AS019PMODEXP-POCZ

Software User Manual

Introduction

This document describes and explains the user manual for AS019PMODEXP-POCZ, which is Qt based automation system. The RZ/G2L platform is used to host the Linux OS. The graphical user interface (GUI) is designed and developed using Qt framework. The RZ/G2L platform is used as sensor data collector and to control/prevent the hazardous event in home/closed environment. The HS3001 sensor is used to collect the temperature and humidity data, which is interface over PMOD connector. The relays and camera are used to indicate the alarm/error event detection

It involves the system overview of the POC, connection set up, how to set host environment to build the BSP, flashing and application usage details.

Target Device

- RZ/G2L SMARC EVK
  - ARM CPU Dual Cortex® A55 running at 1.2Ghz clock frequency.
  - Main Memory DDR4 SDRAM: 2GBytes
  - QSPI NOR FLASH 64Mbyte
  - eMMC 64GByte
- HS3001
  - Highly accurate, fully calibrated relative humidity and temperature sensor

References

- RZ/G2L-EVKIT - RZ/G2L Evaluation Board Kit | Renesas
- US082-HS3001EVZ - Relative Humidity Sensor Pmod™ Board (Renesas Quick-Connect IoT) | Renesas
- HS300x Datasheet (renesas.com)
- https://www.renesas.com/us/en/document/mah/rzg2l-group-rzg2lc-group-users-manual-hardware-0?r=1467981

Acronyms

Name	Description
BSP	Board Support Package
DTB	Device Tree Blob
EVK	Evaluation Kit
eMMC	Embedded Multimedia
FAT	File Allocation Table
GPIO	General Purpose Input Output
GUI	Graphical User Interface

HDMI	High-Definition Multimedia Interface
I2C	Inter-Integrated Circuit
LCD	Liquid-Crystal Display
OS	Operating System
PC	Personal Computer
PMOD	Peripheral Module
POC	Proof Of Concept
SCIF	Serial Communication Interface with FIFO
SD	Secure Digital
SDK	Software Development Kit
SMARC	Smart Mobility ARChitecture
SoC	System on Chip
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus

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1 Overview

The RZ/G2L SMARC EVK and US082-HS3001EVZ is used in smart home automation safety system AS019PMODEXP-POCZ. The PMOD adaptor board is designed to facilitate the PMOD sensor module and relay module interfacing. The relays are controlled based on error/ alarm event occurrence for safety control. The relays eventually control the motors connected to it.

The home automation application is designed and developed using Qt GUI framework. The Qt creator tool is used to implement the following.

- UI Screens
- Peripheral communication – I2C PMOD sensor
- Application and/Business logic

This document briefs the Qt6 BSP build, flashing and application usage.

2 Operating Environment

The operation of this software project has been confirmed with the following environment.

Item	Description
RZ/G2L SMARC EVK	RZ/G2L-EVKIT - RZ/G2L Evaluation Board Kit | Renesas
Microprocessor	RZ/G2L MPU
BSP	Qt6 BSP
OS	Linux kernel
Build	Yocto
Boot Media	SPI Flash – Bootloaders (Kernel & FS from uSD)
Host Build PC	Ubuntu – 20.04
Host PC – Flashing	Windows 10 - Tera term

Table 1. Operating Environment

3 AS019PMODEXP-POCZ Details

This chapter briefs the hardware modules, existing POCs, HDMI display, Power supply and other accessories used in this development. PMOD adaptor is developed to interface multiple sensors and their interconnection schemas options.

3.1 Hardware Details

This section explains the details of each component and/or sub hardware modules/POC used in development of this POC, with their part number wherever applicable.

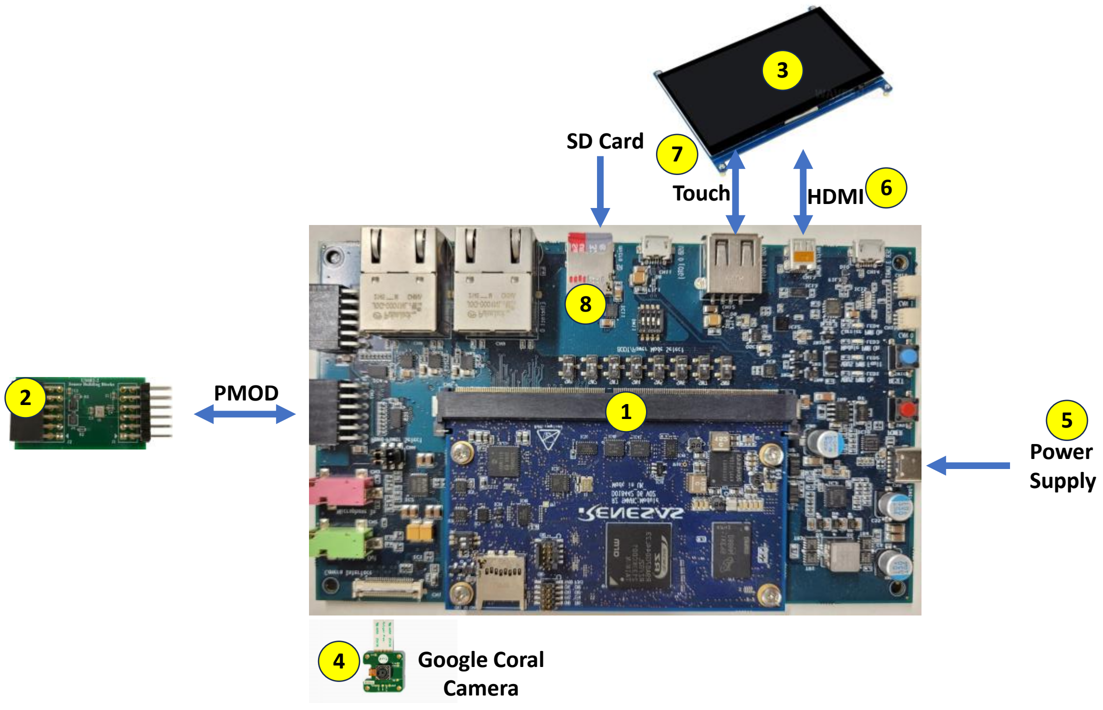


Figure 1. AS019PMODEXP-POCZ Hardware Details

1 RZ/G2L SMARC EVK: It consists of 2 part numbers RTK9744L23C01000BE and RTK97X4XXXB00000BE. The RTK9744L23C01000BE is SMARC SOM module with RZ/G2L MPU (R9A07G044L23GBG), PMIC, DDR4 memory, SPI Flash memory and EMMC memory. The RTK97X4XXXB00000BE SMARC carrier board embedded with camera, display, Micro SD, USB, PMOD (2A, 3A/6A) and others. For more details refer RZ/G2L, RZ/V2L SMARC Module Board User's Manual: Hardware (renesas.com).

