access FRWY-LS1046A board based videos. All these options will be explained in detail in the sections that follow.

## 6 Benchmarking CPU performance

The FRWY-LS1046A demo provides two methods for benchmarking the performance of the central processing unit (CPU) cores used in the FRWY-LS1046A board. Both methods are based on a standard benchmarking utility (Coremark/Dhrystone) and they display CPU performance, power, temperature, and CPU utilization as benchmarking results. The two methods are explained in the subsections below:



- [Performance benchmarking using Coremark](#)
- [Performance benchmarking using Dhrystone](#)

## 6.1 Performance benchmarking using Coremark

Coremark is a modern, sophisticated benchmarking utility that allows you to accurately measure the performance of CPUs used in embedded systems. It is a synthetic benchmarking utility, which means that it is a collection of simple programs that are carefully designed to statistically mimic the processor usage of a set of common programs. Coremark can run in multiple threads based on the number of CPU cores.

Coremark uses a realistic workload, which comprises several commonly used algorithms, including:

- Matrix manipulation to exercise common math operations
- Linked list manipulation to exercise common use of pointers
- State machine operation to exercise data-dependent branches
- Cyclic redundancy check (CRC) (which is a common function in embedded systems)

Follow these steps to measure CPU performance using Coremark:

1. Power ON the board and open the IP address, <http://192.168.99.1>, in Google Chrome on the Linux machine. The FRWY-LS1046A demo GUI launches, displaying its home page.
2. Click the **CPU Performance** button. The CPU Performance page appears that allows to benchmark CPU performance using benchmarking utilities: Coremark and Dhrystone. By default, the Coremark utility is selected with the number of cores as 4, as shown in the figure below.

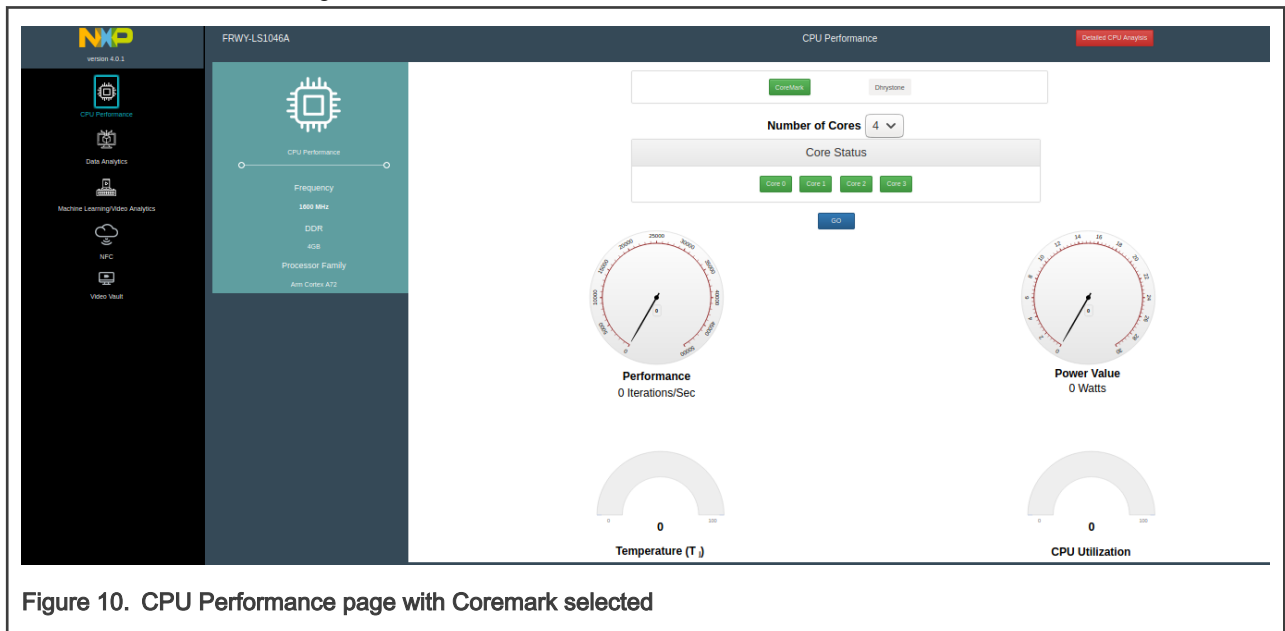


Figure 10. CPU Performance page with Coremark selected

3. Click the **Go** button to start CPU performance measurement using Coremark, as shown in the figure below. The process takes approximately 35 seconds.

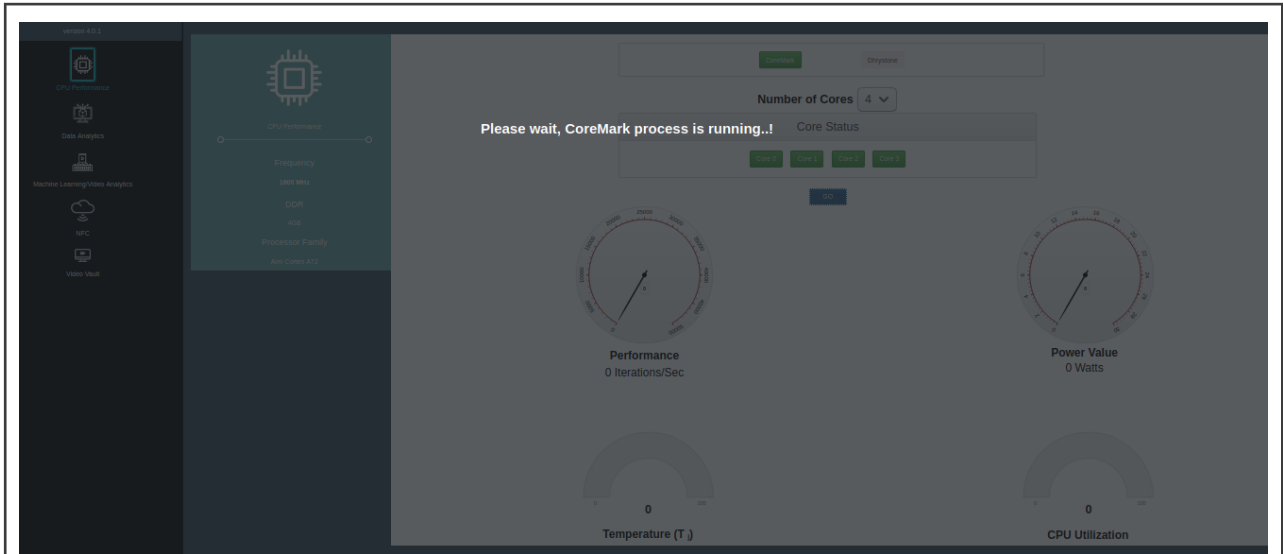


Figure 11. Coremark process is running

After the Coremark process is complete, measurement results are displayed, as shown in the figure below. Observe the CPU performance value, CPU utilization percentage, power value, and temperature value.

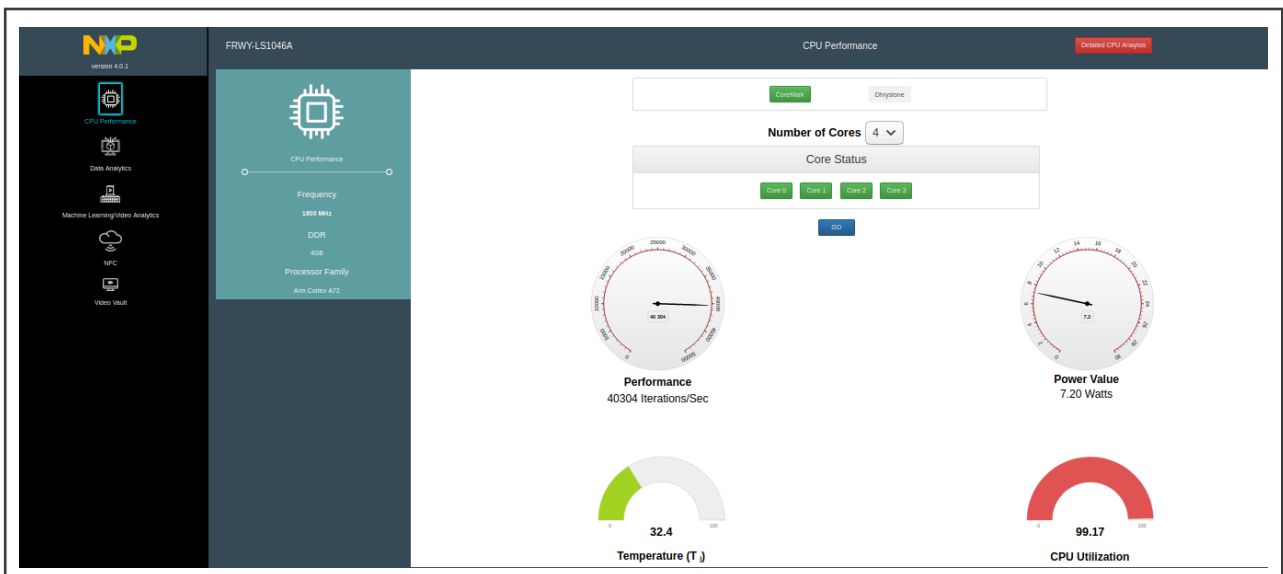


Figure 12. Measurement results with Coremark utility

- Repeat the above steps to get measurement results with three cores, two cores, and one core by choosing 3, 2, and 1, respectively, from the **Number of Cores** menu. The table below shows the expected results for the Coremark benchmarking process.

Table 3. Coremark measurement results

Number of cores	CPU performance (iterations/sec)	Power value (W)	Temperature (°C)	CPU utilization (%)
Four	40000 - 41000	5 - 8	33 - 60	80 – 100
Three	30000 - 31000	5 - 8	33 - 60	80 – 100

Table continues on the next page...

**Table 3. Coremark measurement results (continued)**

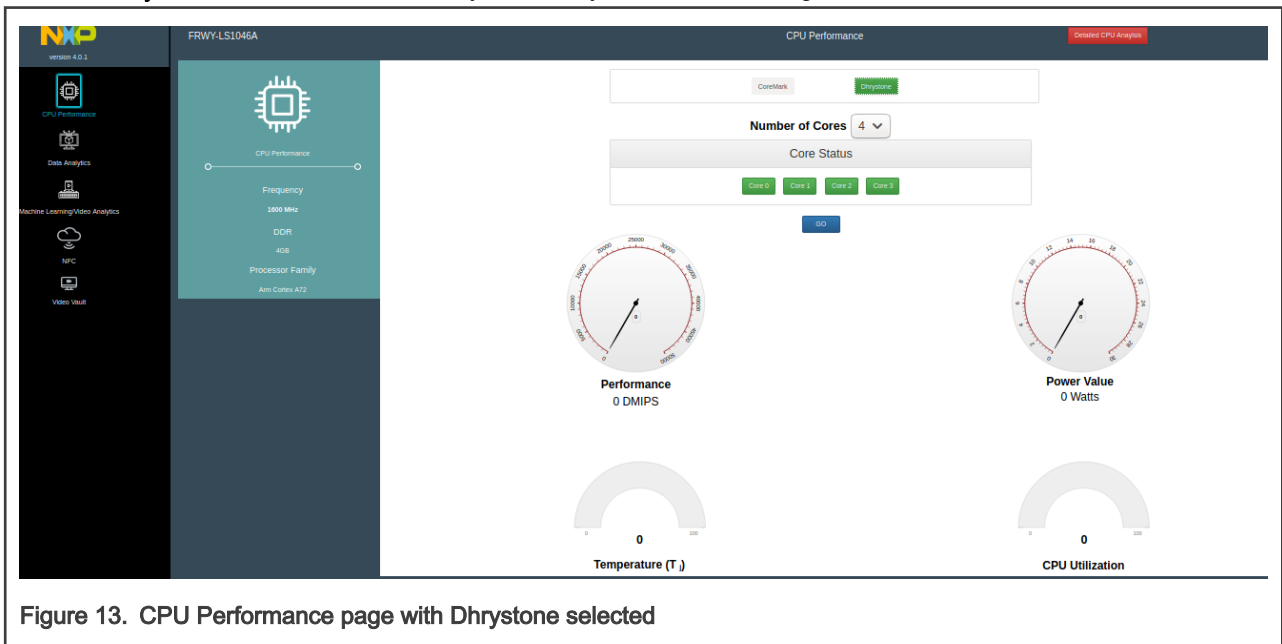
Number of cores	CPU performance (iterations/sec)	Power value (W)	Temperature (°C)	CPU utilization (%)
Two	19000 - 20500	5 - 8	33 - 60	80 – 100
One	9000 - 10000	4.5 - 8	33 - 60	80 – 100

## 6.2 Performance benchmarking using Dhrystone

Dhrystone is also a synthetic CPU benchmarking tool, similar to Coremark. It is a measure of processor and compiler efficiency in executing a "typical" program. Unlike Coremark, it cannot run in multiple threads. Dhrystone contains library calls during the timed portion of the benchmark; therefore, Dhrystone exhibits smaller numbers as compared to Coremark, which does not have any library call during the timed portion of the benchmark.

Follow these steps to measure CPU performance using Dhrystone:

1. Power ON the board and open the IP address, <http://192.168.99.1>, in Google Chrome on the Linux machine. The FRWY-LS1046A demo GUI launches, displaying its home page.
2. Click the **CPU Performance** button. The CPU Performance page appears showing the Coremark utility selected, by default, with the number of cores as 4.
3. Click the **Dhrystone** button to select the Dhrystone utility, as shown in the figure below.



**Figure 13. CPU Performance page with Dhrystone selected**

4. With the number of cores selected as 4, click the **Go** button to start CPU performance measurement using Dhrystone, as shown in the figure below.

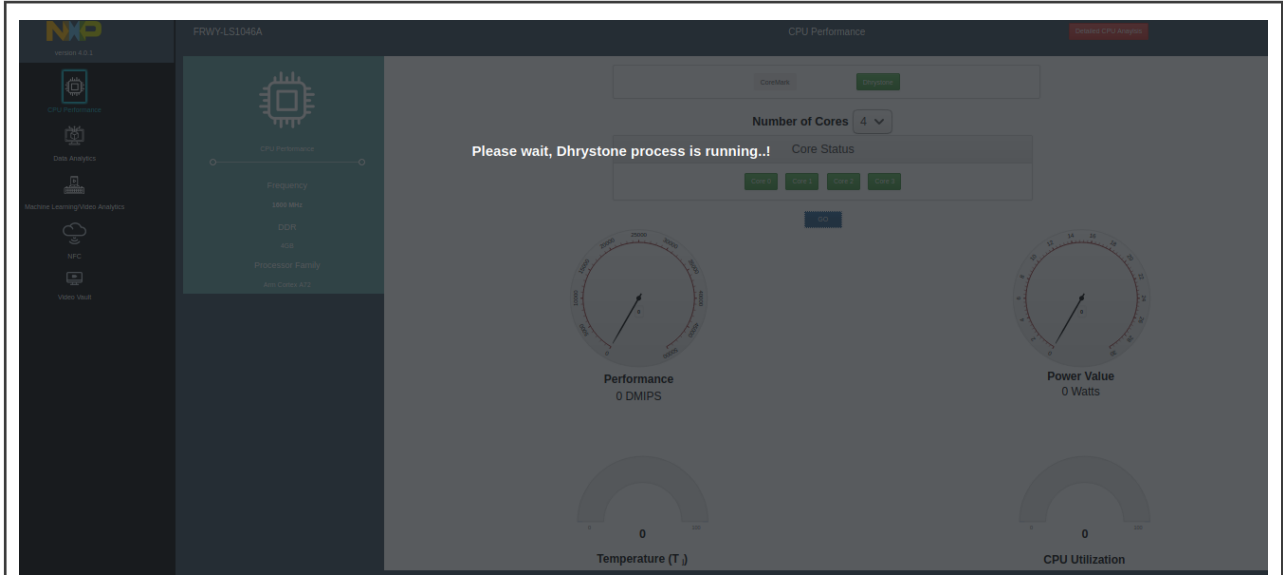


Figure 14. Dhrystone process is running

After the Dhrystone process is complete, measurement results are displayed, as shown in the figure below. Observe the CPU performance value, CPU utilization percentage, power value, and temperature value.

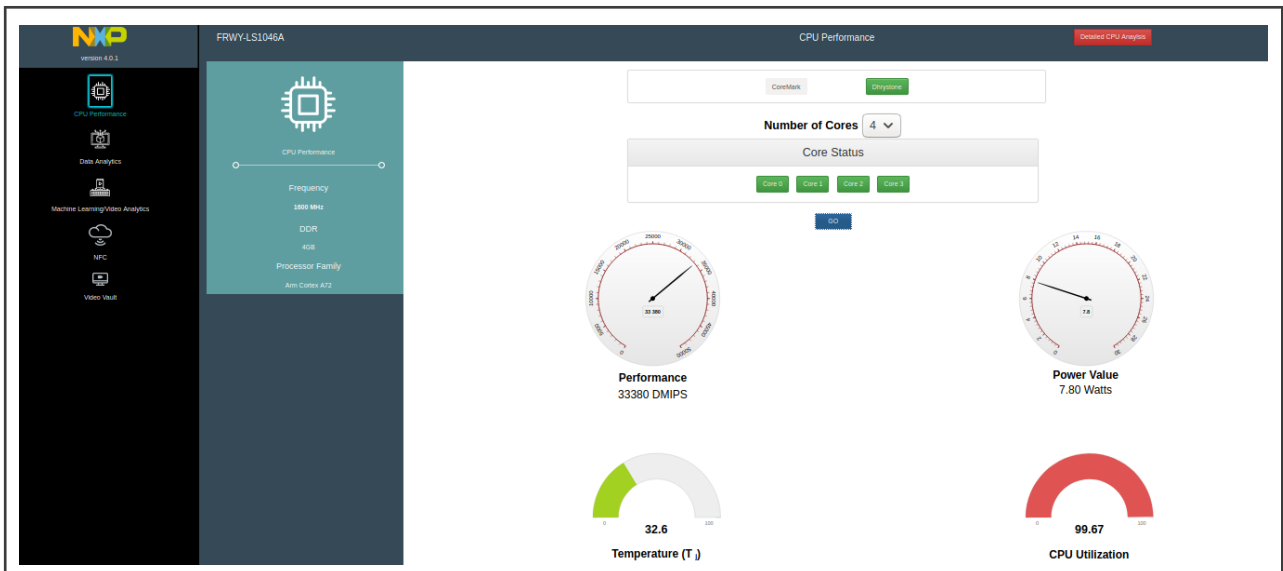


Figure 15. Measurement results with Dhrystone utility

- Repeat the above steps to get measurement results with three cores, two cores, and one core by selecting 3, 2, and 1, respectively, from the **Number of Cores** menu. The table below shows the expected results for the Dhrystone benchmarking process.

Table 4. Dhrystone measurement results

Number of cores	CPU performance (iterations/sec)	Power value (W)	Temperature (°C)	CPU utilization (%)
Four	14500 - 16000	5 - 8	37 - 60	80 – 100
Three	7000 - 8500	5 - 8	37 - 60	80 – 100

Table continues on the next page...

Table 4. Dhrystone measurement results (continued)

Number of cores	CPU performance (iterations/sec)	Power value (W)	Temperature (°C)	CPU utilization (%)
Two	14500 - 16000	5 - 8	37 - 60	80 – 100
One	9000 - 10500	4 - 8	33 - 60	80 – 100

## 7 Performing data analysis

The FRWY-LS1046A demo provides the following two demos for performing data analysis:

- [Cold Storage Data Analytics demo](#)
- [Sensor Data Analytics demo](#)

### 7.1 Cold Storage Data Analytics demo

This demo showcases the compute power of the FRWY-LS1046A board and provides detailed information about CPU utilization and refrigerator status of the board. You can choose the number of refrigerators from among 400 simulated refrigerators to check internal temperature, external temperature, and deviation from set point.

Follow these steps to run the Cold Storage Data Analytics demo:

1. Power ON the board and open the IP address, <http://192.168.99.1>, in Google Chrome on the Linux machine. The FRWY-LS1046A demo GUI launches, displaying its home page.
2. Click the **Data Analytics** button. The Data Analytics page appears which is divided into two tabs, Cold Storage Data Analytics and Sensor Data Analytics. By default, the Cold Storage Data Analytics page is displayed, as shown in the figure below.