2 US082-HS3001EVZ: This has HS3001, a high-performance relative humidity and temperature sensor. It is featured with a standard Pmod™ Type 6A (Extended I2C) connection for the on-board sensor to plug into any desired MCU/MPU evaluation kit.

3 6 7 7 Inch HDMI LCD display with USB capacitive touch screen having 1024x600 pixel. The item # 6 is HDMI cable and item #7 is the USB cable for touch screen.

4 Coral camera, which has 5-MegaPixel OminiVision sensor and dual lane MIPI output interface

5 USB Type-C Power Source, Default 5V~15V @3A: (min 15W requested) with Option 9V @3A: 27W

8 Micro SD Card 32GB: The kernel image and Device Tree File DTB is programmed in windows partition. The rootfs file system is programmed in Linux partition.

3.2 Connection Setup

Please refer figure 1: AS019PMODEXP-POCZ Hardware Details for connection and follow below steps to setup the system

- Connect US082-HS3001EVZ temperature and humidity sensor module to PMOD1 (CN7) connector of SMARC EVK platform.
- Connect the display port of HDMI Display to Micro HDMI port (CN13) of SMARC EVK platform. Micro HDMI convertor should be used for HDMI data. For touch, USB cable is connected between USB1 Host port (CN12) of SMARC EVK to touch port of HDMI display panel.
- Connect coral camera to MIPI CSI connector CN1 of SAMRC EVK platform
- Program micro SD card with kernel image, DTB file and rootfs file system, before inserting into the SD slot (CN10) of SMARC EVK platform
- Plug the USB type C cable to power on the system

3.3 Configuration Switch Settings

3.3.1 SW1 Switch Settings

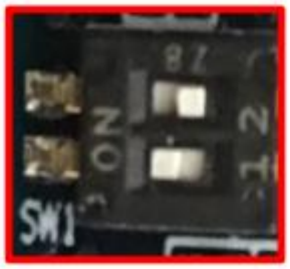


Figure 2. SW1 Switch

/

SW1-1	DEBUGEN
OFF	JTAG debug mode
ON	Normal operation

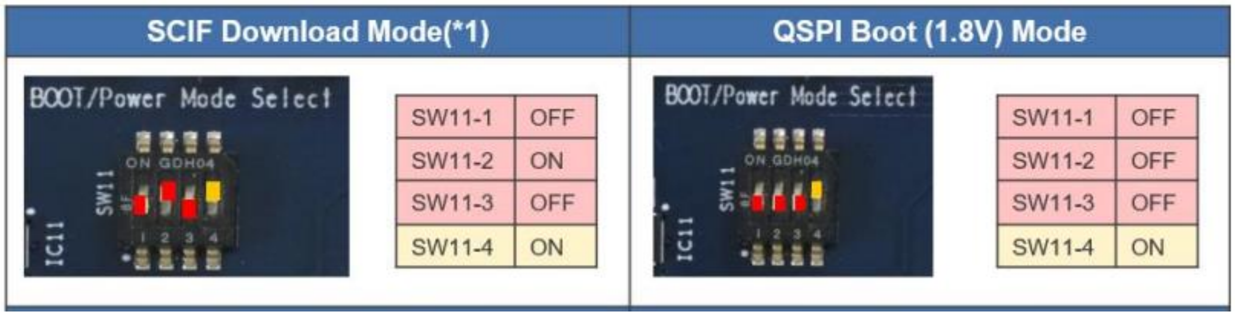
SW1-2	microSD/eMMC selection
OFF	Select eMMC on RTK9744L23C01000BE
ON	Select microSD slot on RTK9744L23C01000BE

Table 2. Mode and Storage Selection

Please set the SW1 switch settings for Normal operation and Micro SD card/slot selection.

3.3.2 SCIF Download Mode

Change switch DP SW12 to set SCIF Download mode and QSPI Boot Mode


BOOT/Power Mode Select
ON GDH04
SW11
IC11
1 2 3 4
BOOT/Power Mode Select
ON GDH04
SW11
IC11
1 2 3 4

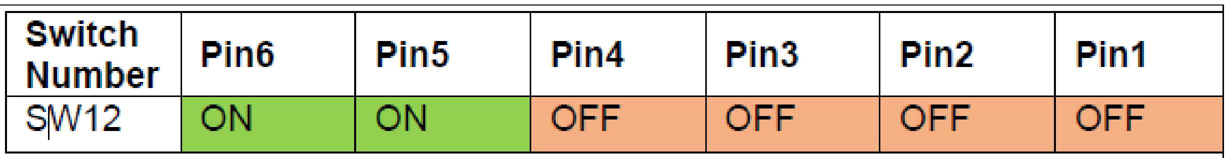
SCIF Download Mode(*1)

SW11-1	OFF
SW11-2	ON
SW11-3	OFF
SW11-4	ON

QSPI Boot (1.8V) Mode

SW11-1	OFF
SW11-2	OFF
SW11-3	OFF
SW11-4	ON

Figure 3. SCIF Download Mode

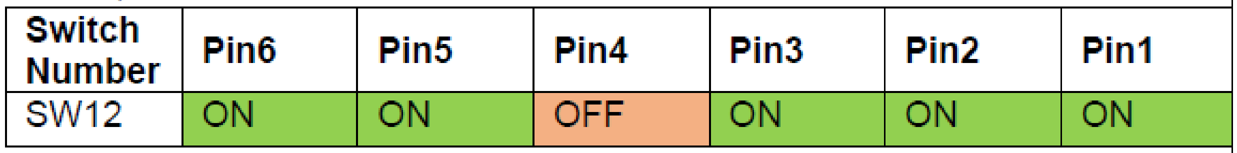


Switch Number	Pin6	Pin5	Pin4	Pin3	Pin2	Pin1
SW12	ON	ON	OFF	OFF	OFF	OFF

Table 3. SW12 Settings - SCIF Download Mode

3.3.3 QSPI Boot Mode

Change switch DP ‘SW12’ switch settings to below for QSPI Boot Mode

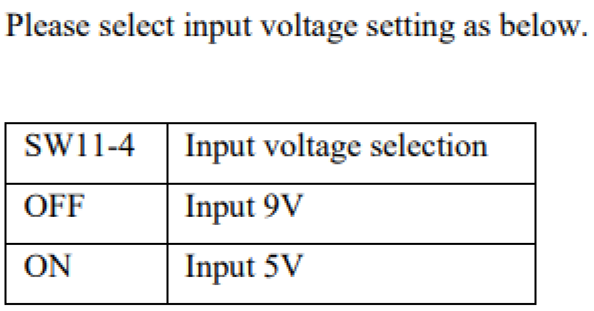


Switch Number	Pin6	Pin5	Pin4	Pin3	Pin2	Pin1
SW12	ON	ON	OFF	ON	ON	ON

Table 4. SW12 Settings – QSPI Boot Mode

3.3.4 Input Power Supply Voltage Selection

Based on the supply voltage connected, set the SW11-4 DP switch accordingly



Please select input voltage setting as below.

SW11-4	Input voltage selection
OFF	Input 9V
ON	Input 5V

Table 5. SW11-4 Settings – Power Supply Selection

3.3.5 PMOD1 Type-6A Selection

Modify the SW3 and SW4 switch settings on RZ/G2L SMARC carrier board to make PMOD1 as Type-6A only for I2C Clock and I2C Data.

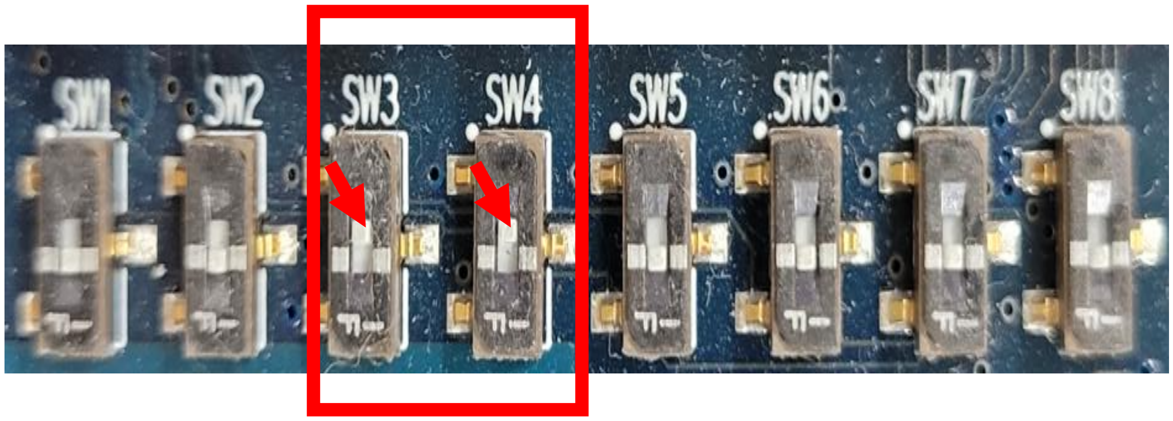


Figure 4. PMOD1 Type-6A Selection

4 Software Build

This chapter describes the details and procedure of building the Qt6 BSP for RZ/G2LSMARC EVK platform. The host build PC requirement is captured in chapter 2: Operating Environment. This chapter also describes the build host PC packages dependencies, fetch the meta layers for Qt6, set up the build environment and configure the build for the RZ/G2L platform.

4.1 Qt6 BSP Build

Download the ***porting-qt-6.2.0-to-rzg2l-master.zip***. from POC release folder. The ***porting-qt-6.2.0-to-rzg2l-master.zip*** includes following

- rzg_bsp_v300.tar.gz: Yocto recipe packages,
- RTK0EF0045Z13001ZJ-v1.0_JP.zip: for enabling GPU,
- RTK0EF0045Z15001ZJ-v0.56_JP.zip: for enabling video codec.

Unzip the ***porting-qt-6.2.0-to-rzg2l-master.zip*** folder and follow the below steps to build Qt6 system binaries/images.

a. Update the system with all host dependent and required packages

```
$ sudo apt-get update
$ sudo apt-get install gawk wget git-core diffstat unzip texinfo gcc-multilib build-essential chrpath socat cpio python python3 python3-pip python3-pexpect xz-utils debianutils iputils-ping libsdl1.2-dev xterm p7zip-full python-is-python3
```

b. Configure the git for user name and eMail

```
$ git config --global user.email "you@example.com"
$ git config --global user.name "Your Name"
```

c. Download the below meta sources from the repos using git command

- meta-qt6
  ```
  $ git clone -b v6.2.0 git://code.qt.io/yocto/meta-qt6.git
  ```
- meta-python2
  ```
  $ git clone -b dunfell https://git.openembedded.org/meta-python2
  ```
- meta-boot2qt
  ```
  $ git clone -b v6.2.0 git://code.qt.io/yocto/meta-boot2qt.git
  $ git am patch/0001-meta-boot2qt-patch.patch
  ```
- meta-mingw
  ```
  $ git clone -b yocto-3.3.4 git://code.qt.io/yocto/meta-mingw.git
  $ git am patch/0001-meta-mingw-yocto-3.3.4.patch
  ```

d. Set up the build environment

```
$ source poky/oe-init-build-env
```

e. Update the configuration file for RZ/G2L SMARC EVK machine

```
$ cp ../meta-renesas/docs/template/conf/smarc-rzg2l/*.conf ./conf/
```

f. Modify build/conf/bblayers.conf file to use meta-qt6 layer.

```
- `QT_LAYER = "${@os.path.isdir("${TOPDIR}/../meta-qt6")}"`
```

```
- `${@'${TOPDIR}/../meta-qt6' if '${QT_LAYER}' == 'True' else ''} \`
```