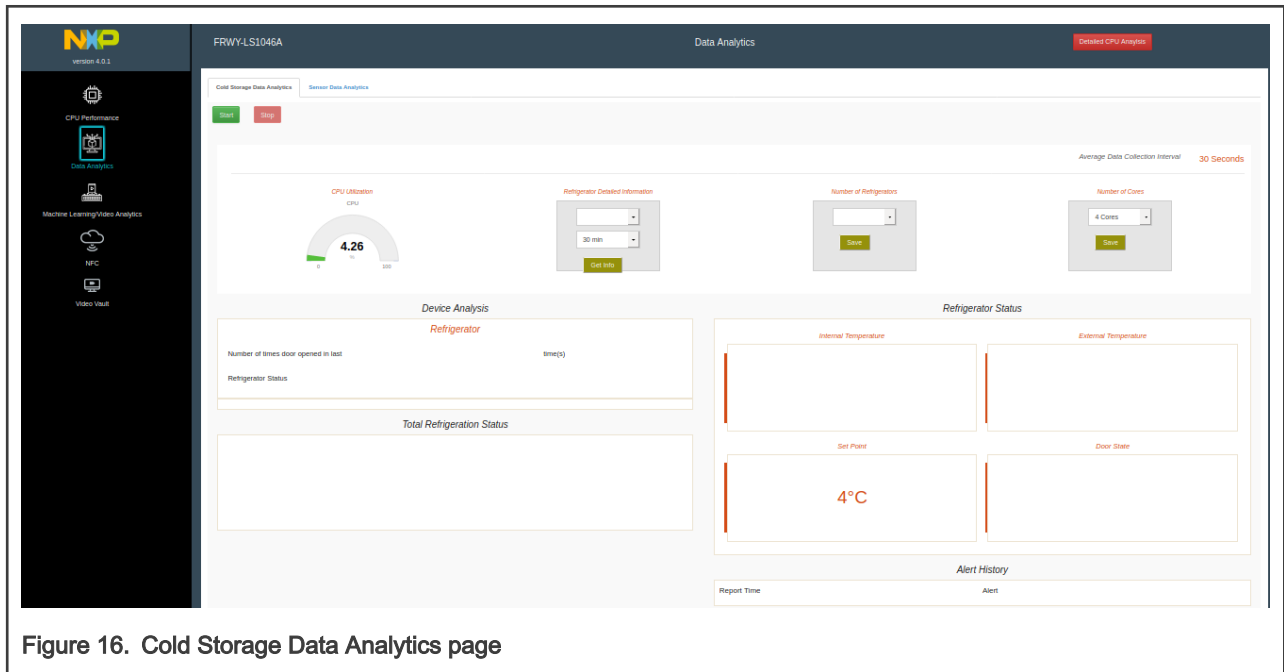


Figure 16. Cold Storage Data Analytics page

3. Click the **Start** button to start the Cold Storage Data Analytics demo. The demo starts running and the results of the cold storage data analysis are displayed, as shown in the figure below.

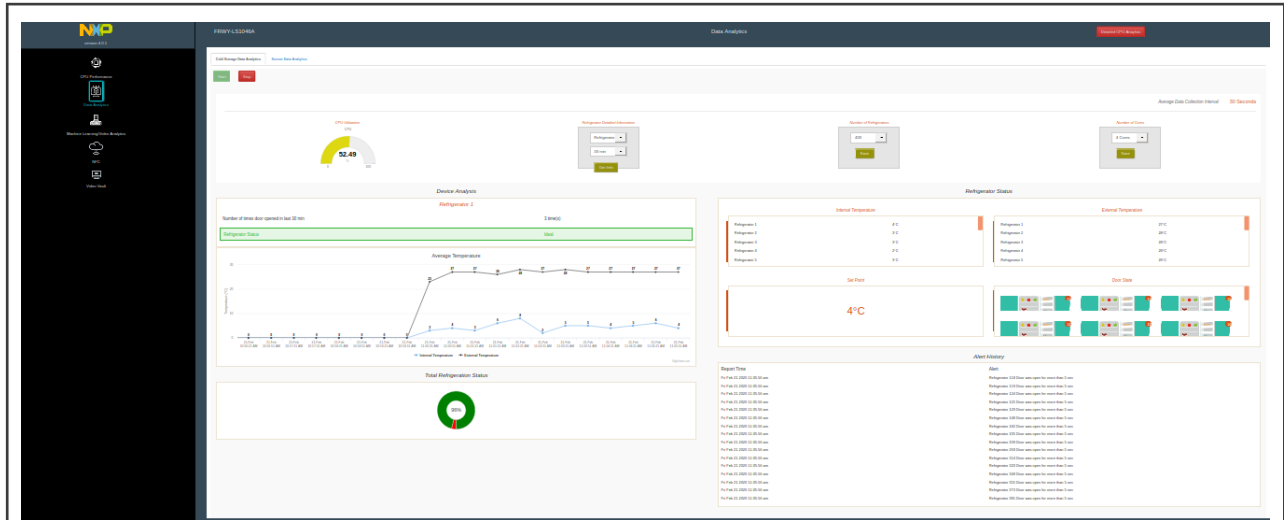


Figure 17. Cold storage data analysis results

As you can see in the figure above, the demo results shows CPU utilization, internal temperature, external temperature, set point, and door state of refrigerators (that is, the number of opened refrigerators):

- The "Device Analysis" section provides detailed information about selected refrigerator, for example, if it is in ideal status or in caution status (based on if the temperature is above the set point for more than allowed time). The "Average Temperature" graph shows the internal and external temperatures of the selected refrigerators.
- The "Total Refrigeration Status" section shows refrigeration status based on total number of refrigerators and the number of refrigerators that are in open state

**NOTE**

The results of the demo get updated after every 30 seconds.

4. Click the **Stop** button to stop the Cold Storage Data Analytics demo.

**NOTE**

Additional details, such as the number of refrigerators opening for ideal status and caution status, will be added to the demo in a future release.

## 7.2 Sensor Data Analytics demo

The Sensor Data Analytics demo showcases the compute power of the FRWY-LS1046A board using live and simulated sensors on the board. The demo displays the accelerometer sensor data in the form of gauge readings and graphs with respect to x-axis, y-axis, and z-axis. If the board is moved to a different position, then sensor data displayed as gauge readings and graphs may change.

**NOTE**

Before running the Sensor Data Analytics demo, ensure that the ADXL345 device is mounted on the mikroBUS socket of the FRWY-LS1046A board.

Follow these steps to run the Sensor Data Analytics demo:

1. Power ON the board and open the IP address, <http://192.168.99.1>, in Google Chrome on the Linux machine. The FRWY-LS1046A demo GUI launches, displaying its home page.
2. Click the **Data Analytics** button. The Data Analytics page appears, displaying its Cold Storage Data Analytics tab.
3. Click the **Sensor Data Analytics** tab. The Sensor Data Analytics page gets displayed, as shown in the figure below.

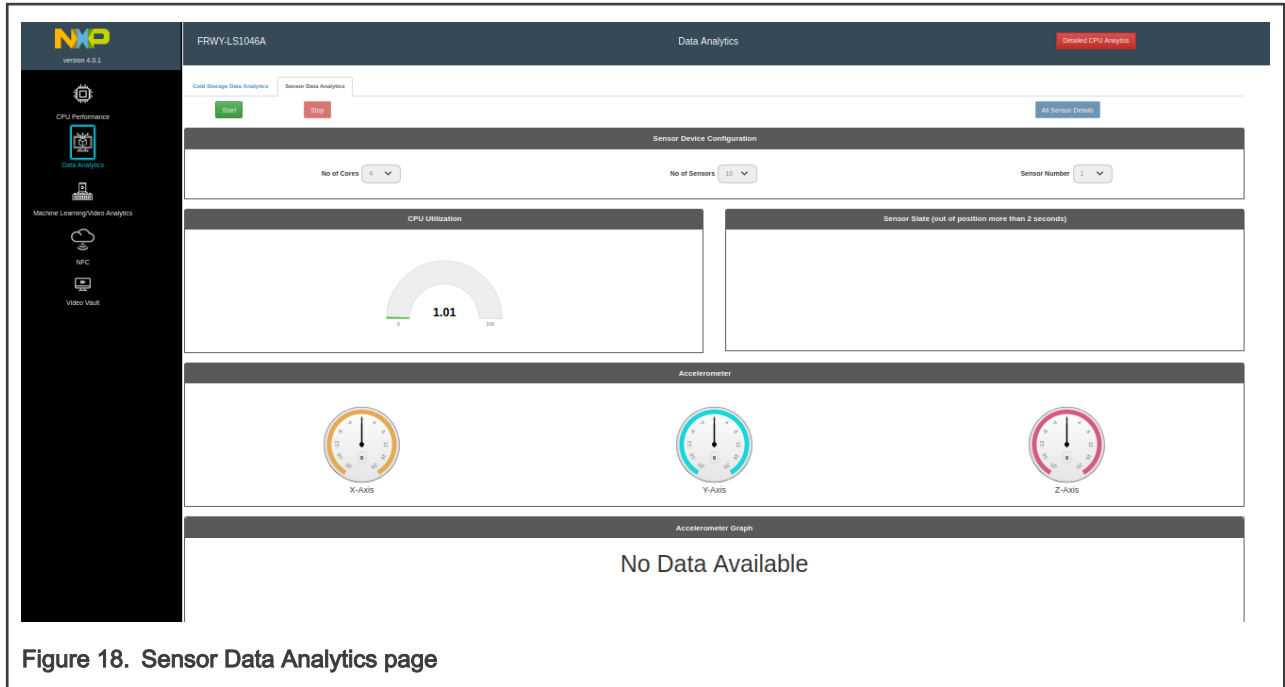


Figure 18. Sensor Data Analytics page

- Click the **Start** button to start the Sensor Data Analytics demo. The demo starts running and the results of sensor data analysis are displayed, as shown in the figure below.

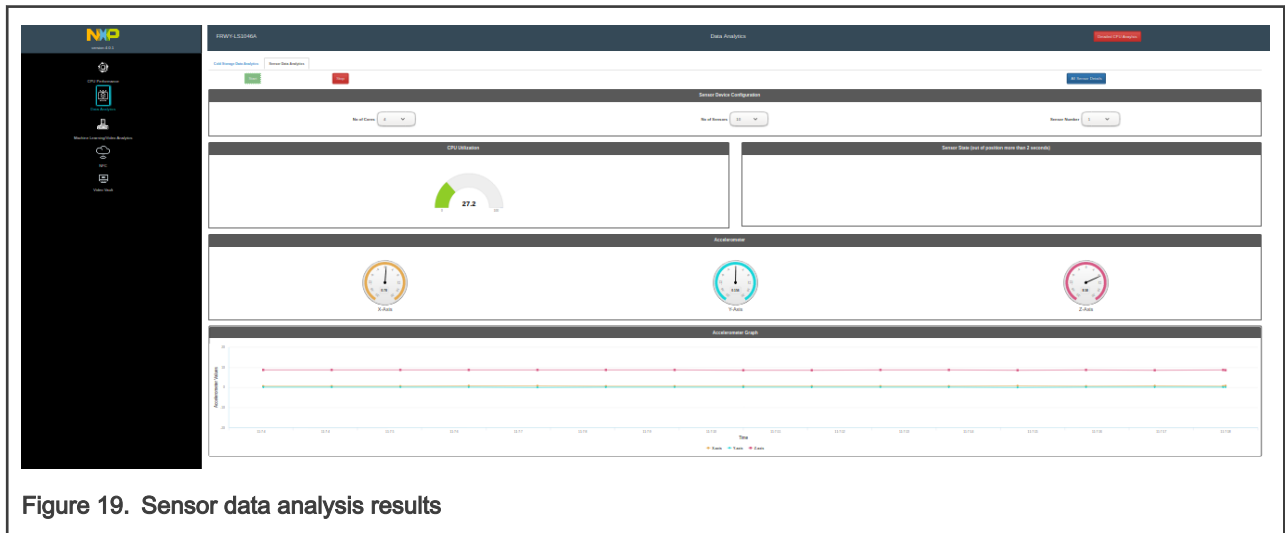


Figure 19. Sensor data analysis results

In the figure above, you can see sensor data as gauge readings and graphs with respect to x-axis, y-axis, and z-axis. You can also see CPU utilization and state of currently selected sensor (in the figure above, the sensor is out of position for more than 2 seconds).

- Click the **Stop** button to stop the Sensor Data Analytics demo.

## 8 Implementing machine learning / video analytics

The following demos included in the FRWY-LS1046A demo demonstrate the machine learning / video analytics capabilities of the FRWY-LS1046A board:

- [Face Recognition Demo \(CPU\)](#)
- [People Counting Demo \(CPU\)](#)
- [Pose Detection Demo \(TPU\)](#)

- [Industrial Safety & Security Demo \(CPU\)](#)
- [Industrial Safety & Security Demo \(TPU\)](#)

The demos marked with "CPU" work the help of the LS1046A processor, whereas the demos marked with "TPU" work with the help of Google Coral Edge TPU module.

### 8.1 Face Recognition Demo (CPU)

The Face Recognition Demo (CPU) allows to build a database of people by identifying their faces and recognize them later through their faces. Follow these steps to use the Face Recognition Demo (CPU):

**NOTE**

You may need to enable pop ups at top-right corner of the demo GUI to allow URL redirection.

1. Power ON the board and open the IP address, <http://192.168.99.1>, in Google Chrome on the Linux machine. The FRWY-LS1046A demo GUI launches, displaying its home page.
2. Click the **Machine Learning / Video Analytics** button. The Machine Learning / Video Analytics page gets displayed, as shown in the figure below. The page is divided into five sections, each section allowing access to one Machine Learning / Video Analytics demo.

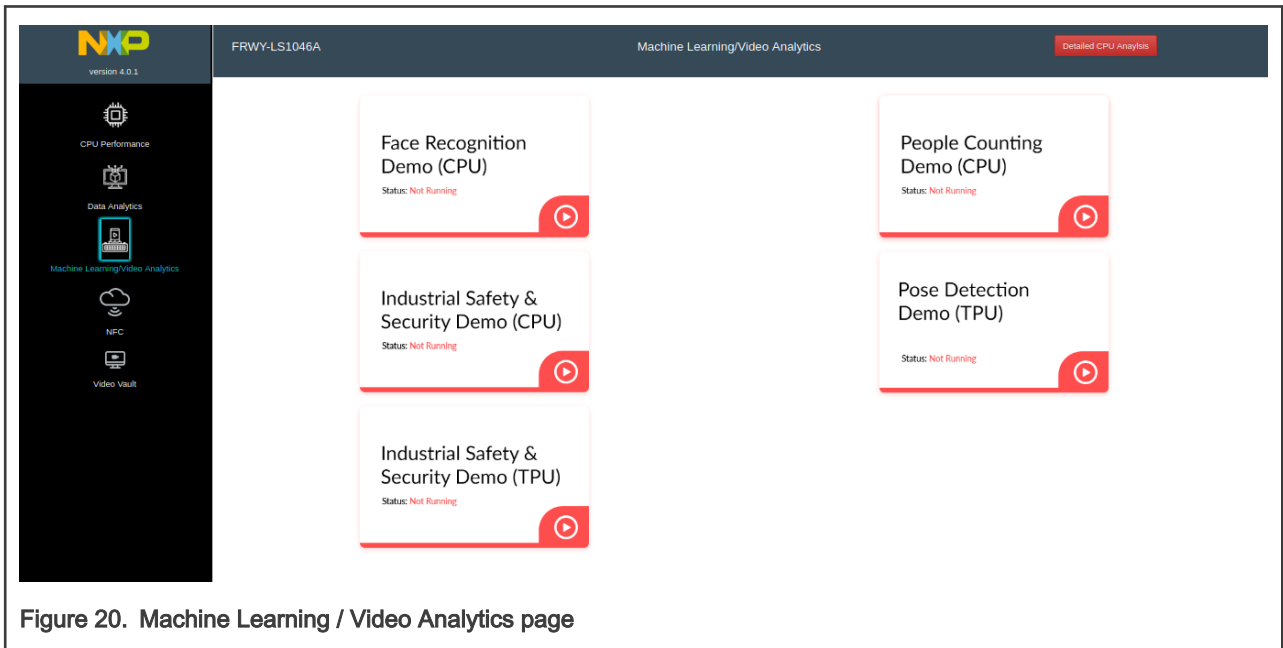


Figure 20. Machine Learning / Video Analytics page

3. Click the **Play** button in the **Face Recognition Demo (CPU)** section to start the demo. The docker starts loading with a message "Please wait for 10 sec, while docker is loading!!!", as shown in the figure below.



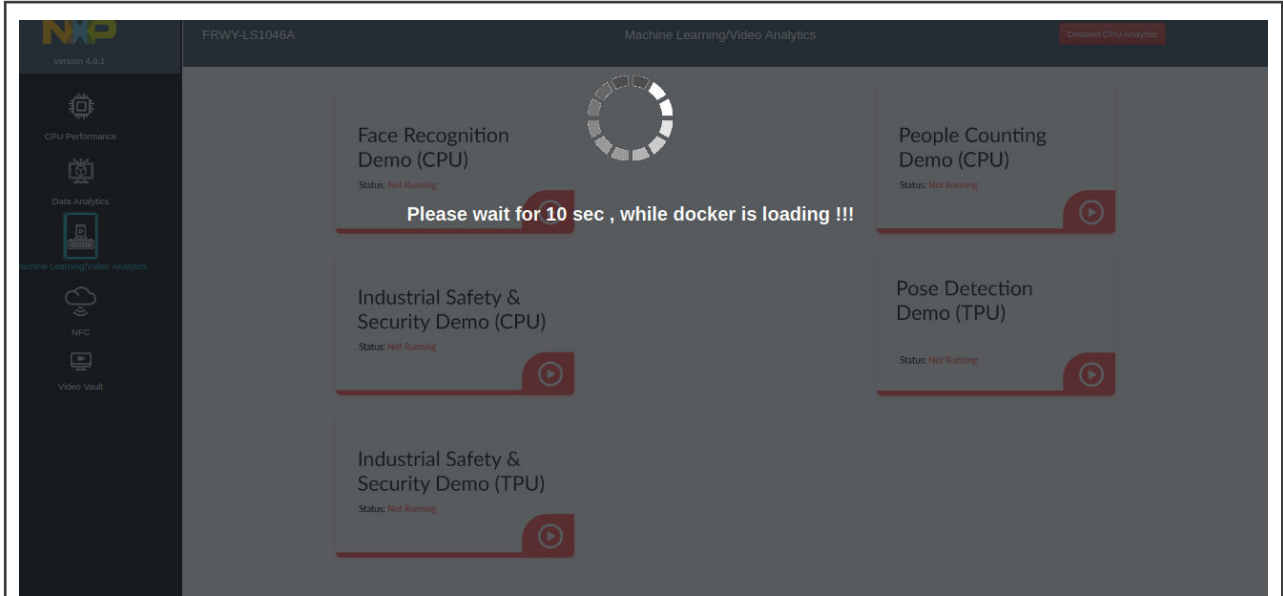


Figure 21. Starting Face Recognition Demo (CPU)

When the docker completes loading, the status of the demo changes from "Not Running" to "Running", as shown in the figure below.

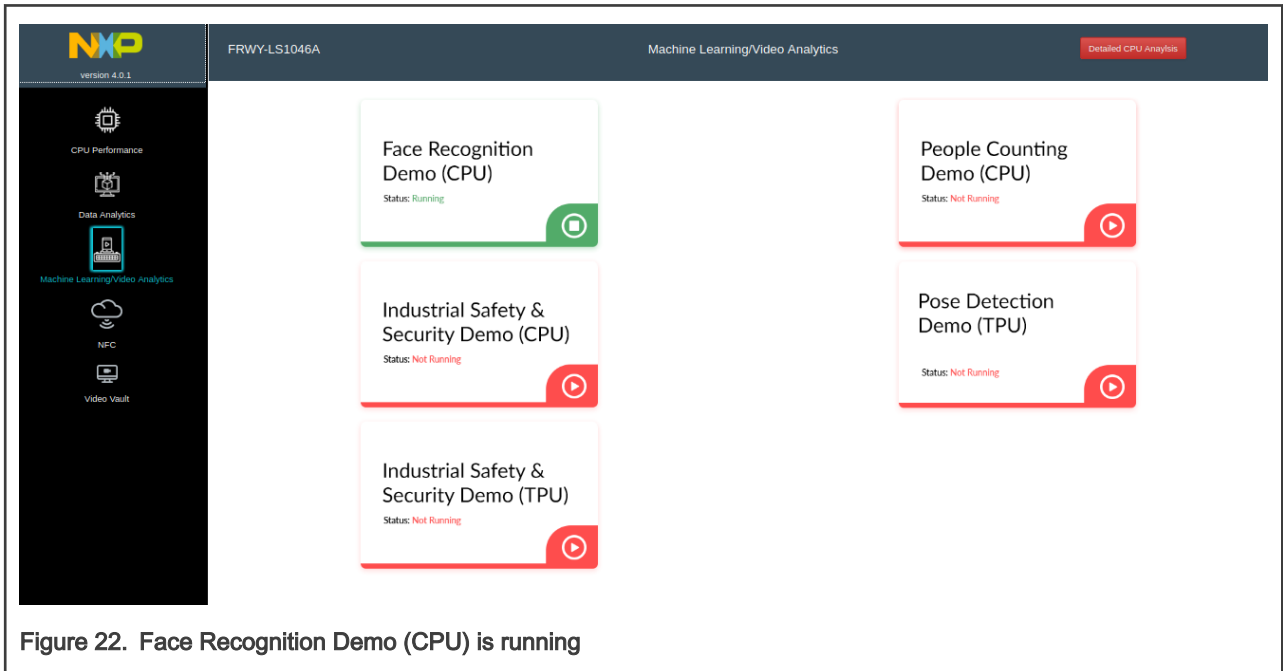


Figure 22. Face Recognition Demo (CPU) is running

Also, Face Recognition Demo (CPU) starts on a new browser tab, as shown in the figure below.