g. Now build the Qt image

```
$ export DISTRO=poky
$ bitbake core-image-qt
```

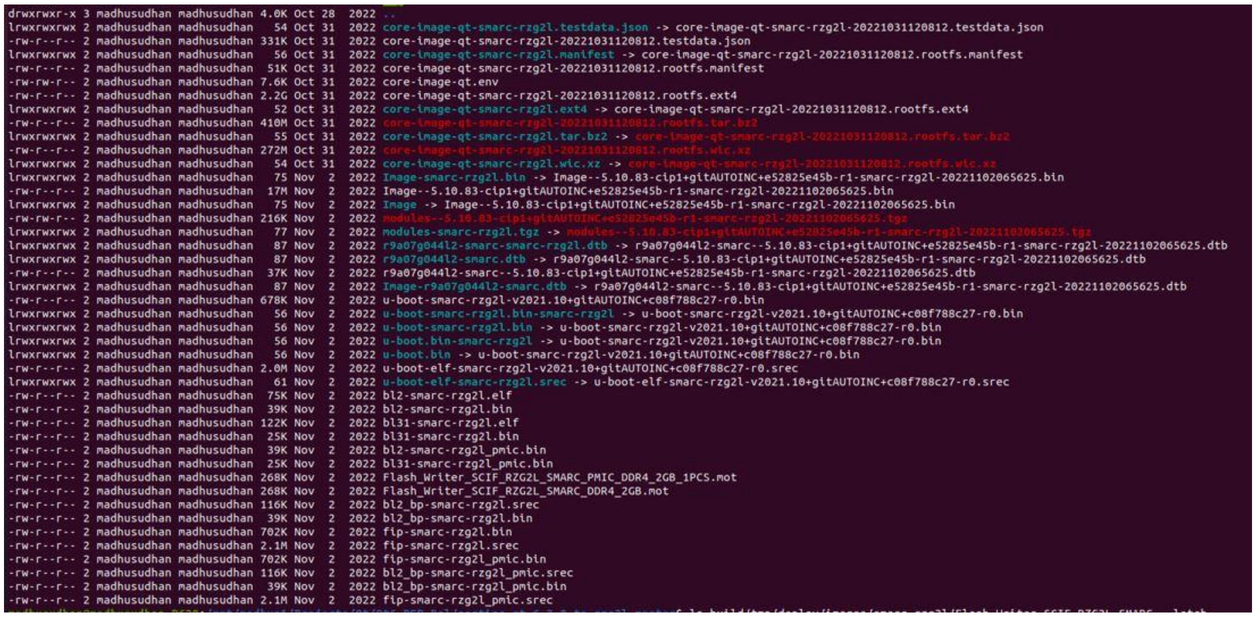
The build artifacts are available in the *build/tmp/deploy/images/smarc-rzg2l* folder location. For future reference in this document this folder location path is mentioned as {BUILD_DIR_OUTPUT}

h. To build and populate software development kit, use below command

```
$ bitbake core-image-qt -c populate_sdk
```

5 Flashing/Programing

The flashing procedure can be initiated with system binaries generated from chapter 4: ‘Software Build’ or use the binary folder (Pre-Built Images) available in POC release folder. An example of system binary folder snapshot is given below for the reference.



```
drwxrwxr-x 3 madhusudhan madhusudhan 4.0K Oct 28  2022 ..
lrwxrwxrwx 2 madhusudhan madhusudhan   54 Oct 31  2022 core-image-qt-smarc-rzg2l.testdata.json -> core-image-qt-smarc-rzg2l-20221031120812.testdata.json
-rw-r--r-- 2 madhusudhan madhusudhan 331K Oct 31  2022 core-image-qt-smarc-rzg2l-20221031120812.testdata.json
lrwxrwxrwx 2 madhusudhan madhusudhan   56 Oct 31  2022 core-image-qt-smarc-rzg2l.manifest -> core-image-qt-smarc-rzg2l-20221031120812.rootfs.manifest
-rw-r--r-- 2 madhusudhan madhusudhan  51K Oct 31  2022 core-image-qt-smarc-rzg2l-20221031120812.rootfs.manifest
-rw-rw-r-- 2 madhusudhan madhusudhan 7.6K Oct 31  2022 core-image-qt.env
-rw-r--r-- 2 madhusudhan madhusudhan 2.2G Oct 31  2022 core-image-qt-smarc-rzg2l-20221031120812.rootfs.ext4
lrwxrwxrwx 2 madhusudhan madhusudhan   52 Oct 31  2022 core-image-qt-smarc-rzg2l.ext4 -> core-image-qt-smarc-rzg2l-20221031120812.rootfs.ext4
-rw-r--r-- 2 madhusudhan madhusudhan 410M Oct 31  2022 core-image-qt-smarc-rzg2l-20221031120812.rootfs.tar.bz2
lrwxrwxrwx 2 madhusudhan madhusudhan   55 Oct 31  2022 core-image-qt-smarc-rzg2l.tar.bz2 -> core-image-qt-smarc-rzg2l-20221031120812.rootfs.tar.bz2
-rw-r--r-- 2 madhusudhan madhusudhan 272M Oct 31  2022 core-image-qt-smarc-rzg2l-20221031120812.rootfs.wic.xz
lrwxrwxrwx 2 madhusudhan madhusudhan   54 Oct 31  2022 core-image-qt-smarc-rzg2l.wic.xz -> core-image-qt-smarc-rzg2l-20221031120812.rootfs.wic.xz
lrwxrwxrwx 2 madhusudhan madhusudhan   75 Nov  2  2022 Image-smarc-rzg2l.bin -> Image--5.10.83-cip1+gitAUTOINC+e52825e45b-r1-smarc-rzg2l-20221102065625.bin
-rw-r--r-- 2 madhusudhan madhusudhan  17M Nov  2  2022 Image--5.10.83-cip1+gitAUTOINC+e52825e45b-r1-smarc-rzg2l-20221102065625.bin
lrwxrwxrwx 2 madhusudhan madhusudhan   75 Nov  2  2022 Image -> Image--5.10.83-cip1+gitAUTOINC+e52825e45b-r1-smarc-rzg2l-20221102065625.bin
-rw-rw-r-- 2 madhusudhan madhusudhan 216K Nov  2  2022 modules--5.10.83-cip1+gitAUTOINC+e52825e45b-r1-smarc-rzg2l-20221102065625.tgz
lrwxrwxrwx 2 madhusudhan madhusudhan   77 Nov  2  2022 modules-smarc-rzg2l.tgz -> modules--5.10.83-cip1+gitAUTOINC+e52825e45b-r1-smarc-rzg2l-20221102065625.tgz
lrwxrwxrwx 2 madhusudhan madhusudhan   87 Nov  2  2022 r9a07g044l2-smarc-smarc-rzg2l.dtb -> r9a07g044l2-smarc--5.10.83-cip1+gitAUTOINC+e52825e45b-r1-smarc-rzg2l-20221102065625.dtb
lrwxrwxrwx 2 madhusudhan madhusudhan   87 Nov  2  2022 r9a07g044l2-smarc.dtb -> r9a07g044l2-smarc--5.10.83-cip1+gitAUTOINC+e52825e45b-r1-smarc-rzg2l-20221102065625.dtb
-rw-r--r-- 2 madhusudhan madhusudhan  37K Nov  2  2022 r9a07g044l2-smarc--5.10.83-cip1+gitAUTOINC+e52825e45b-r1-smarc-rzg2l-20221102065625.dtb
lrwxrwxrwx 2 madhusudhan madhusudhan   87 Nov  2  2022 Image-r9a07g044l2-smarc.dtb -> r9a07g044l2-smarc--5.10.83-cip1+gitAUTOINC+e52825e45b-r1-smarc-rzg2l-20221102065625.dtb
-rw-r--r-- 2 madhusudhan madhusudhan 678K Nov  2  2022 u-boot-smarc-rzg2l-v2021.10+gitAUTOINC+c08f788c27-r0.bin
lrwxrwxrwx 2 madhusudhan madhusudhan   56 Nov  2  2022 u-boot-smarc-rzg2l.bin-smarc-rzg2l -> u-boot-smarc-rzg2l-v2021.10+gitAUTOINC+c08f788c27-r0.bin
lrwxrwxrwx 2 madhusudhan madhusudhan   56 Nov  2  2022 u-boot-smarc-rzg2l.bin -> u-boot-smarc-rzg2l-v2021.10+gitAUTOINC+c08f788c27-r0.bin
lrwxrwxrwx 2 madhusudhan madhusudhan   56 Nov  2  2022 u-boot.bin-smarc-rzg2l -> u-boot-smarc-rzg2l-v2021.10+gitAUTOINC+c08f788c27-r0.bin
lrwxrwxrwx 2 madhusudhan madhusudhan   56 Nov  2  2022 u-boot.bin -> u-boot-smarc-rzg2l-v2021.10+gitAUTOINC+c08f788c27-r0.bin
-rw-r--r-- 2 madhusudhan madhusudhan 2.0M Nov  2  2022 u-boot-elf-smarc-rzg2l-v2021.10+gitAUTOINC+c08f788c27-r0.srec
lrwxrwxrwx 2 madhusudhan madhusudhan   61 Nov  2  2022 u-boot-elf-smarc-rzg2l.srec -> u-boot-elf-smarc-rzg2l-v2021.10+gitAUTOINC+c08f788c27-r0.srec
-rw-r--r-- 2 madhusudhan madhusudhan  75K Nov  2  2022 bl2-smarc-rzg2l.elf
-rw-r--r-- 2 madhusudhan madhusudhan  39K Nov  2  2022 bl2-smarc-rzg2l.bin
-rw-r--r-- 2 madhusudhan madhusudhan 122K Nov  2  2022 bl31-smarc-rzg2l.elf
-rw-r--r-- 2 madhusudhan madhusudhan  25K Nov  2  2022 bl31-smarc-rzg2l.bin
-rw-r--r-- 2 madhusudhan madhusudhan  39K Nov  2  2022 bl2-smarc-rzg2l_pmic.bin
-rw-r--r-- 2 madhusudhan madhusudhan  25K Nov  2  2022 bl31-smarc-rzg2l_pmic.bin
-rw-r--r-- 2 madhusudhan madhusudhan 268K Nov  2  2022 Flash_Writer_SCIF_RZG2L_SMARC_PMIC_DDR4_2GB_1PCS.mot
-rw-r--r-- 2 madhusudhan madhusudhan 268K Nov  2  2022 Flash_Writer_SCIF_RZG2L_SMARC_DDR4_2GB.mot
-rw-r--r-- 2 madhusudhan madhusudhan 116K Nov  2  2022 bl2_bp-smarc-rzg2l.srec
-rw-r--r-- 2 madhusudhan madhusudhan  39K Nov  2  2022 bl2_bp-smarc-rzg2l.bin
-rw-r--r-- 2 madhusudhan madhusudhan 702K Nov  2  2022 fip-smarc-rzg2l.bin
-rw-r--r-- 2 madhusudhan madhusudhan 2.1M Nov  2  2022 fip-smarc-rzg2l.srec
-rw-r--r-- 2 madhusudhan madhusudhan 702K Nov  2  2022 fip-smarc-rzg2l_pmic.bin
-rw-r--r-- 2 madhusudhan madhusudhan 116K Nov  2  2022 bl2_bp-smarc-rzg2l_pmic.srec
-rw-r--r-- 2 madhusudhan madhusudhan  39K Nov  2  2022 bl2_bp-smarc-rzg2l_pmic.bin
-rw-r--r-- 2 madhusudhan madhusudhan 2.1M Nov  2  2022 fip-smarc-rzg2l_pmic.srec
```

Figure 5. System Binaries

Flashing the system binaries with RZ/G2L SMARC EVK involves following two steps

- IPL
- SD Card image.

The programming of SD Card Image includes following

- Windows Partition: Kernel Image and DTB
- Linux Partition: Filesystem (Rootfs)

5.1 Flashing IPL

- Set the SW12 DP switch to put the RZ/G2L MPU in serial download mode. Please refer the section 3.2.1: SCIF Download Mode for SW12 switch settings
- Connect the debug serial port of RZ/G2L SMARC EVK to windows host PC, running tera term terminal application.