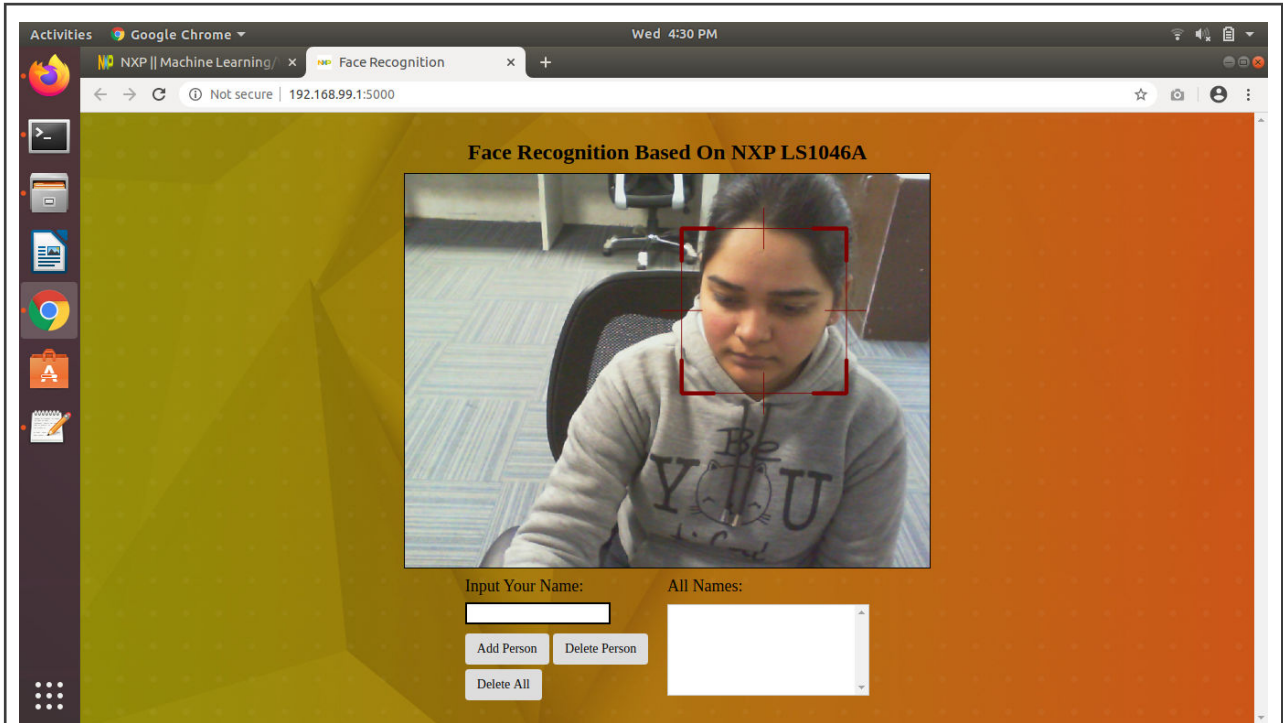


Figure 23. Face Recognition Demo (CPU) in progress

- Specify the name of the person in the "Input Your Name" field and click **Add Person** to add the person's name to face recognition database. The name gets added in the database and also in the "All Names" list. Now, the person is recognized with the specified name and the name appears next to the person's face on the face recognition screen, as shown in the figure below.

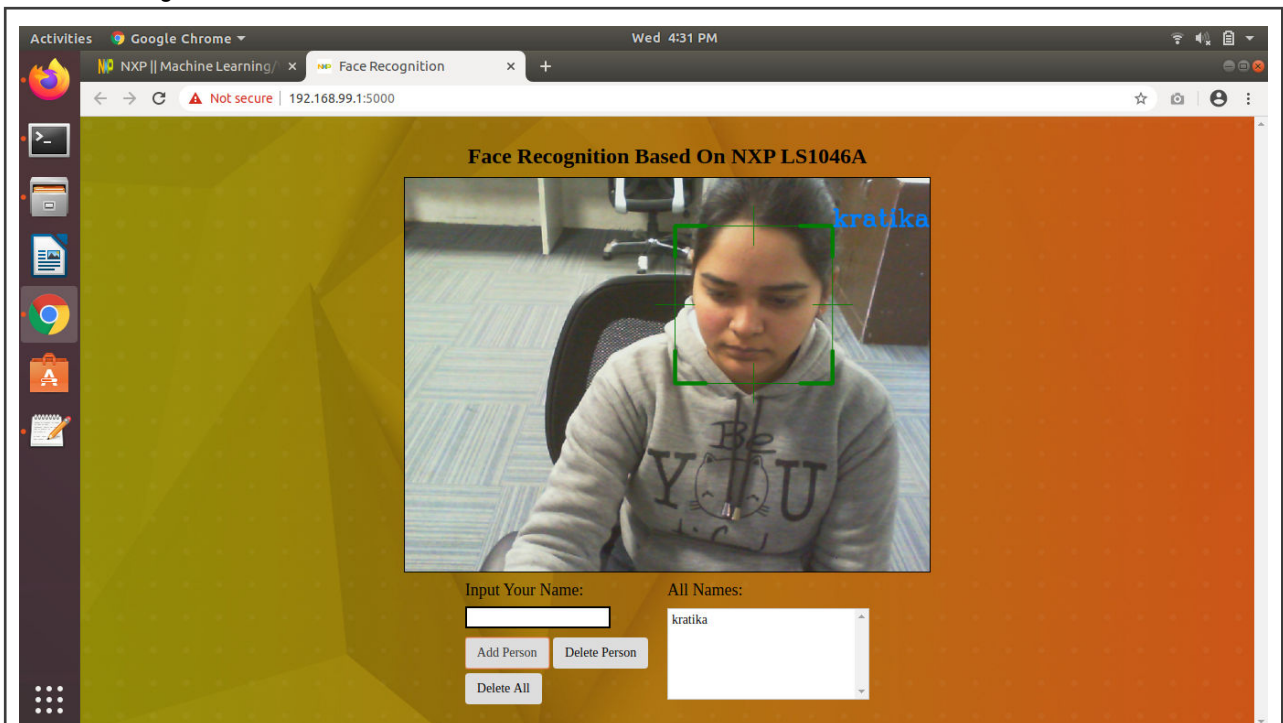


Figure 24. Adding a person's name to database

**NOTE**

If you click **Add Person** without specifying a name in the "Input Your Name" field, then an error message "Please input your name!" gets displayed.

- 5. If you need to delete a person's name from the face recognition database, then specify the name in the "Input Your Name" field and click **Delete Person**. The name gets deleted from the database and a confirmation message "Deleted Successfully" appears, as shown in the figure below.

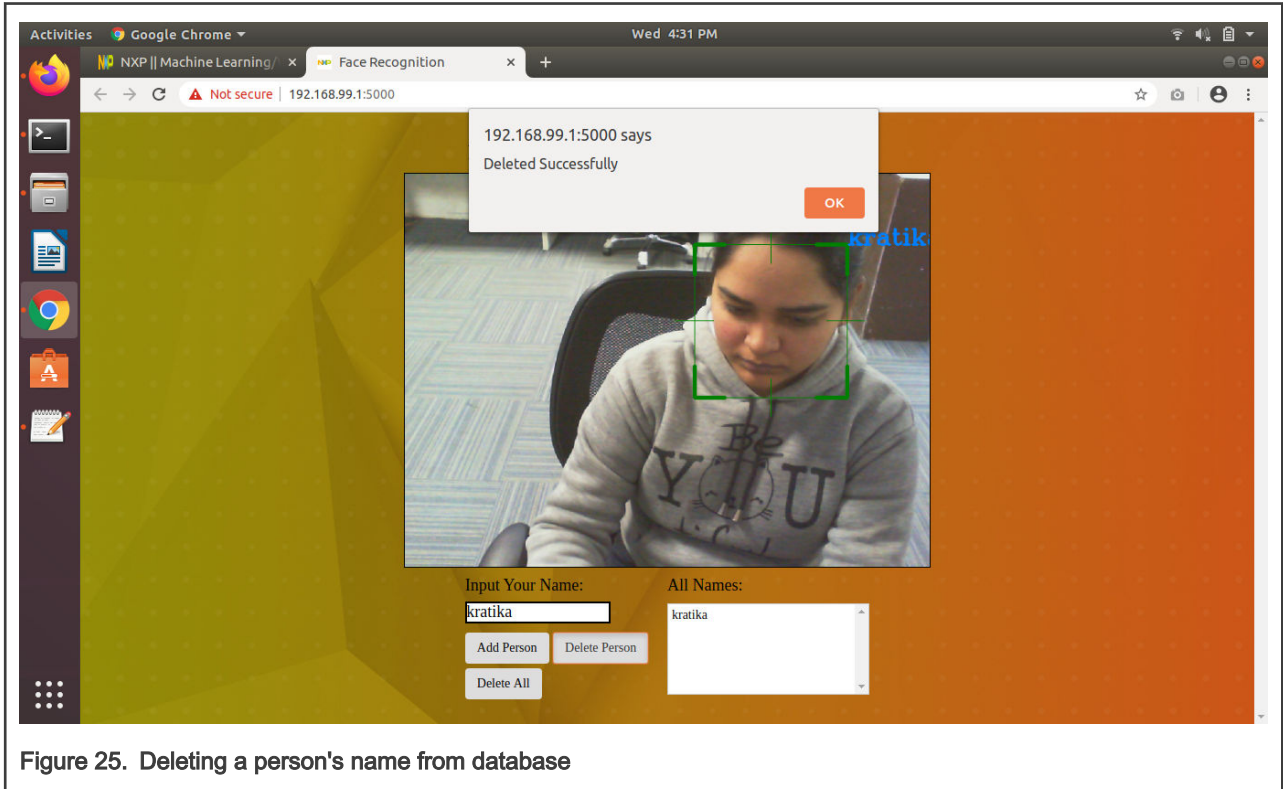


Figure 25. Deleting a person's name from database

**NOTE**

If the name you are trying to delete does not exist in the database, then an error message "Name is not present in the database" gets displayed.

**NOTE**

If you click **Delete Person** without specifying a name in the "Input Your Name" field, then an error message "Please input your name!" gets displayed.

- 6. If you need to delete all names from the face recognition database, then click **Delete All**. All names get deleted from the database and a confirmation message "Deleted Successfully" appears, as shown in the figure below. When you click **OK** in the message, all names also get deleted from the "All Names" list.

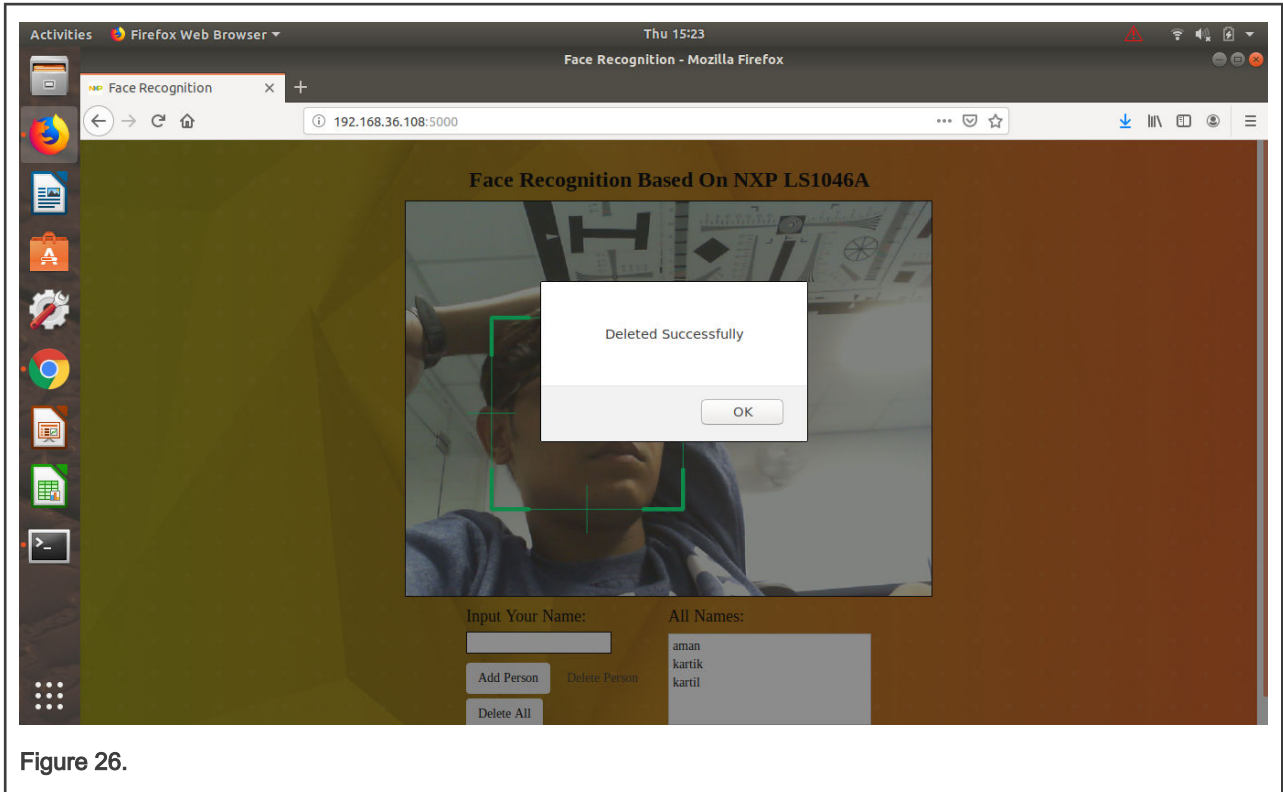


Figure 26.

**NOTE**

If you click **Delete All** when no record exists in the database, then an error message "No entry in database" gets displayed.

7. Switch to the Machine Learning / Video Analytics page and click the **Stop** button in the **Face Recognition Demo (CPU)** section to stop the demo. A message "Please wait, while docker is stopping!!!" appears, as shown in the figure below.

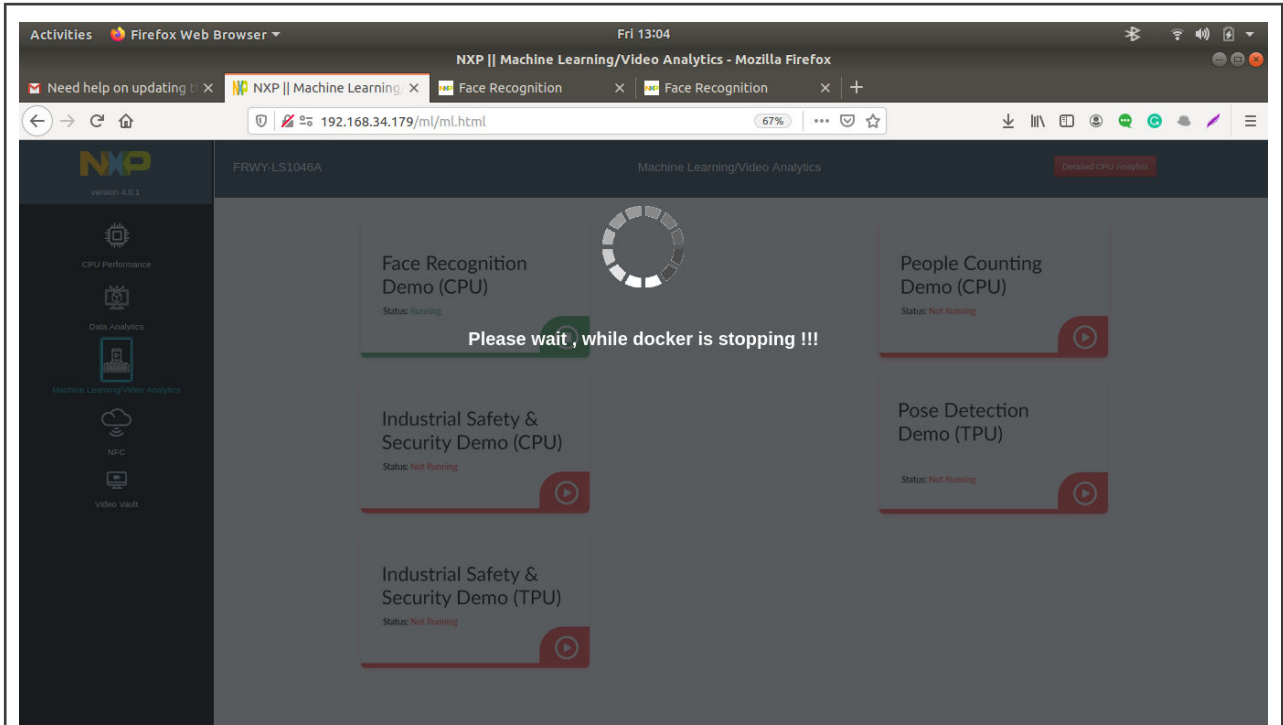


Figure 27. Stopping Face Recognition Demo (CPU)

## 8.2 People Counting Demo (CPU)

The People Counting Demo (CPU) allows to perform live people counting. It is based on TensorFlow (which helps in object detection) and OpenCV (which provides ease of use and smooth deployment and development options). The demo exhibits the machine learning (ML) and artificial intelligence (AI) capabilities of the FRWY-LS1046A board. Using the demo, a trained object detection model can be added for almost any object.

Follow these steps to use the People Counting Demo (CPU):

**NOTE**

You may need to enable pop ups at top-right corner of the demo GUI to allow URL redirection.

1. Power ON the board and open the IP address, <http://192.168.99.1>, in Google Chrome on the Linux machine. The FRWY-LS1046A demo GUI launches, displaying its home page.
2. Click the **Machine Learning / Video Analytics** button. The Machine Learning / Video Analytics page gets displayed.
3. Click the **Play** button in the **People Counting Demo (CPU)** section to start the demo. The docker starts loading with a message "Please wait for 10 sec, while docker is loading!!!". When the docker completes loading, the status of the demo changes from "Not Running" to "Running", as shown in the figure below.

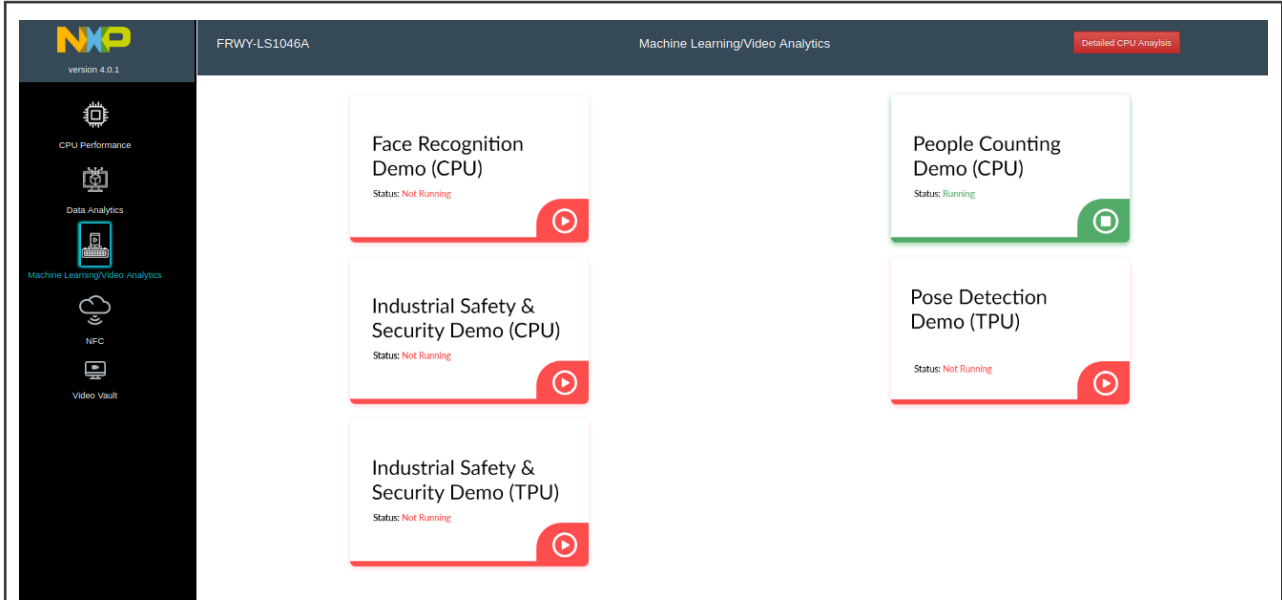


Figure 28. People Counting Demo (CPU) is running

Also, People Counting Demo (CPU) starts on a new browser tab, as shown in the figure below.



Figure 29. People Counting Demo (CPU) in progress

The demo should do the following:

- Count the number of people available in the camera frame
  - Display the names of the objects available in camera frame that are already trained to the FRWY-LS1046A board (such as TV monitor, bottle, chair, and flower vase)
4. Switch to the Machine Learning / Video Analytics page and click the **Stop** button in the **People Counting Demo (CPU)** section to stop the demo. A message "Please wait, while docker is stopping!!!" appears, as shown in the figure below.

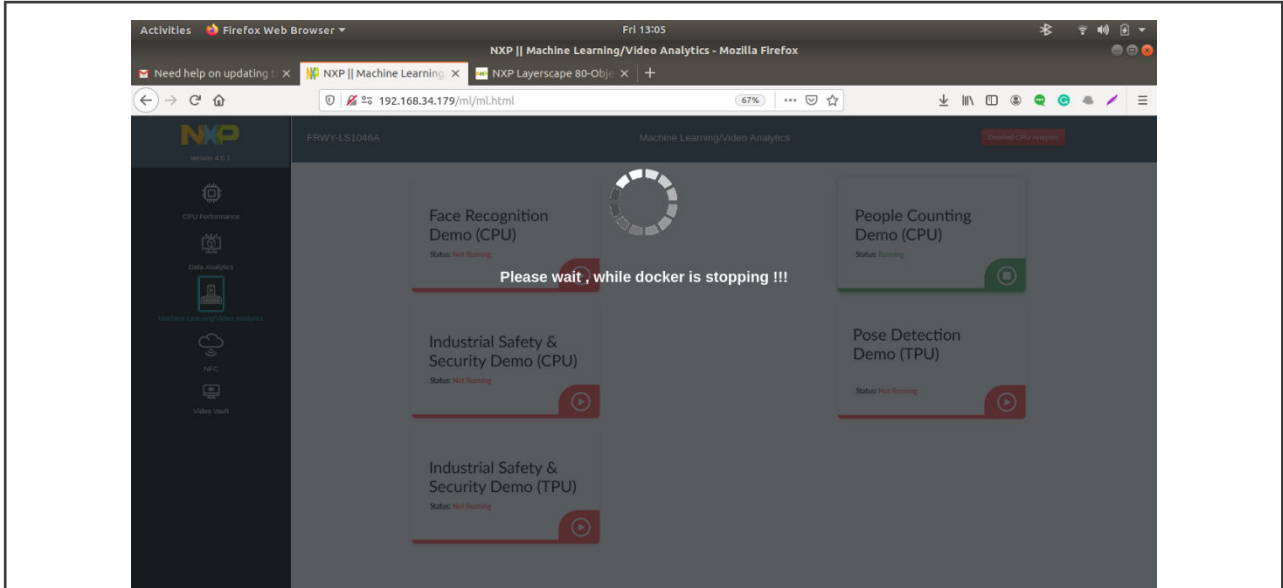


Figure 30. Stopping People Counting Demo (CPU)

### 8.3 Pose Detection Demo (TPU)

The Pose Detection Demo (TPU) is designed to detect and display human pose. Follow these steps to use the Pose Detection Demo (TPU):

**NOTE**

You may need to enable pop ups at top-right corner of the demo GUI to allow URL redirection.

1. Power ON the board and open the IP address, <http://192.168.99.1>, in Google Chrome on the Linux machine. The FRWY-LS1046A demo GUI launches, displaying its home page.
2. Click the **Machine Learning / Video Analytics** button. The Machine Learning / Video Analytics page gets displayed.
3. Click the **Play** button in the **Pose Detection Demo (TPU)** section to start the demo. The docker starts loading with a message "Please wait for 10 sec, while docker is loading!!!". When the docker completes loading, the status of the demo changes from "Not Running" to "Running", as shown in the figure below.

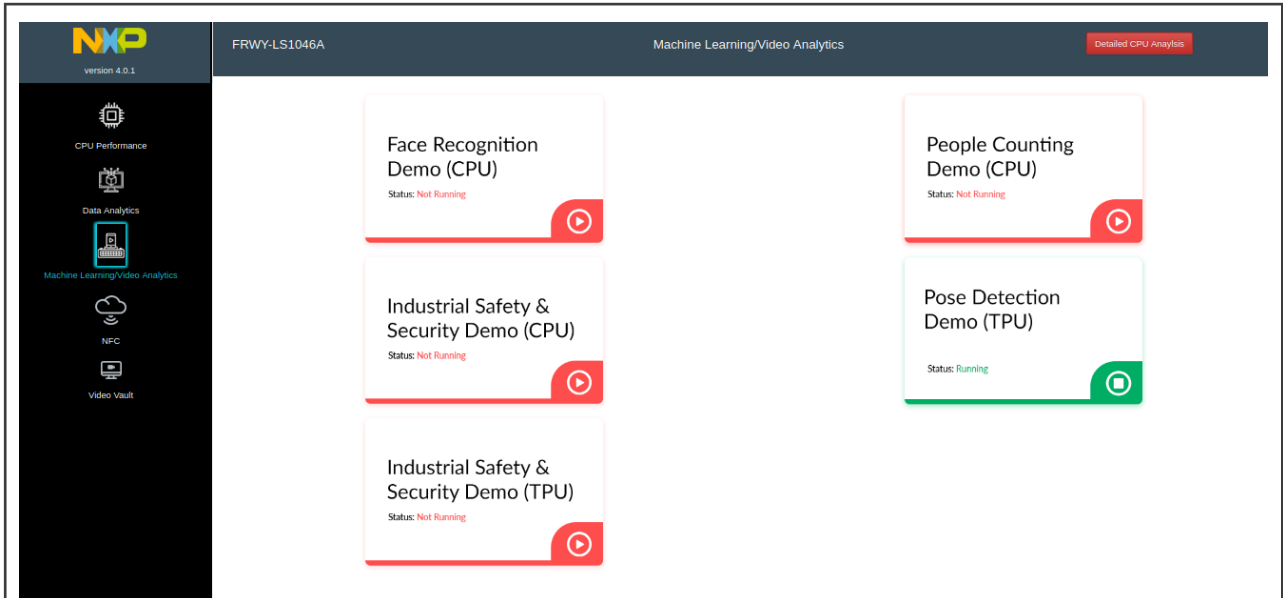


Figure 31. Pose Detection Demo (TPU) is running

Also, Pose Detection Demo (TPU) starts on a new browser tab, as shown in the figure below. The demo should detect and display human pose.

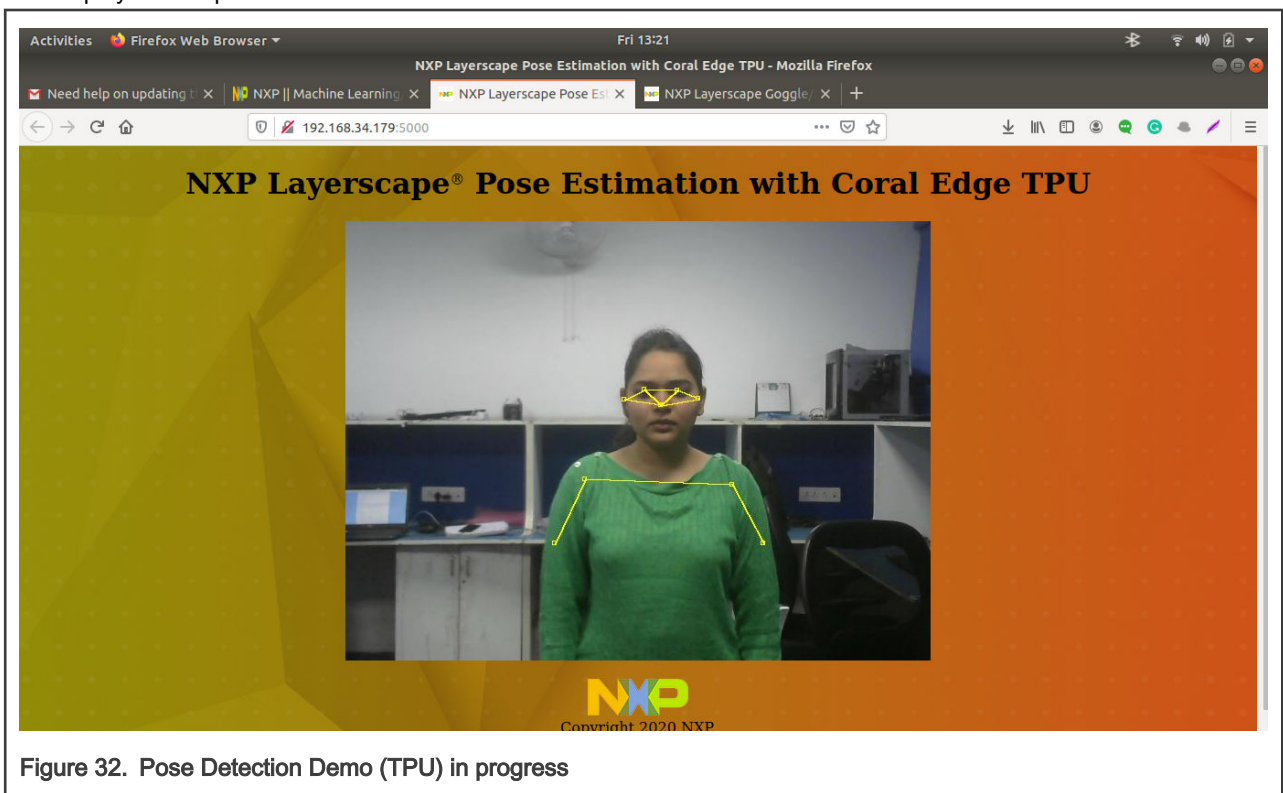


Figure 32. Pose Detection Demo (TPU) in progress

4. Switch to the Machine Learning / Video Analytics page and click the **Stop** button in the **Pose Detection Demo (TPU)** section to stop the demo. A message "Please wait, while docker is stopping!!!" appears, as shown in the figure below.



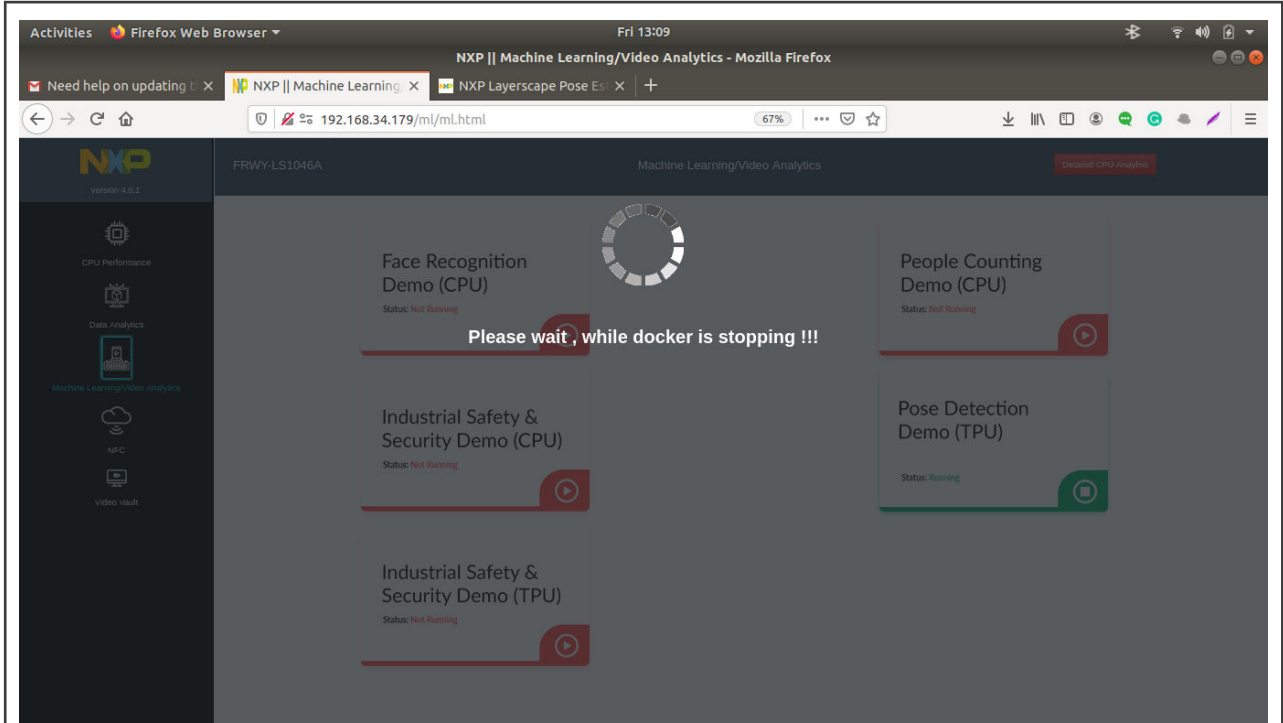


Figure 33. Stopping Pose Detection Demo (TPU)

**NOTE**

You should stop the currently running demo before switching to other pages for running other demos.

### 8.4 Industrial Safety & Security Demo (CPU)

The Industrial Safety & Security Demo (CPU) implements industrial safety and security through the LS1046A processor used in the FRWY-LS1046A board. Follow these steps to use the Industrial Safety & Security Demo (CPU):

**NOTE**

You may need to enable pop ups at top-right corner of the demo GUI to allow URL redirection.

1. Power ON the board and open the IP address, <http://192.168.99.1>, in Google Chrome on the Linux machine. The FRWY-LS1046A demo GUI launches, displaying its home page.
2. Click the **Machine Learning / Video Analytics** button. The Machine Learning / Video Analytics page gets displayed.
3. Click the **Play** button in the **Industrial Safety & Security Demo (CPU)** section to start the demo. The docker starts loading with a message "Please wait for 10 sec, while docker is loading!!!!". When the docker completes loading, the status of the demo changes from "Not Running" to "Running", as shown in the figure below.

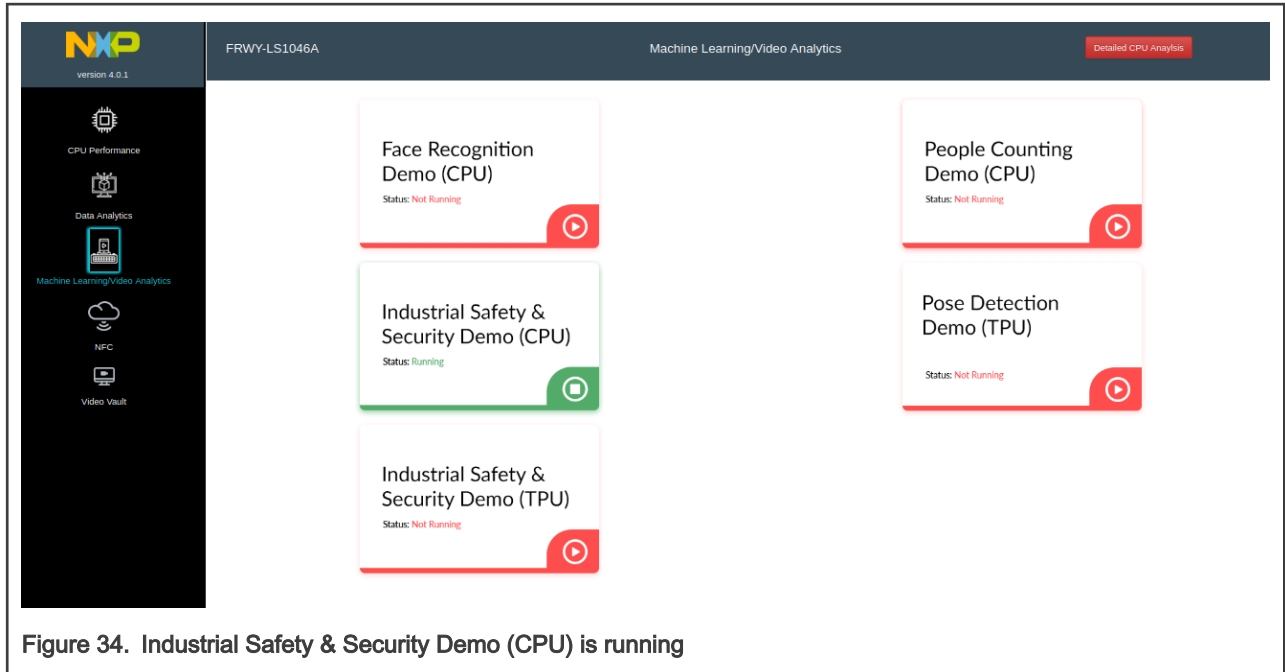


Figure 34. Industrial Safety & Security Demo (CPU) is running

Also, Industrial Safety & Security Demo (CPU) starts on a new browser tab, as shown in the figure below. The demo should detect and highlight industrial goggles and helmet, but should not detect normal spectacles and helmet.

**NOTE**

To get accurate results, ensure that camera is set with proper angle (75.5° to 109°), light is proper, and background is not white.

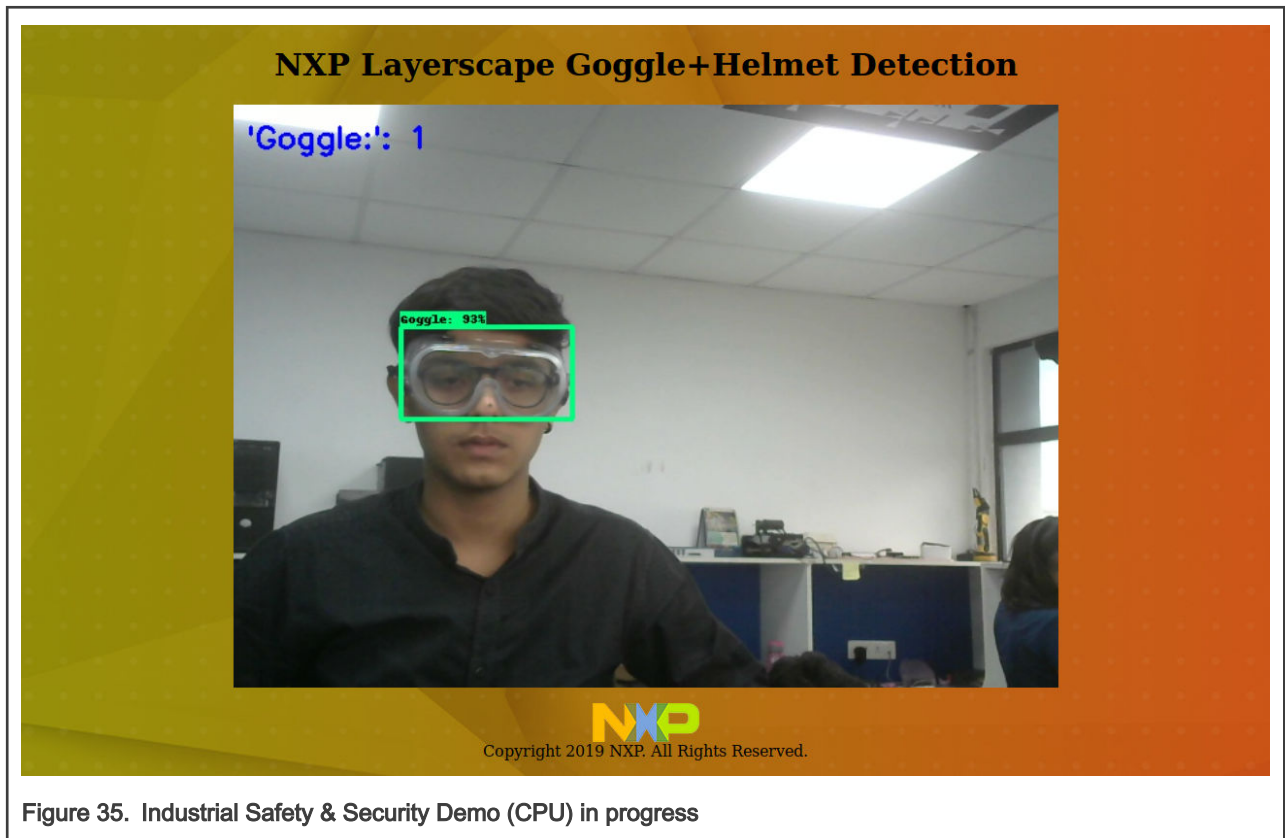


Figure 35. Industrial Safety & Security Demo (CPU) in progress

- Switch to the Machine Learning / Video Analytics page and click the **Stop** button in the **Industrial Safety & Security Demo (CPU)** section to stop the demo. A message "Please wait, while docker is stopping!!!" appears, as shown in the figure below.