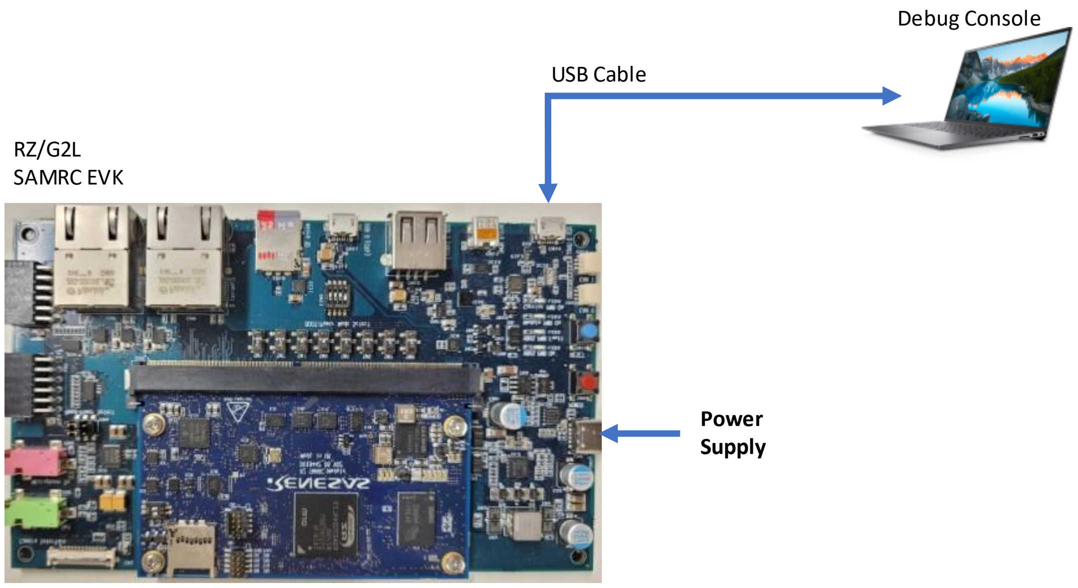
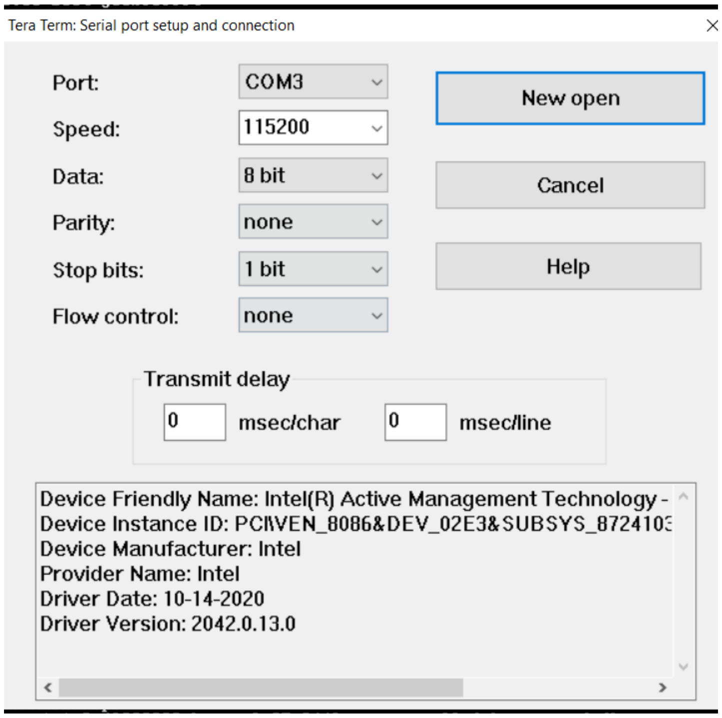


Figure 6. IPL Programming Setup

- Open the Tera term application and configure the serial settings as below



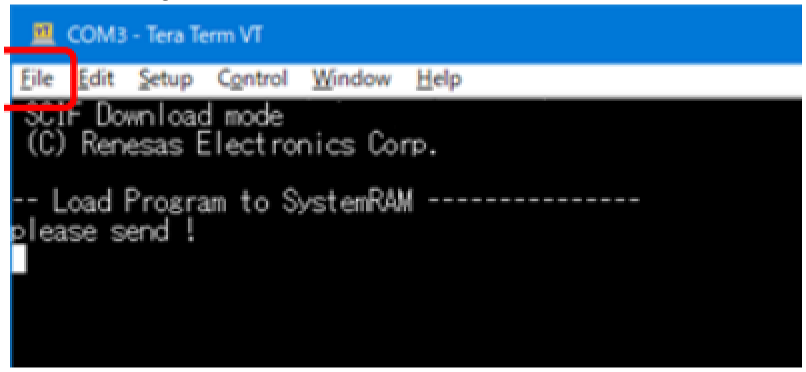
Port: COM3
Speed: 115200
Data: 8 bit
Parity: none
Stop bits: 1 bit
Flow control: none

Transmit delay
0 msec/char 0 msec/line

```
Device Friendly Name: Intel(R) Active Management Technology -
Device Instance ID: PCI\VEN_8086&DEV_02E3&SUBSYS_8724103
Device Manufacturer: Intel
Provider Name: Intel
Driver Date: 10-14-2020
Driver Version: 2042.0.13.0
```

Figure 7. Serial Configuration Settings

- ➢ Power on the system with USB Type-C power adapter. Press “POWER” button followed “RESET” button. The following screen will be displayed on serial console terminal confirming that MPU has gone to serial download mode

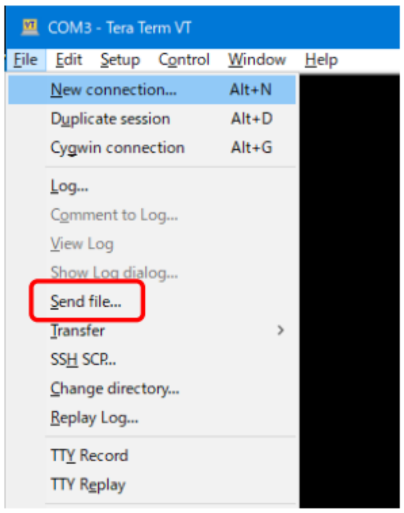


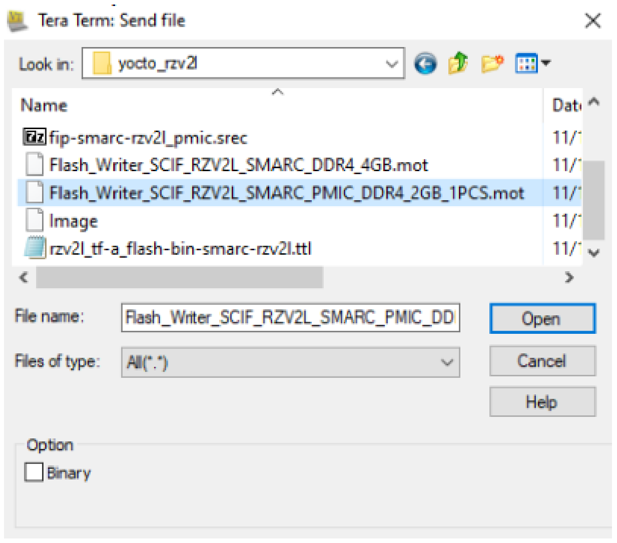
```
SCIF Download mode
(C) Renesas Electronics Corp.

-- Load Program to SystemRAM ---------------
please send !
```

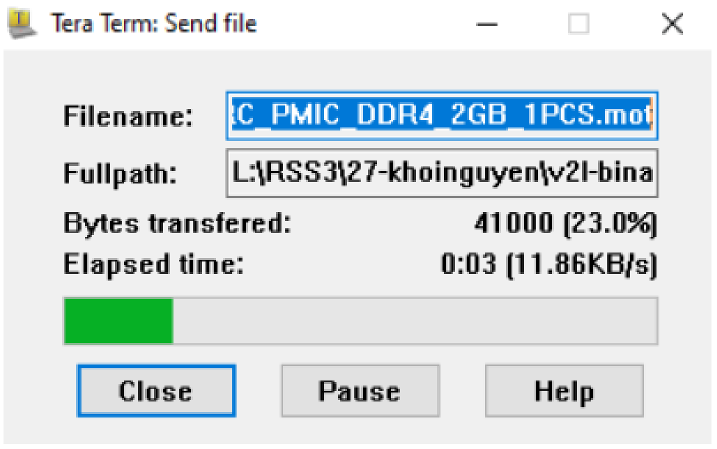
Figure 8. SCIF Download Mode Screen

- ➢ Transfer the Flash writer tool as shown below.

(**File --> Send file --> Flash_Writer_SCIF_RZG2L_SMARC_PMIC_DDR4_2GB_1PCS.mot --> Open**)




Tera Term: Send file
Look in: yocto_rzv2l
Name
Date
fip-smarc-rzv2l_pmic.srec
Flash_Writer_SCIF_RZV2L_SMARC_DDR4_4GB.mot
Flash_Writer_SCIF_RZV2L_SMARC_PMIC_DDR4_2GB_1PCS.mot
Image
rzv2l_tf-a_flash-bin-smarc-rzv2l.ttl
File name: Flash_Writer_SCIF_RZV2L_SMARC_PMIC_DD
Files of type: All(*.*)
Open
Cancel
Help
Option
Binary


Tera Term: Send file

Filename: C_PMIC_DDR4_2GB_1PCS.mot

Fullpath: L:\RSS3\27-khoinguyen\v2l-bina

Bytes transfered: 41000 (23.0%)

Elapsed time: 0:03 (11.86KB/s)

Figure 9. Flash Writer Tool Transfer

- Program the Bootloaders through Flash Writer Tool to SPI Flash. Use ***XLS2*** command to download the bootloaders to respective Flash address and RAM address as shown below

File name	Address to load to RAM	Address to save to ROM
bl2_bp-smarc-rzg2l_pmic.srec	11E00	00000
fip-smarc-rzg2l_pmic.srec	00000	1D200

Table 6. Loaders Load & Program Address

5.2 Qt6 System Binaries

5.2.1 SD Card partition

Create two partitions on Micro SD card. Use ***fdisk*** command on Linux/Ubuntu OS environment for partitioning

- First Partition: FAT32
- Second Partition : Linux

An instance of creating partition log in Micro SD card is shown below for the reference

```
$ sudo fdisk /dev/sdb
Welcome to fdisk (util-linux 2.34).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Command (m for help): o

Created a new DOS disklabel with disk identifier 0x6b6aac6e.

Command (m for help): n
Partition type
      p primary (0 primary, 0 extended, 4 free)
      e extended (container for logical partitions)
Select (default p): p
Partition number (1-4, default 1):
First sector (2048-62333951, default 2048):
Last sector, +/-sectors or +/-size{K,M,G,T,P} (2048-62333951, default
62333951): +500M

Created a new partition 1 of type 'Linux' and of size 500 MiB.
Partition #1 contains a vfat signature.

Do you want to remove the signature? [Y]es/[N]o: Y

The signature will be removed by a write command.

Command (m for help): n
Partition type
      p primary (1 primary, 0 extended, 3 free)
      e extended (container for logical partitions)
Select (default p): p
Partition number (2-4, default 2): (Push the enter key)
First sector (1026048-62333951, default 1026048): (Push the enter key)
Last sector, +/-sectors or +/-size{K,M,G,T,P} (1026048-62333951,
default 62333951): (Push the enter key)

Created a new partition 2 of type 'Linux' and of size 29.2 GiB.

Command (m for help): p
Disk /dev/sdb: 29.74 GiB, 31914983424 bytes, 62333952 sectors
Disk model: Transcend
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
```

```
Disklabel type: dos
Disk identifier: 0x6b6aac6e

Device Boot Start End Sectors Size Id Type
/dev/sdb1 2048 1026047 1024000 500M 83 Linux
/dev/sdb2 1026048 62333951 61307904 29.2G 83 Linux

Filesystem/RAID signature on partition 1 will be wiped.

Command (m for help): t
Partition number (1,2, default 2): 1
Hex code (type L to list all codes): b
Changed type of partition 'Linux' to 'W95 FAT32'.
Command (m for help): w
The partition table has been altered.
      Syncing disks.
```