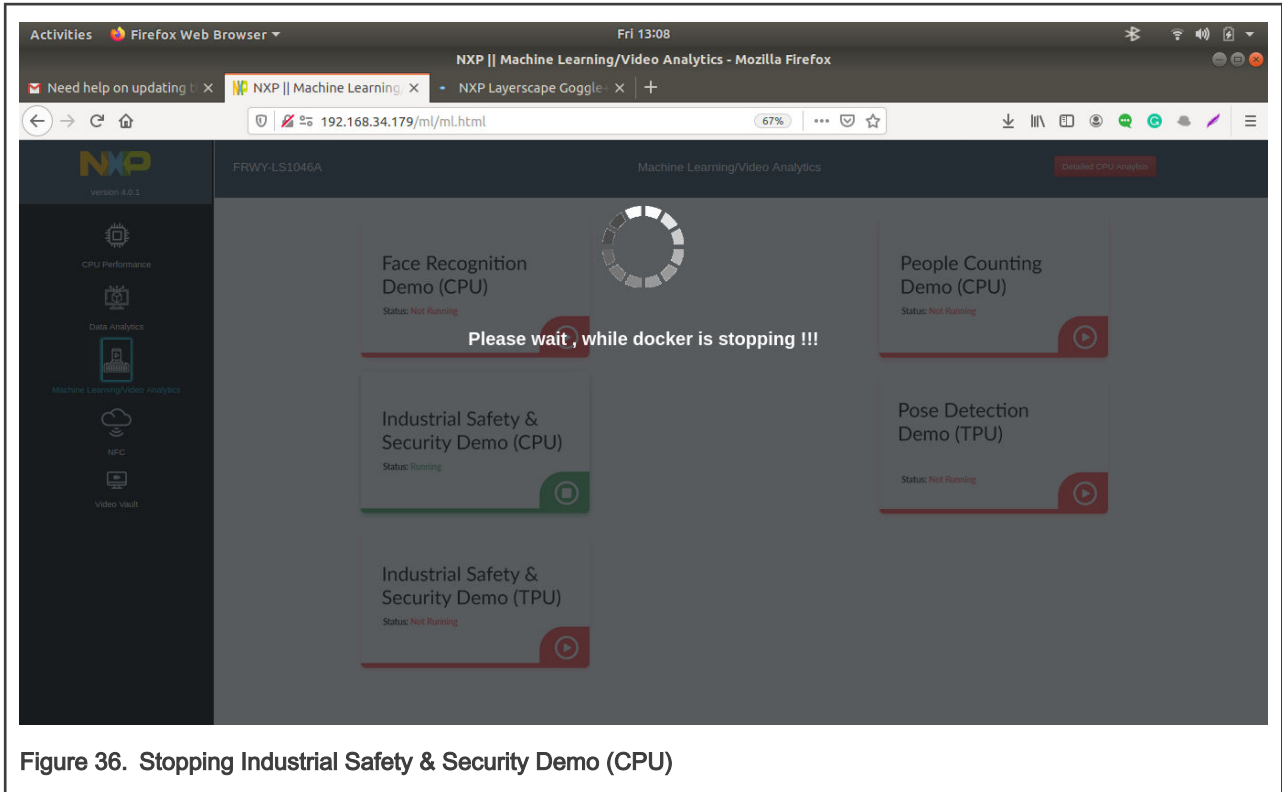


Figure 36. Stopping Industrial Safety & Security Demo (CPU)

#### NOTE

You should stop the currently running demo before switching to other pages for running other demos.

## 8.5 Industrial Safety & Security Demo (TPU)

The Industrial Safety & Security Demo (TPU) implements industrial safety and security through the Google Coral Edge TPU module attached to the FRWY-LS1046A board. Follow these steps to use the Industrial Safety & Security Demo (TPU):

#### NOTE

You may need to enable pop ups at top-right corner of the demo GUI to allow URL redirection.

- Power ON the board and open the IP address, <http://192.168.99.1>, in Google Chrome on the Linux machine. The FRWY-LS1046A demo GUI launches, displaying its home page.
- Click the **Machine Learning / Video Analytics** button. The Machine Learning / Video Analytics page gets displayed.
- Click the **Play** button in the **Industrial Safety & Security Demo (TPU)** section to start the demo. The docker starts loading with a message "Please wait for 10 sec, while docker is loading!!!". When the docker completes loading, the status of the demo changes from "Not Running" to "Running", as shown in the figure below.

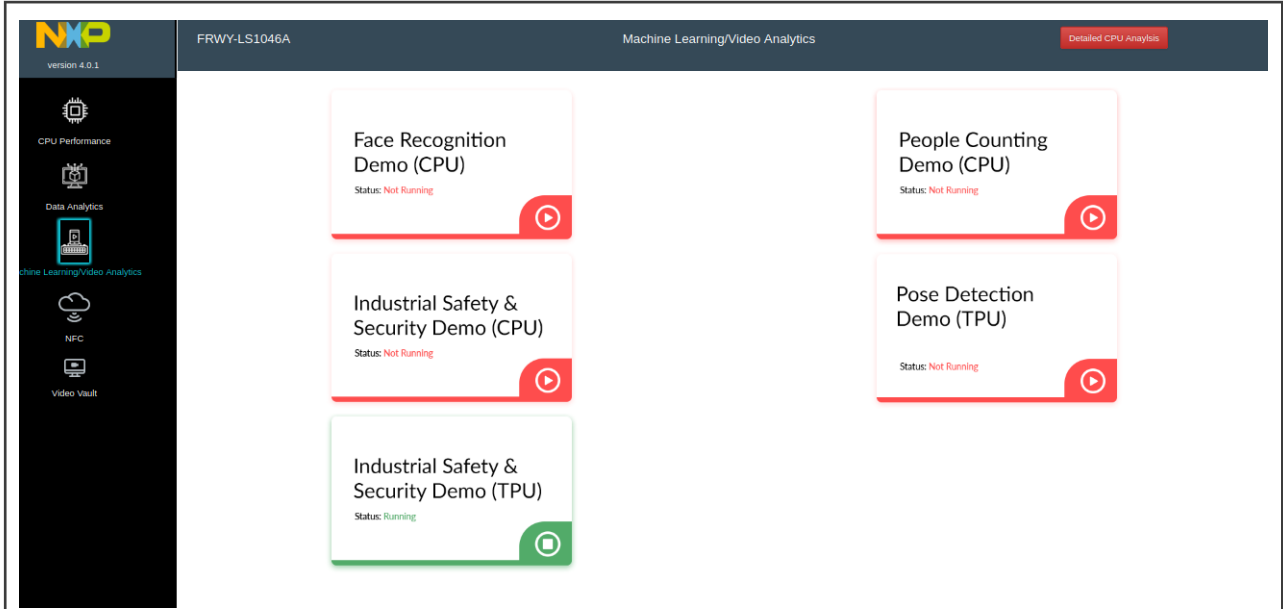


Figure 37. Industrial Safety & Security Demo (TPU) is running

Also, Industrial Safety & Security Demo (TPU) starts on a new browser tab, as shown in the figure below. The demo should detect and highlight industrial goggles and helmet, but should not detect normal spectacles and helmet.

**NOTE**

To get accurate results, ensure that camera is set with proper angle (75.5° to 109°), light is proper, and background is not white.

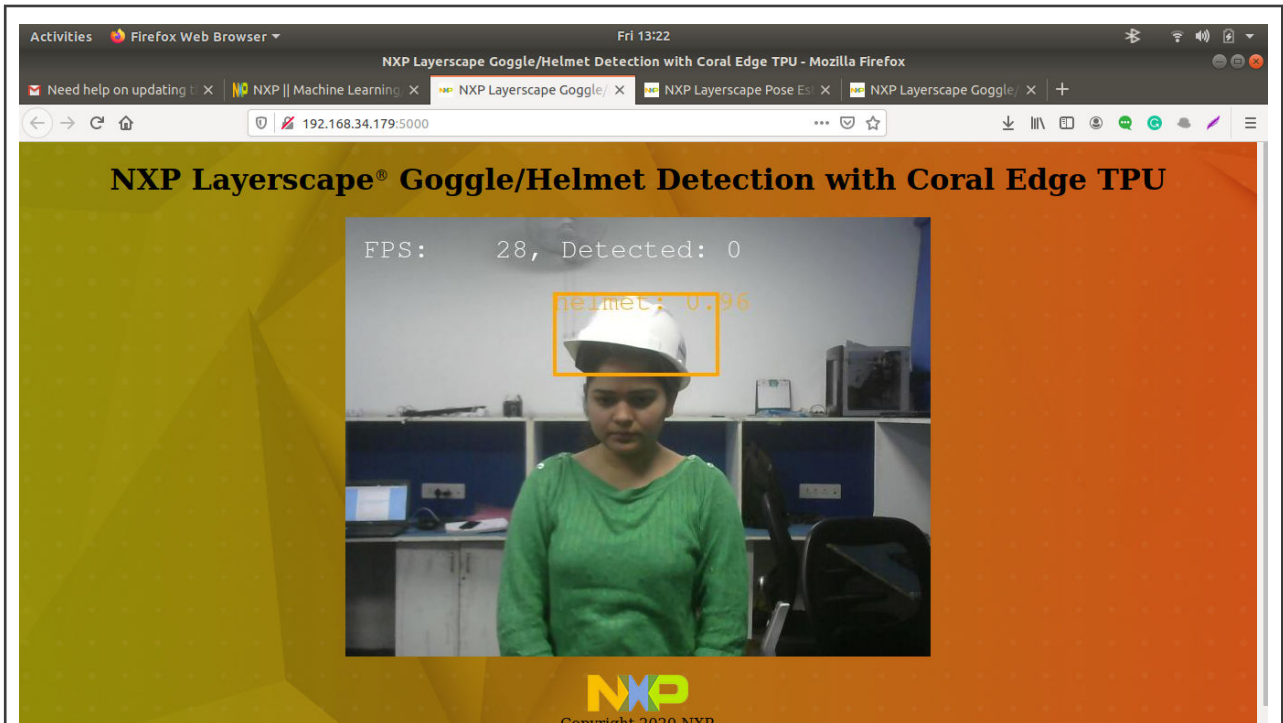


Figure 38. Industrial Safety & Security Demo (TPU) in progress

- Switch to the Machine Learning / Video Analytics page and click the **Stop** button in the **Industrial Safety & Security Demo (TPU)** section to stop the demo. A message "Please wait, while docker is stopping!!!" appears, as shown in the figure below.

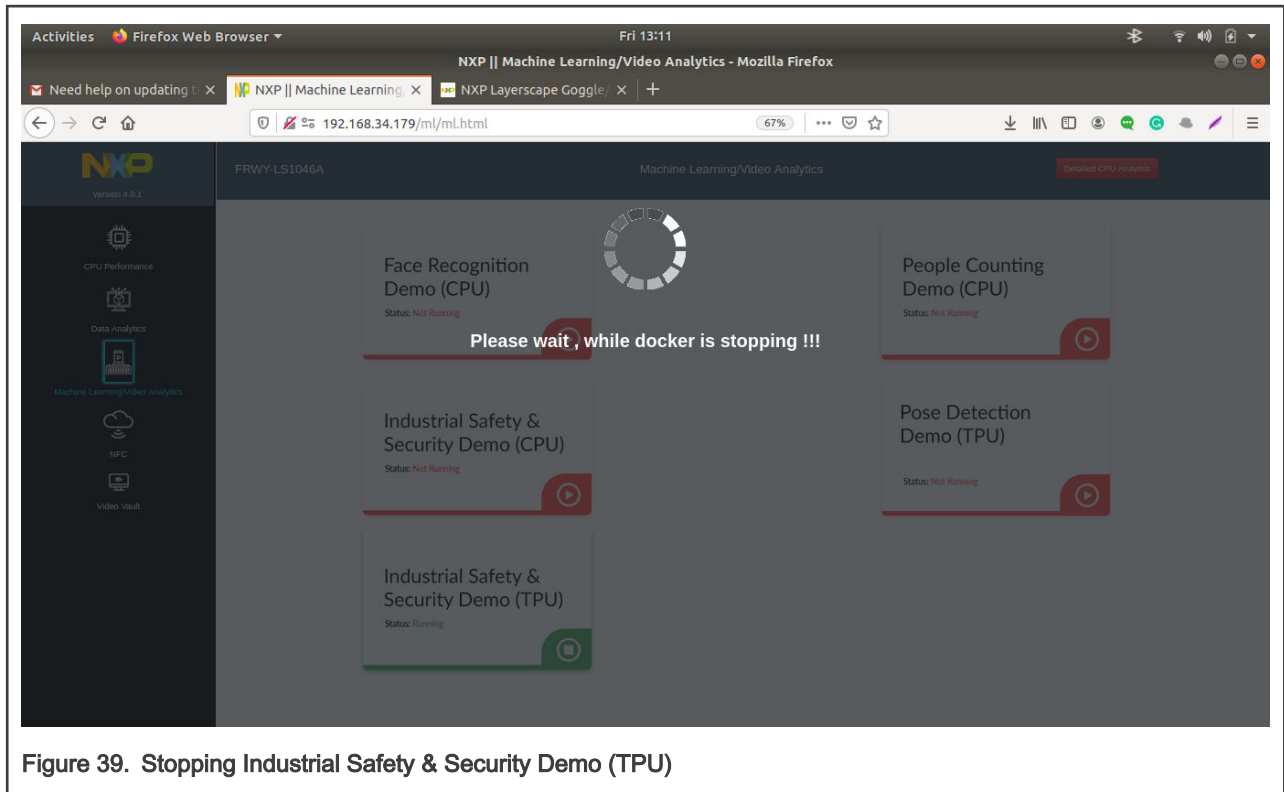


Figure 39. Stopping Industrial Safety & Security Demo (TPU)

#### NOTE

You should stop the currently running demo before switching to other pages for running other demos.

## 9 Implementing user authentication

The FRWY-LS1046A board supports NFC, which provides authentication capabilities to the board. The authentication capabilities of the board can be explained using the following two major steps:

#### NOTE

Before testing authentication capabilities of the FRWY-LS1046A board, ensure that the NFC click board is mounted on the mikroBUS socket of the board.

- Create user database
- Perform user authentication

### 9.1 Create user database

This section explains the steps to create a user database, which will be used for authentication in [Perform user authentication](#). You can add as many user entries as you want. In this example, we are creating a database of employees.

Follow these steps to create an employee database:

- Power ON the board and open the IP address, <http://192.168.99.1>, in Google Chrome on the Linux machine. The FRWY-LS1046A demo GUI launches, displaying its home page.

- Click the **NFC** button. The NFC page gets displayed, as shown in the figure below. The page is divided into two sections, one section allows to create/modify an employee database and the other section allows to run the Employee Database Demo.

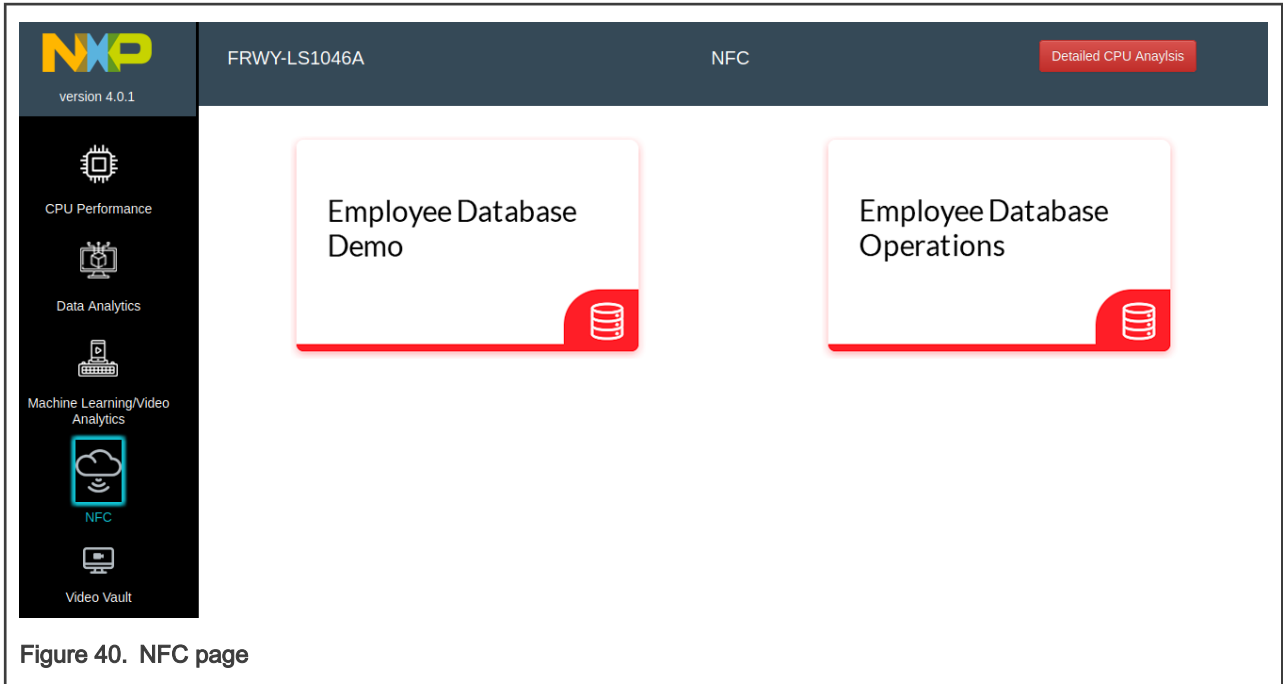


Figure 40. NFC page

- Click in the **Employee Database Operations** section. The Employee Database Operations page appears, as shown in the figure below.

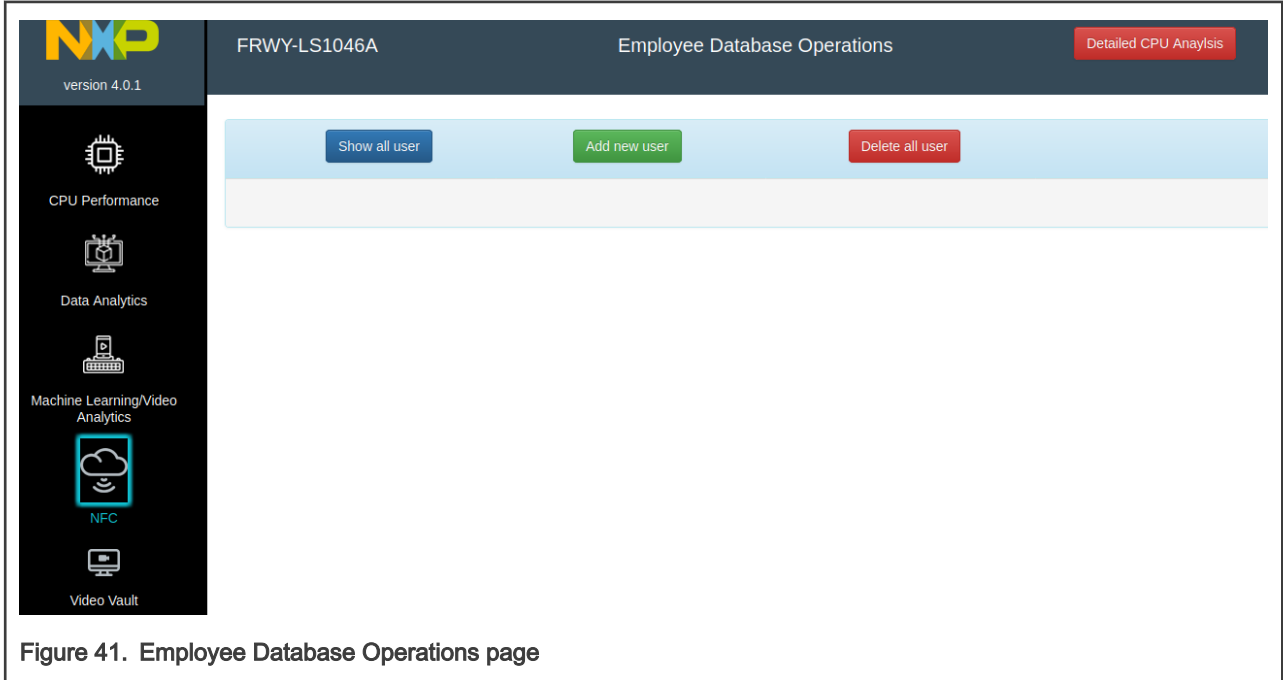


Figure 41. Employee Database Operations page

- To start creating employee database, click the **Add new user** button.

**NOTE**

Before creating a new employee database, click the **Delete all user** button to delete existing entries from the database.

- Enter details of an employee and click **Submit** to add the employee to the database, as shown in the figure below. Similarly, add more employees to complete employee database creation.

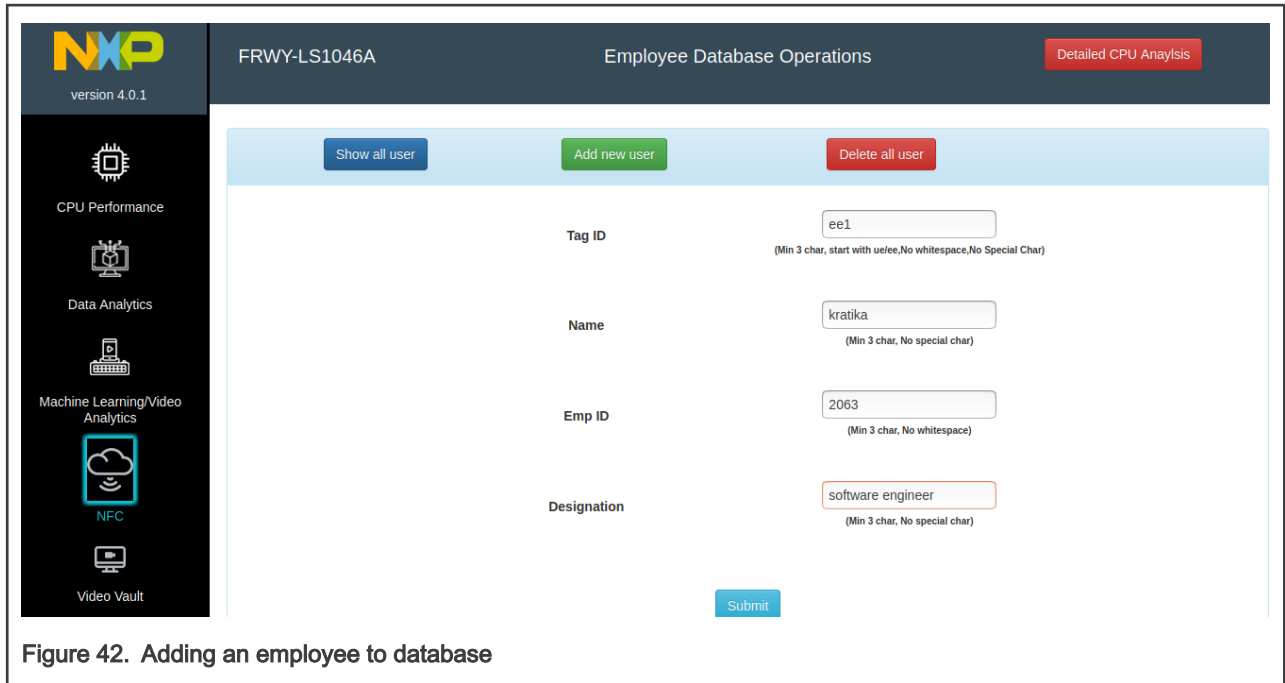


Figure 42. Adding an employee to database

- Click the **Show all user** button to see details of all employees added to the employee database, as shown in the figure below.

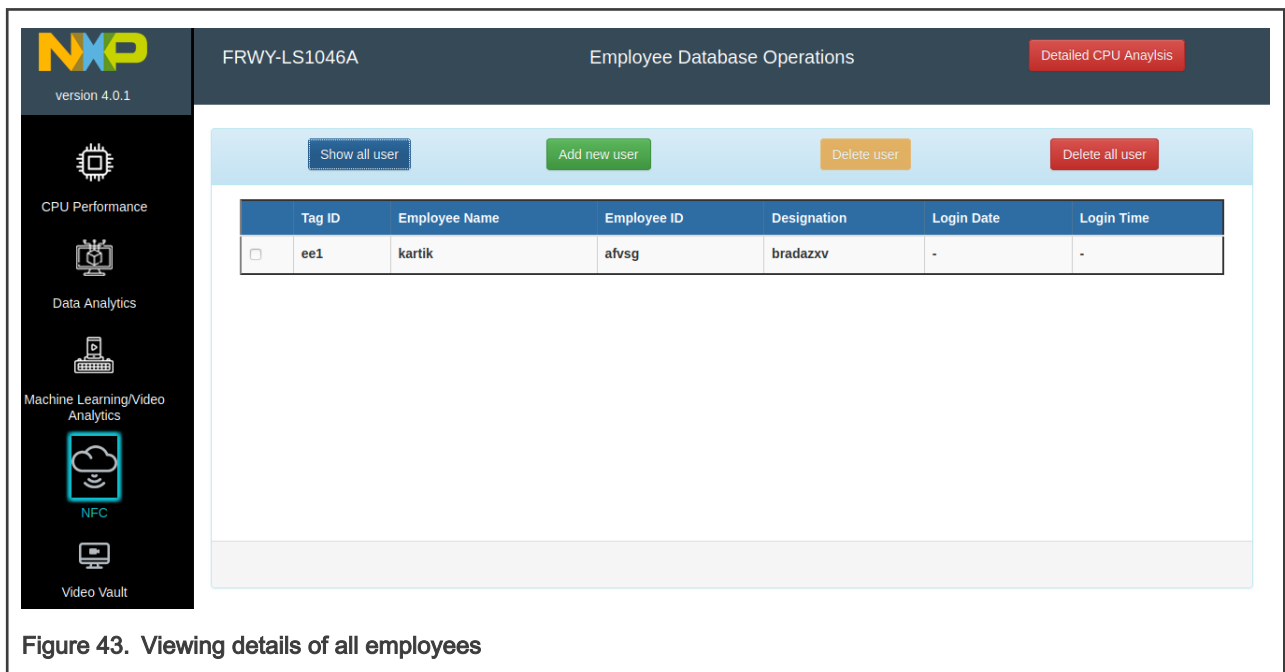


Figure 43. Viewing details of all employees

- To delete an employee from the database, select the check box in the beginning of the employee row in the database and click the **Delete user** button, as shown in the figure below.

**NOTE**

Before deleting individual employees from the database, you need to click the **Show all user** button to display all employee records.

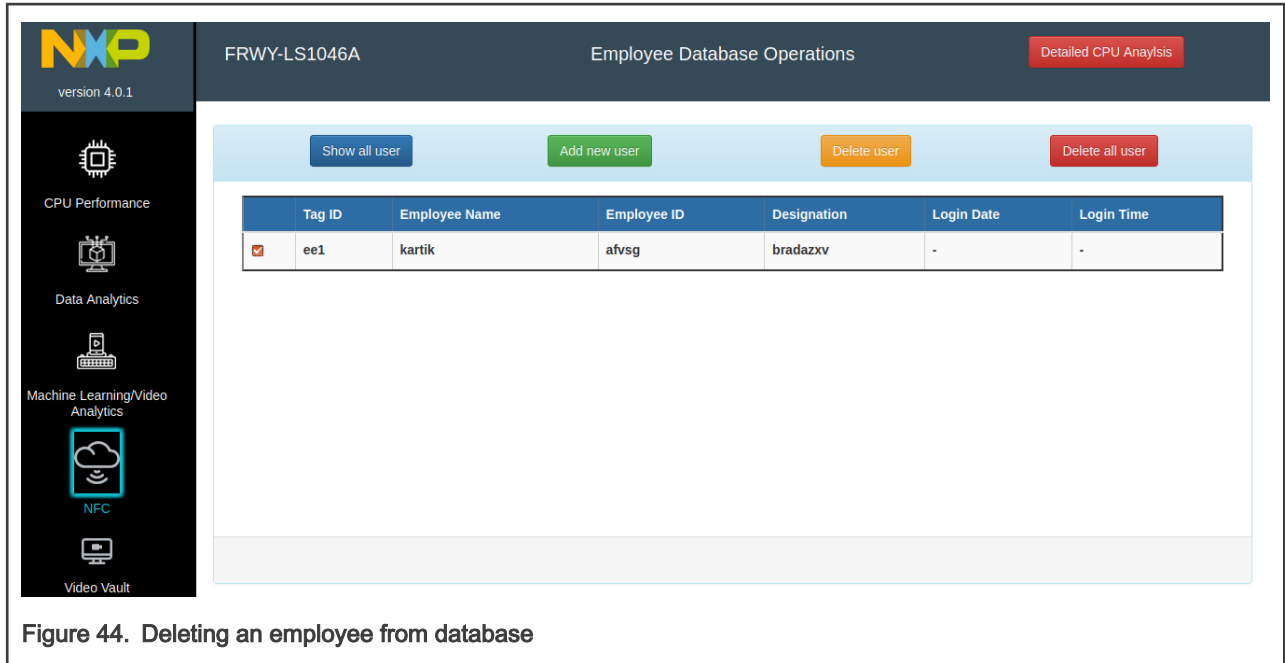


Figure 44. Deleting an employee from database

The details of the selected employee get deleted from the database, as shown in the figure below.

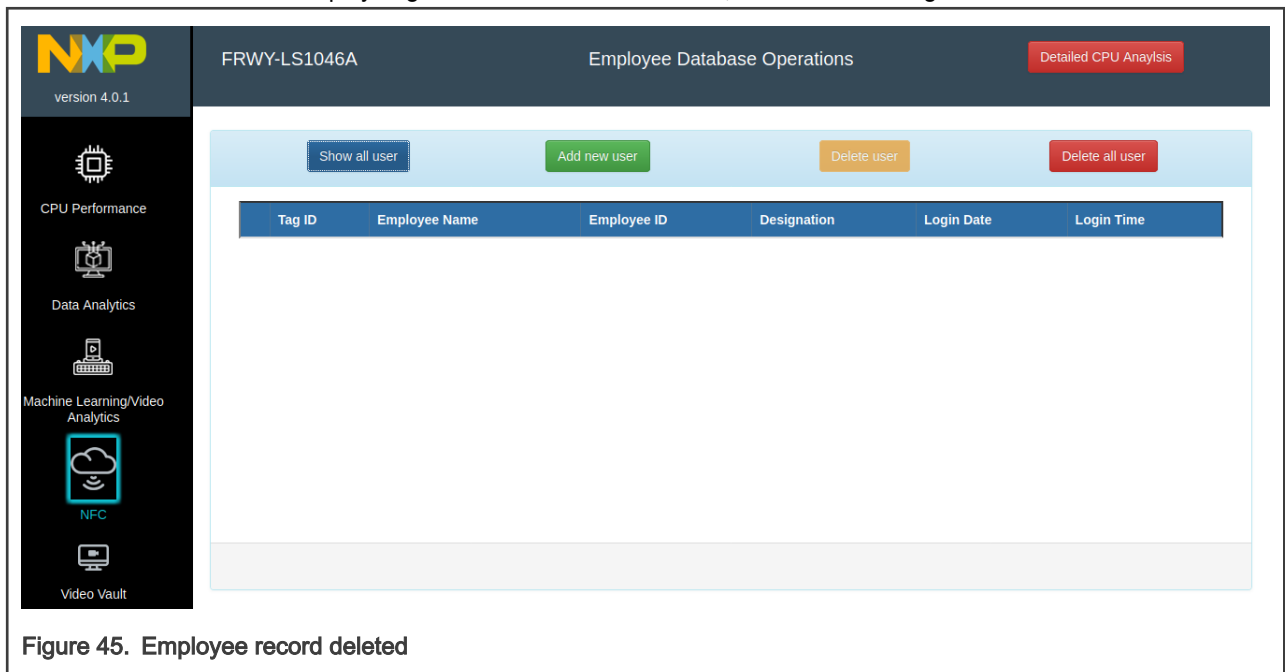


Figure 45. Employee record deleted

### 9.1.1 Prepare NFC tag with tag ID starting with ee/ue

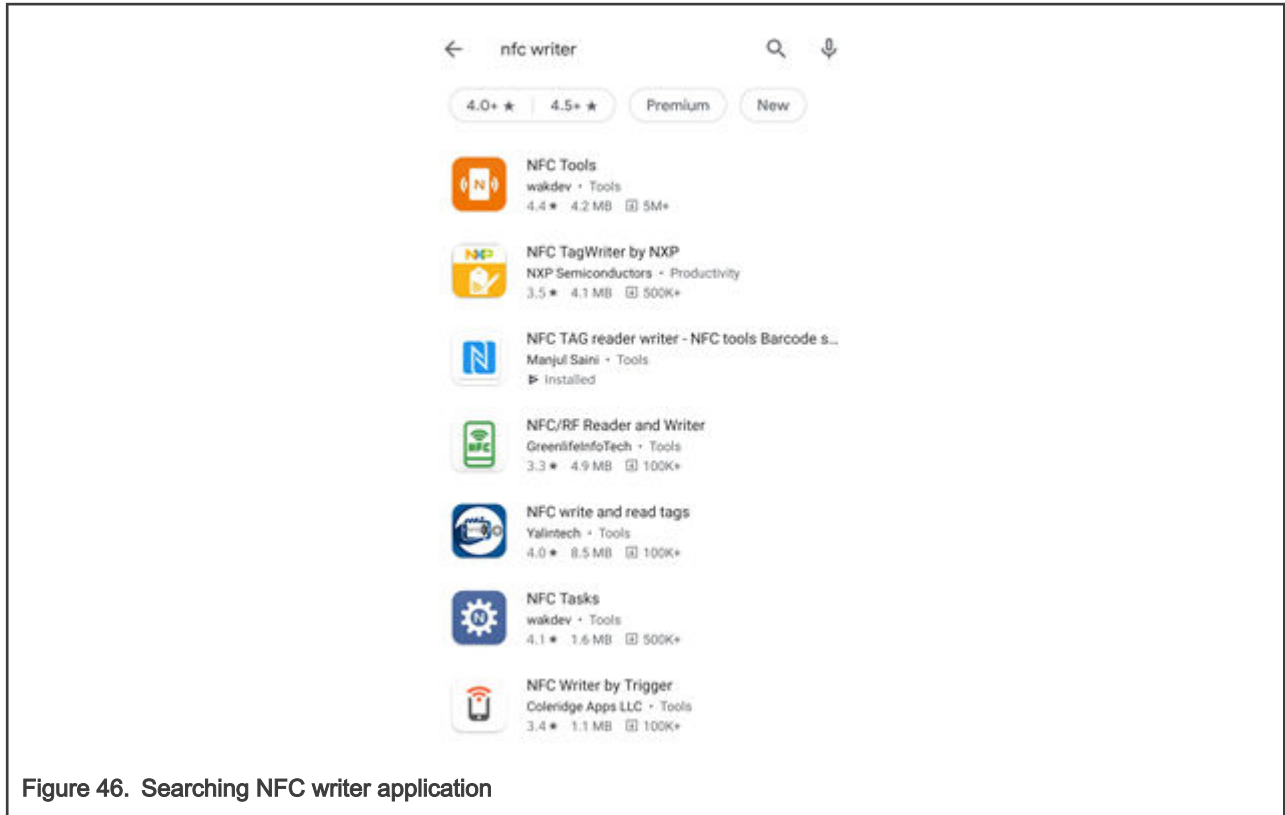
Follow these steps to write tag ID details on a near-field communication (NFC) tag/card:

**NOTE**

NFC tag preparation is only tested on an Android phone supporting NFC.

1. Go to **Play Store** on your Android phone and search for **nfc writer**, as shown in the figure below.





2. Click the “NFC TAG reader writer - NFC tools Barcode scanner” application. You will get an option to install the application, as shown in the figure below.

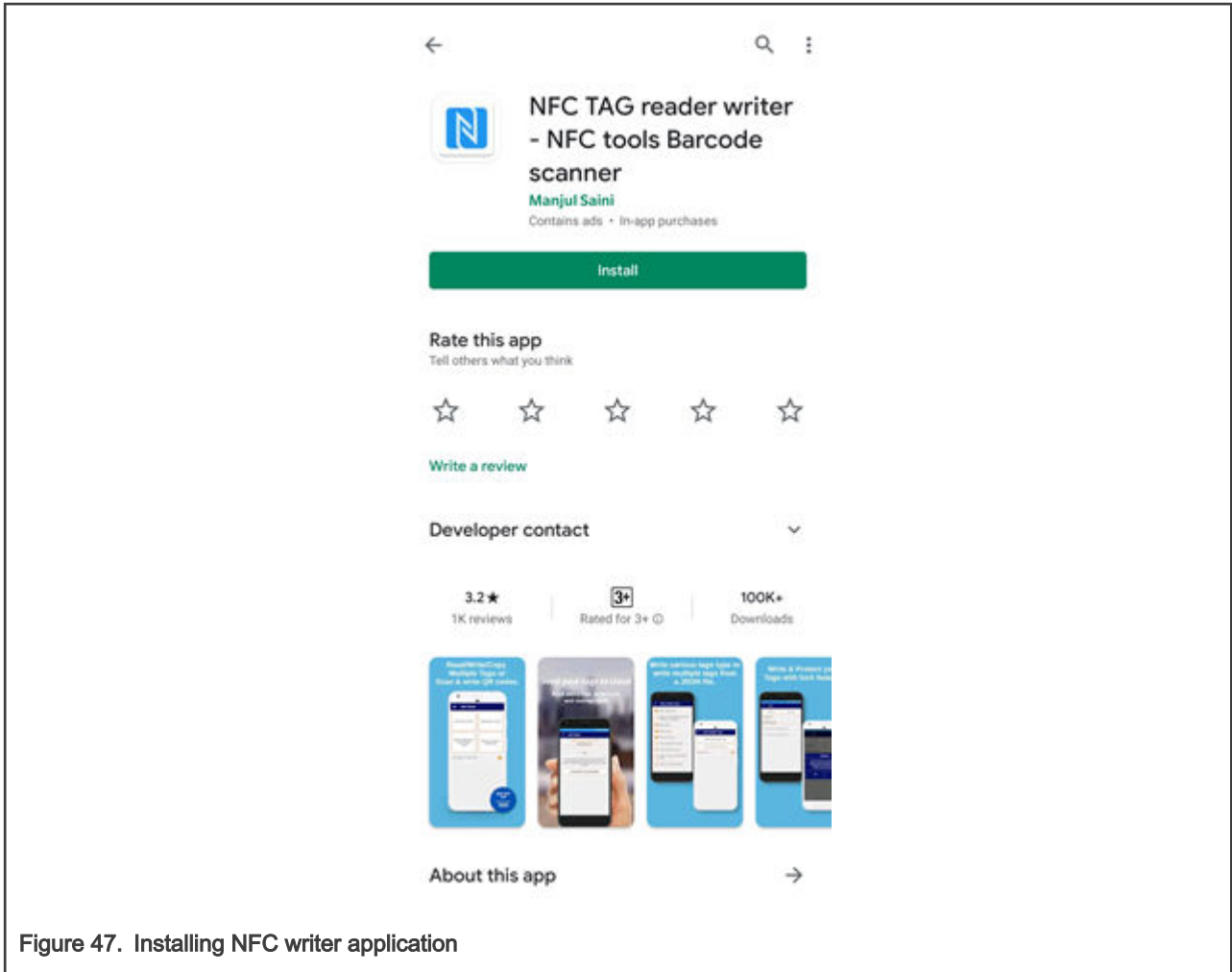


Figure 47. Installing NFC writer application

- 3. Click **Install** to download and install the application on the Android phone. After the installation is complete, you will get an option to open the application, as shown in the figure below.

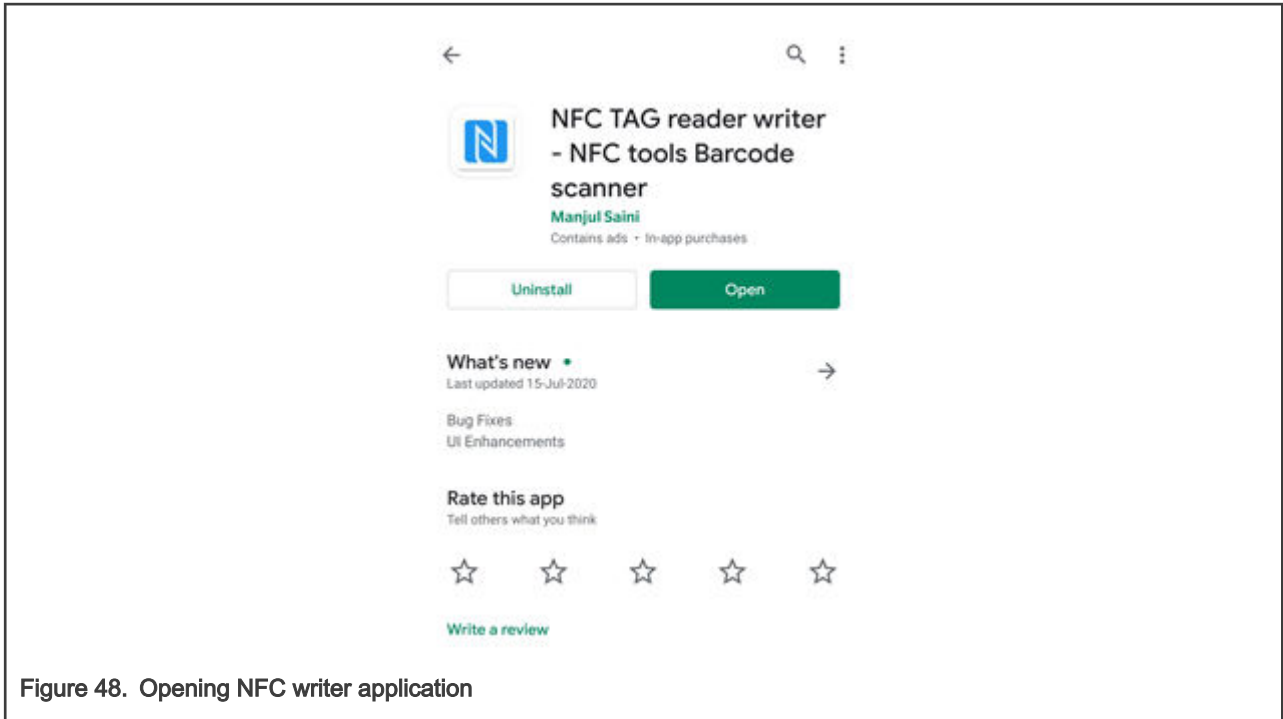


Figure 48. Opening NFC writer application

4. Click **Open** to open the application. The NFC writer application opens and a message "NFC is Disabled" appears if NFC is not enabled on your Android phone, as shown in the figure below.



Figure 49. "NFC is Disabled" message

5. Click **YES** to enable NFC on the Android phone. You are redirected to the setting to turn ON the NFC.
6. Turn ON the NFC, as shown in the below figure.

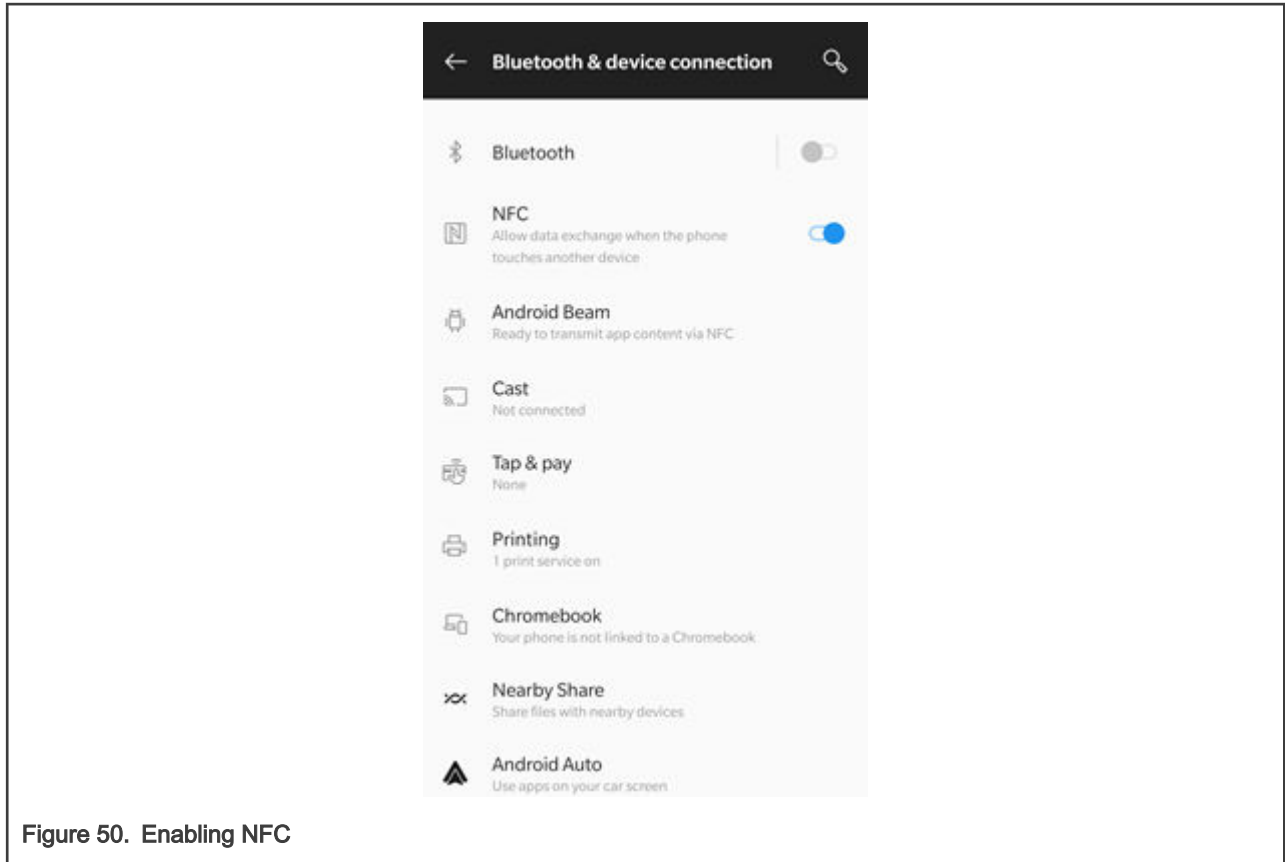


Figure 50. Enabling NFC

7. Go back to the NFC writer application (see figure below) and click **WRITE NFC TAGS**.

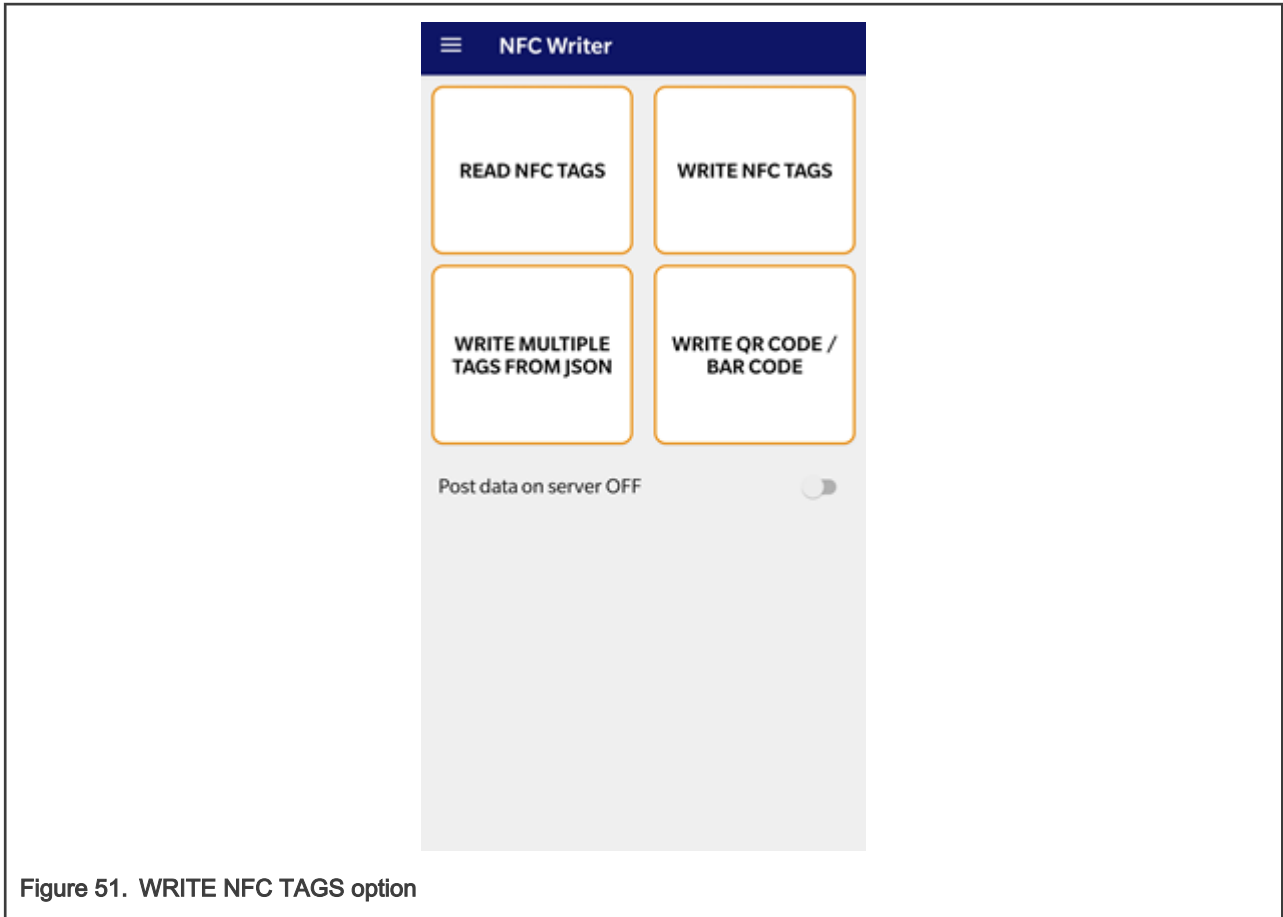


Figure 51. WRITE NFC TAGS option

The options to select a record type for writing are displayed, as shown in the figure below.

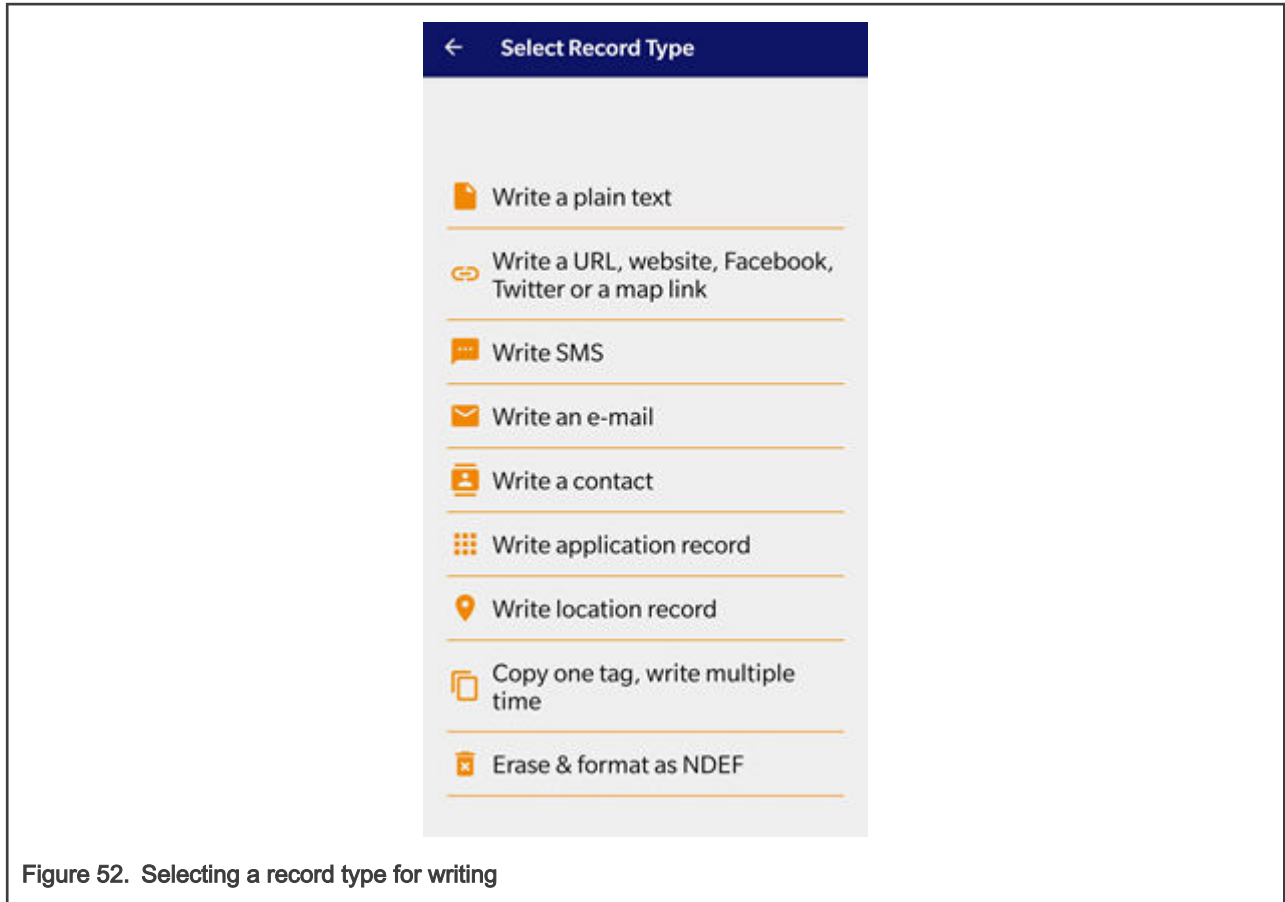


Figure 52. Selecting a record type for writing

8. Click **Write a plain text**. You are redirected to the **Write Tag** page, as shown in the figure below.

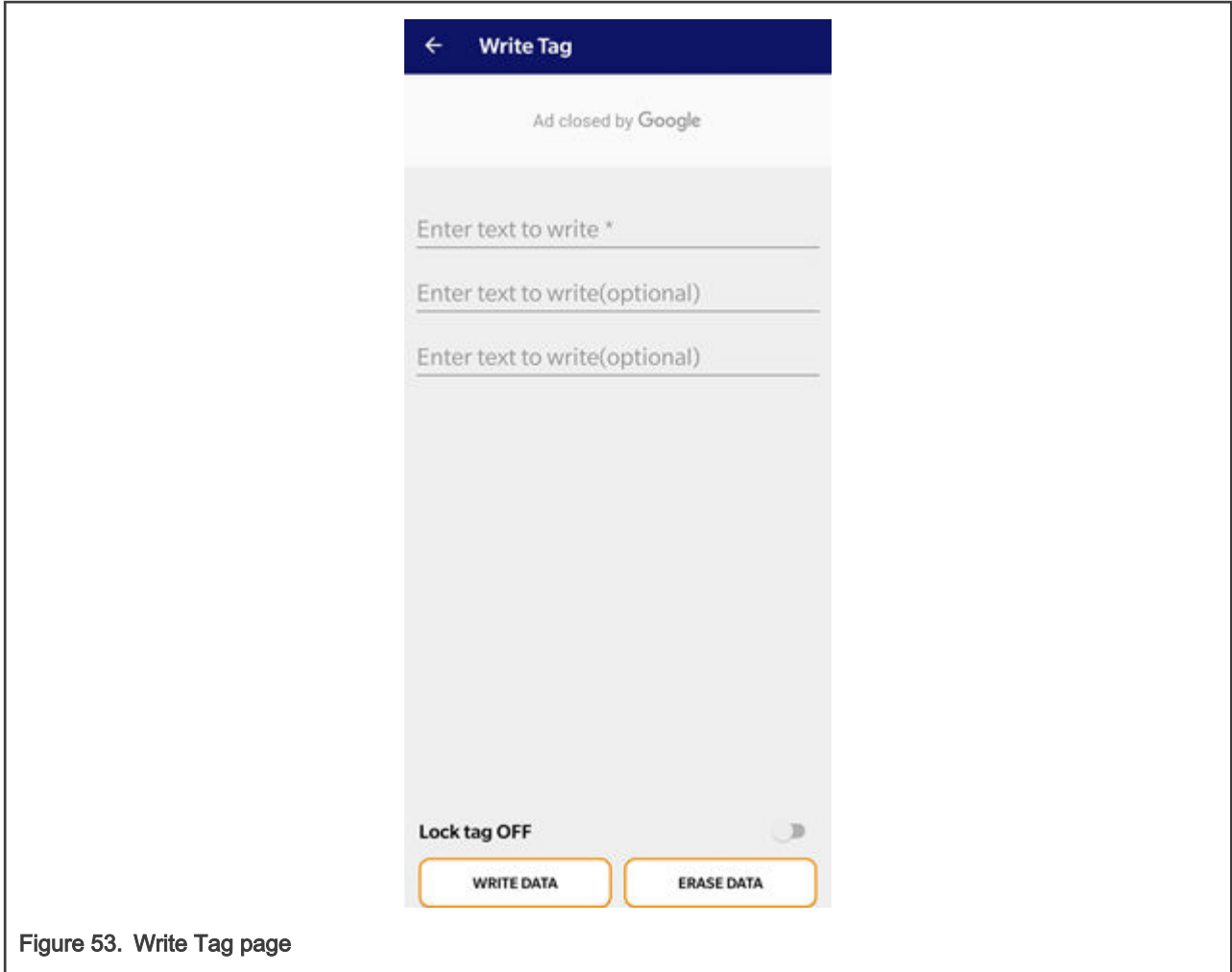


Figure 53. Write Tag page

9. Enter the text that you want to be made as the tag ID for the NFC tag/card in the **Enter text to write** field, as shown in the figure below.

**NOTE**

Only tag IDs starting with "ee" or "ue" and containing no special characters are supported currently.



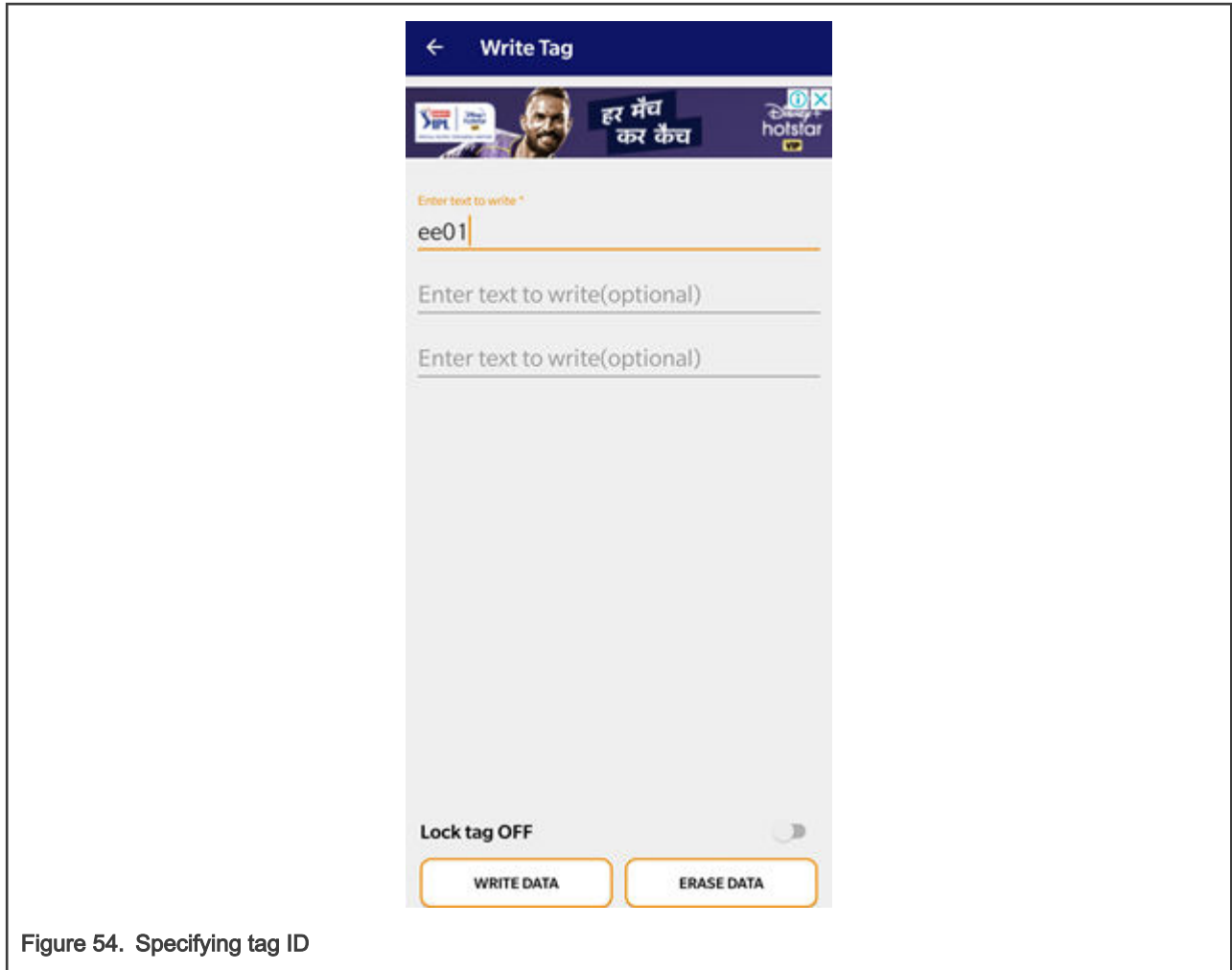
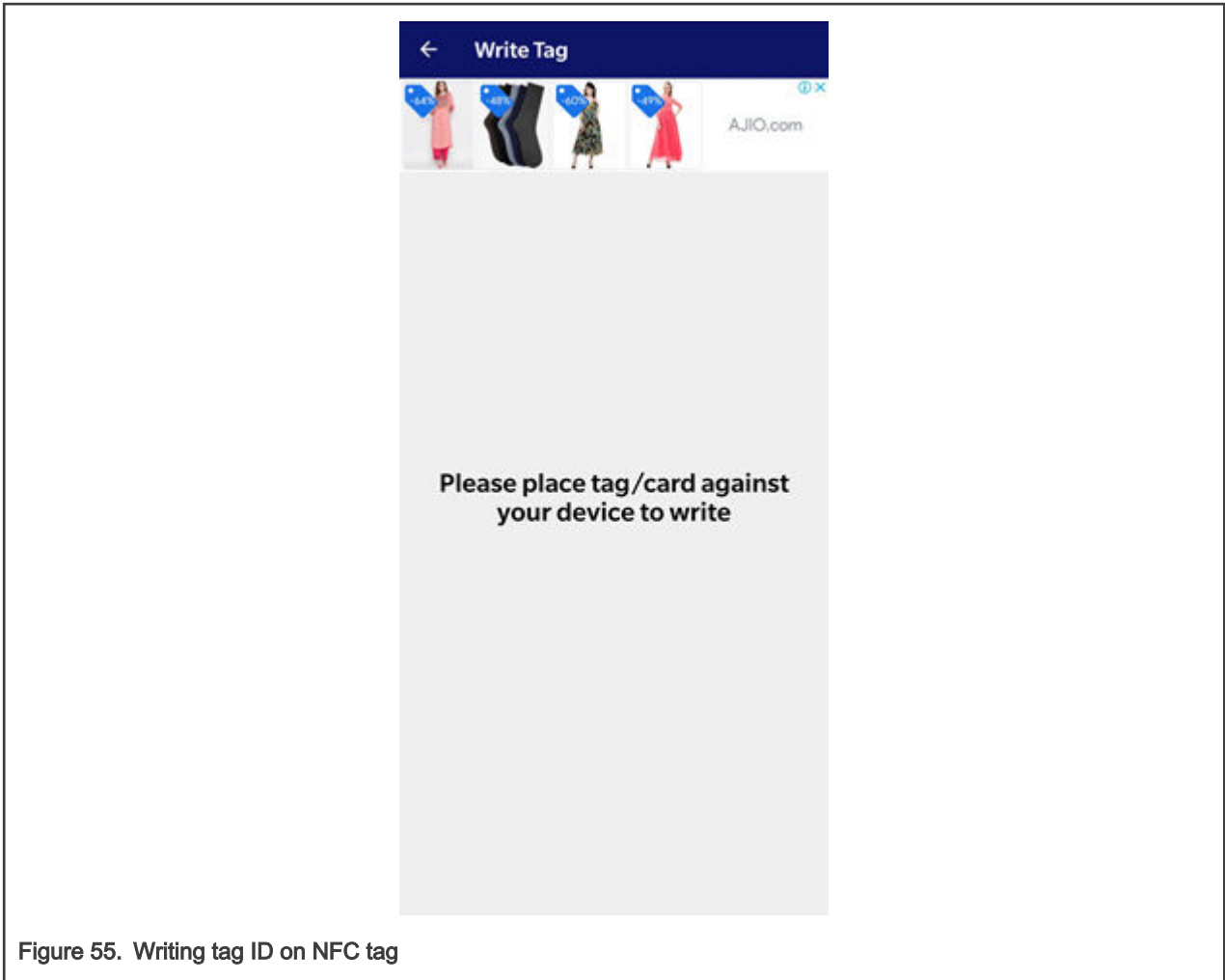


Figure 54. Specifying tag ID

10. After specifying tag ID details, click **WRITE DATA** at the bottom of the page to proceed with writing on the NFC tag/card. A message "Please place tag/card against your device to write" appears, as shown in the figure below.



11. Now, place the NFC tag on the back side of the Android phone to write tag ID details on the NFC tag, until you get a message "Data successfully written", as shown in the figure below.



## 9.2 Perform user authentication

This section explains how to authenticate the users (employees) from the database created in [Create user database](#). User authentication is done using the NFC click board and NFC tag. The authentication process is demonstrated in the Employee Database Demo of the FRWY-LS1046A demo.

Follow these steps to run the Employee Database Demo:

1. Power ON the board and open the IP address, <http://192.168.99.1>, in Google Chrome on the Linux machine. The FRWY-LS1046A demo GUI launches, displaying its home page.
2. Click the **NFC** button. The NFC page gets displayed.
3. Click in the **Employee Database Demo** section. The Employee Database Demo page appears, as shown in the figure below.

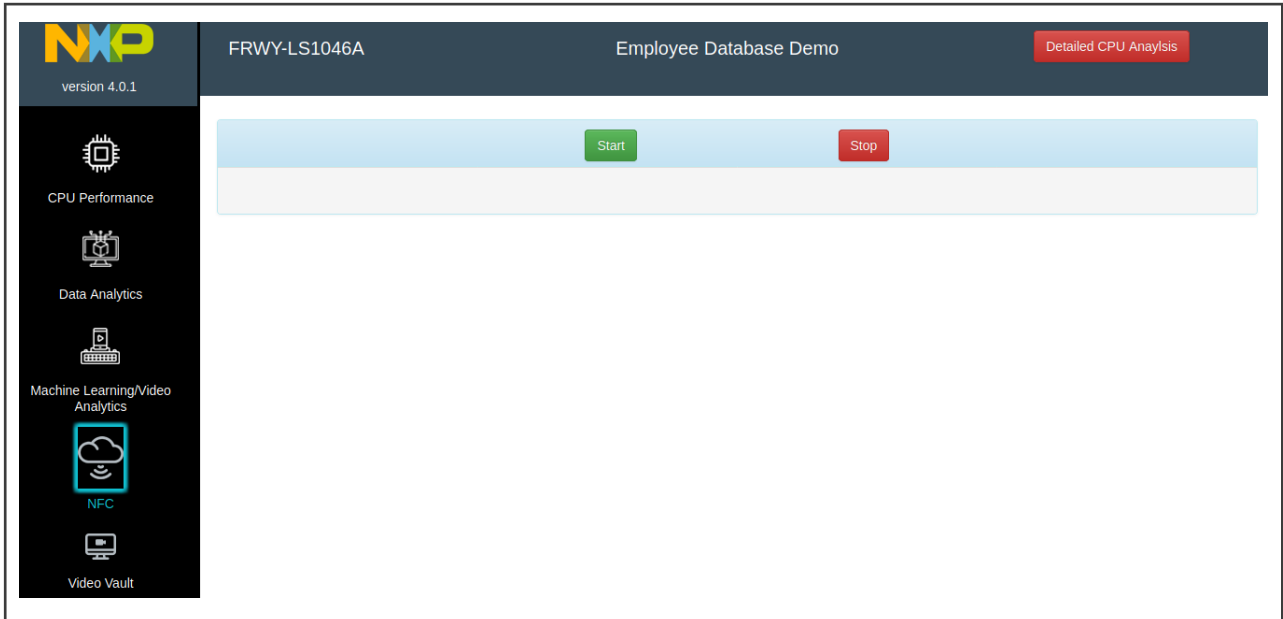


Figure 57. Employee Database Demo page

4. Click the **Start** button to start the demo on the FRWY-LS1046A board. A message "Please scan your NFC card" appears, as shown in the figure below.

**NOTE**

After starting the demo, you will not be able to switch to other demos until you stop the current demo.

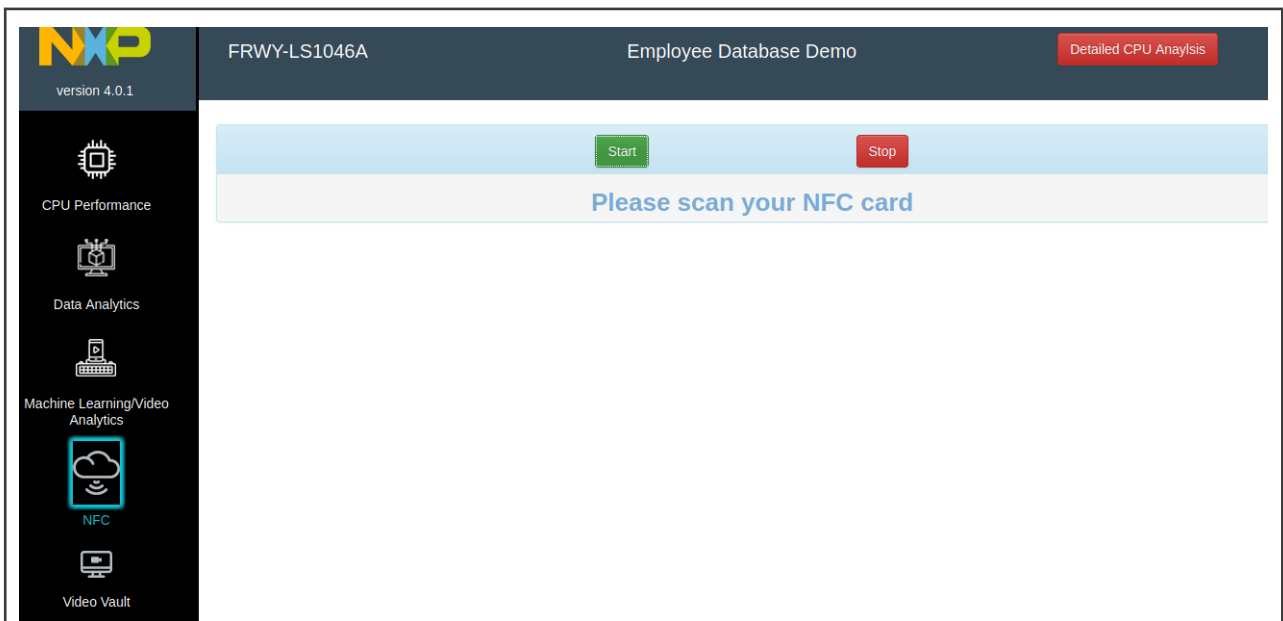


Figure 58. Scan NFC card message

5. To authenticate a user, show the user's NFC tag near the FRWY-LS1046A NFC module. The NFC module reads the NFC tag to authenticate the user:
  - If the tag ID on the NFC tag matches with a tag ID in the employee database, then a message "Authenticated successfully." gets displayed along with employee details, as shown in the figure below.

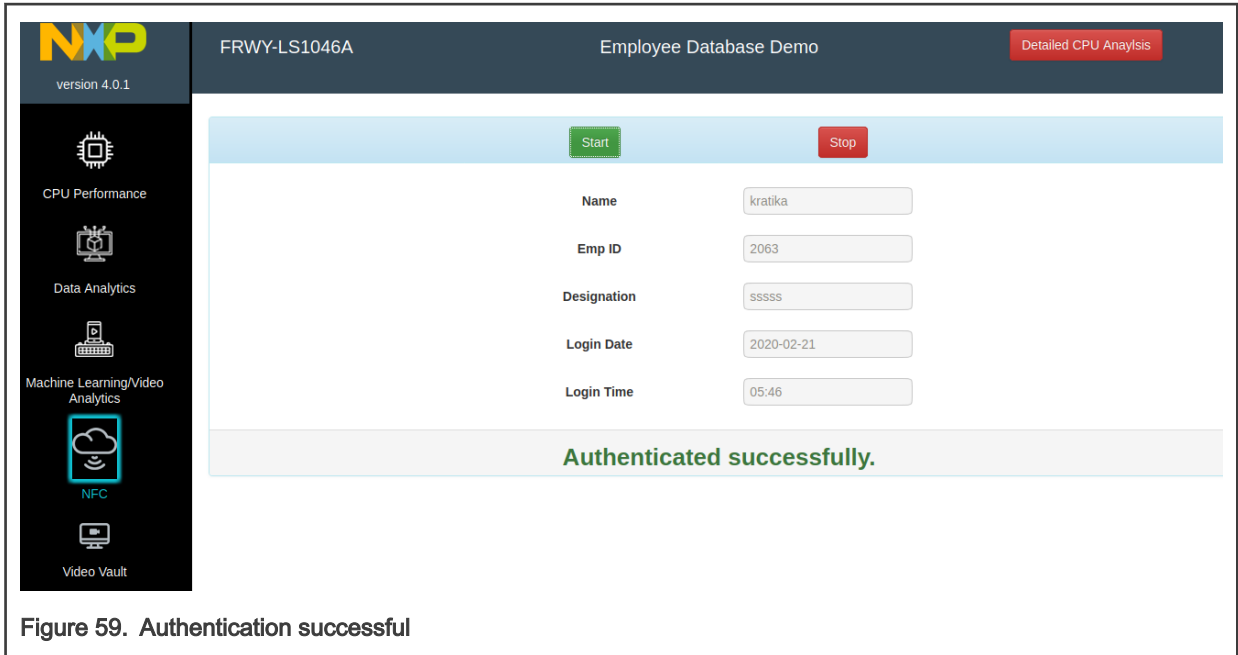


Figure 59. Authentication successful

- If the tag ID on the NFC tag does not match with any tag ID in the employee database, then a message "Not an authorized user." gets displayed, as shown in the figure below.

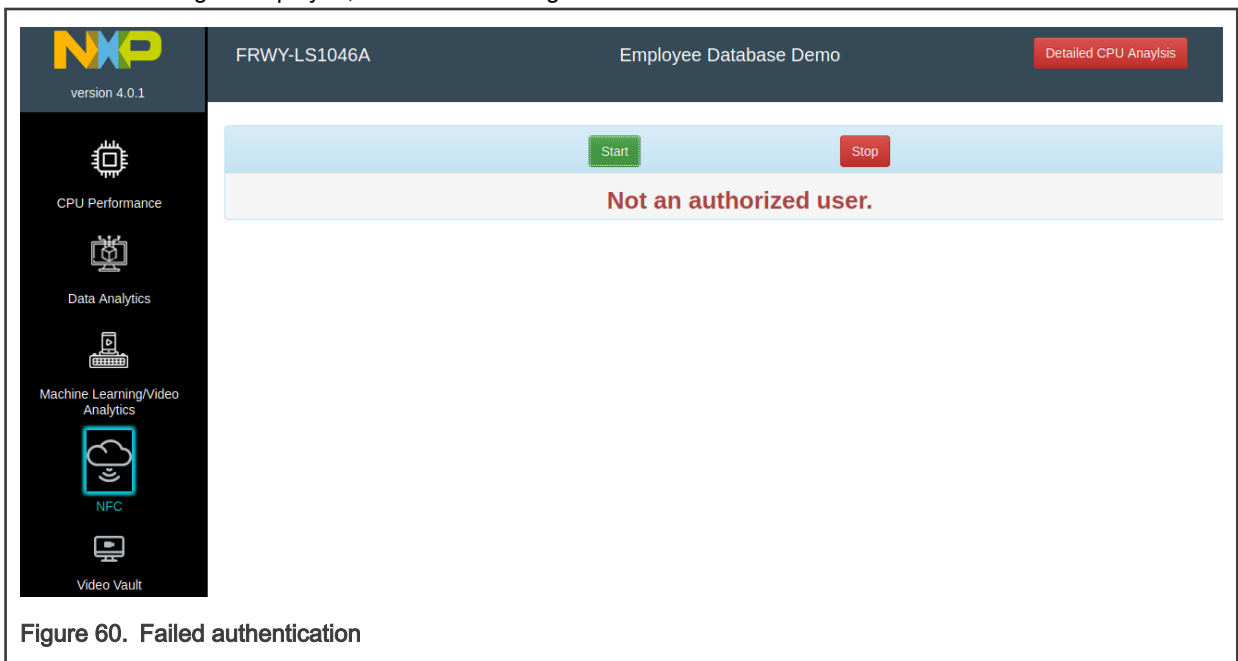


Figure 60. Failed authentication

6. Click the **Stop** button to stop the demo.

## 10 Accessing FRWY-LS1046A videos

This section explains the option available in the FRWY-LS1046A demo for accessing FRWY-LS1046A board based videos. Follow these steps to access the FRWY-LS1046A videos:

1. Power ON the board and open the IP address, <http://192.168.99.1>, in Google Chrome on the Linux machine. The FRWY-LS1046A demo GUI launches, displaying its home page.

- Click the **Video Vault** button. The Video Vault page gets displayed, as shown in the figure below. The page shows links to play six different videos related to the FRWY-LS1046A board. You can watch these videos to know more about the FRWY-LS1046A board.



Figure 61. Video Vault page

## 11 Known issues and limitations

Following are some known issues and limitations of the current FRWY-LS1046A demo release:

- Due to a limitation, a demo can only run on one client machine at a time. If another client tries to run the same demo, tries to access any page of the demo user interface, or tries to refresh any already open page of the demo user interface, then the currently running demo instance automatically stops execution.
- Currently running demo needs to be stopped before starting another demo on a client machine
- For Face Recognition Demo, the training is done live; therefore, a small change in angle can make a significant difference and can affect the face recognition activity
- For Face Recognition Demo, only one person should be present in front of the camera during training
- For industrial safety and security demos (CPU and TPU), camera to be used for detecting objects must be set with proper angle (75.5° to 109°), light should be proper, and background should not be white
- For Industrial Safety & Security Demo (CPU), inferencing running on the CPU shows latency of approximately 2 seconds, when displaying inferencing results on the GUI, with the TensorFlow Lite framework. Industrial Safety & Security Demo (TPU), which also uses TensorFlow Lite framework, does not show any latency.
- The NFC demo (Employee Database Demo) only supports NFC tags having tag IDs starting with "ee" or "ue"

## 12 Revision history

The table below summarizes the changes made to this document.

Table 5. Revision history

Revision	Date	Topic cross-reference	Change description
Rev. 1	12/2020	<a href="#">Launch demo GUI</a>	Updated the section

Table continues on the next page...

Table 5. Revision history (continued)

Revision	Date	Topic cross-reference	Change description
		<a href="#">Prepare NFC tag with tag ID starting with ee/ue</a>	Added as a new section
		<a href="#">Known issues and limitations</a>	Updated the section
Rev. 0	09/2020		Initial public release

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