5.2.2 SD Card Format

- Format the first partition with VFAT filesystem format. The ***mkfs.vfat*** command can be used for this formatting. An instance of using this command is given below for the reference

```
$ sudo mkfs.vfat -v -c -F 32 -n RZ_WIN /dev/sdb1
```

- Format the second partition with ext4 filesystem format. The ***mkfs.ext4*** command can be used for this formatting. An instance of using this command is given below for the reference

```
$ sudo mkfs.ext4 -L RZ_EXT /dev/sdb2
```

5.2.3 SD Card Load/Program

- Load or Program the kernel Image file and Device Tree Blob DTB file to window partition. An instance of copying the file is given below for the reference

```
$cd ${BUILD_DIR_OUTPUT}
$ cp -arL Image r9a07g044l2-smarc.dtb /media/user/RZ_WIN/
$ sync
```

- Load or Program the kernel Image file and Device Tree Blob DTB file to window partition. An instance of copying the file is given below for the reference

```
$cd /media/user/RZ_EXT
$sudo tar -xvjf ${BUILD_DIR_OUTPUT}/core-image-qt-smarc-rzg2l.tar.bz2
$ sync
```

- Copy the Qt Application (***SHD_03***) in /home/root folder location. Please refer section 7.1: Qt Application, for building the Qt application.
- Service for auto launch on power up (Need super user - permission)
  - Create a file ***home_auto.service*** in ***/etc/systemd/system/*** folder location of SD card with below file content. (Note: Change file attributes ***chmod a+x home_auto.service***)

```
[Unit]

Description=Service to launch Home Automation QT Application
After=weston@root.service multi-user.target
 [Service]
WorkingDirectory=/home/root/
Environment=QT_WAYLAND_DISABLE_WINDOWDECORATION=1
Environment=QT_GSTREAMER_CAMERABIN_VIDEOSRC="rzg2l_csi2"
Environment=DISPLAY=":0"
Environment=QT_GSTREAMER_CAMERABIN_VIDEOSRC_DEVICE="/dev/video0"
Environment=QT_QPA_PLATFORM=wayland

ExecStart=/home/root/launch_qt.sh
Restart=always
RestartSec=3

 [Install]
WantedBy=multi-user.target
```

- Create ***launch_qt.sh*** script file ***/home/root/*** folder location. (Note: Change file attributes ***chmod a+x launch_qt.sh***)

```
#!/bin/bash
QT_WAYLAND_DISABLE_WINDOWDECORATION=1
media-ctl -d /dev/media0 -r
media-ctl -d /dev/media0 -l "'rzg2l_csi2 10830400.csi2':1 -> 'CRU output':0 [1]"
media-ctl -d /dev/media0 -V "'rzg2l_csi2 10830400.csi2':1 [fmt:UYVY8_2X8/1920x1080 field:none]"
media-ctl -d /dev/media0 -V "'ov5645 0-003c':0 [fmt:UYVY8_2X8/1920x1080 field:none]"
export QT_GSTREAMER_CAMERABIN_VIDEOSRC="rzg2l_csi2"
export DISPLAY=":0"
export QT_GSTREAMER_CAMERABIN_VIDEOSRC_DEVICE="/dev/video0"

export XDG_RUNTIME_DIR=/run/user/0
export QT_QPA_PLATFORM=wayland

./SHD_03
```

- Remove weston tool bar in the main panel
  Add following highlighted lines in ***weston.ini*** file located in ***/etc/xdg/weston/*** folder location of SD card

```
[core]
idle-time=0
require-input=false
repaint-window=17

[shell]
panel-position=none
```

- Un-mount the SD card using below command

```
$ sync
$ umount /media/user/RZ_*
```

- To enable the home_auto.service service to run on every power on/reset and launch QT Application, use below command. (Execute the this command only once on first time execution. For subsequent power on cycle this is not required)

```
$systemctl enable home_auto
```

6 Boot

- Insert Micro SD Card with system binaries loaded to SD slot in carrier board. (Please refer chapter 5, for Flashing/Programming)
- Connect the accessories to RZ/G2L SMARC EVK. Accessories comprise of HDMI display, Touch, Camera, Temperature Sensor and Power Supply. Please refer section 3.2, for connection Setup.
- Configure the switch setting to QSPI Boot Mode. Please refer section 3.3.3 for details
- Please refer section 3.3.5 for PMOD1 Type-6A selection
- Please refer to Figure 7: Serial port configuration settings of Tera term application
- Power on the system using USB Type-3 adaptor.
- Please interrupt the booting process in bootloader to U-Boot prompt and avoid further booting process. Please make sure the environmental variable is set as follows to load from micro SD.

```
=> setenv sd_boot1 'mmc dev 1 ; fatload mmc 1:1 0x48080000 Image ; fatload mmc 1:1
0x48000000 /Image-r9a07g044l2-smarc.dtb'

=> setenv sd_boot2 'setenv bootargs 'root=/dev/mmcblk1p2 rootwait' ; booti 0x48080000
- 0x48000000'

=> setenv bootcmd 'run sd_boot1 sd_boot2'

=> saveenv

 Saving Environment to MMC... Writing to MMC(0)….OK
```

Figure 10. U-Boot Env Settings

- Please make sure the MMC device is set to Micro SD and not eMMC. Also kernel image and DTB file names are intact with that of SD Card storage device
- Power On/Off or Reset the system to execute Qt home automation application automatically.

7 Qt Application

The Qt application is developed using Qt creator tool. The application is designed using Qt widgets. This chapter describes the UI screens, configuration settings, graphical plots, peripheral sensor data collection and application logic implemented. The Qt application is auto launched on system power-on. The method and procedure for auto launch is explained in chapter 6, Boot.

7.1 Qt Application Build

7.1.1 Qt6 SDK

a. Extract/Install the Software Development Kit -SDK to the preferred location

```
$ ./poky-glibc-x86_64-core-image-qt-aarch64-smarc-rzg2l-toolchain-3.1.14.sh
```

For instance, ***/opt/poky/latestqt6*** can be considered

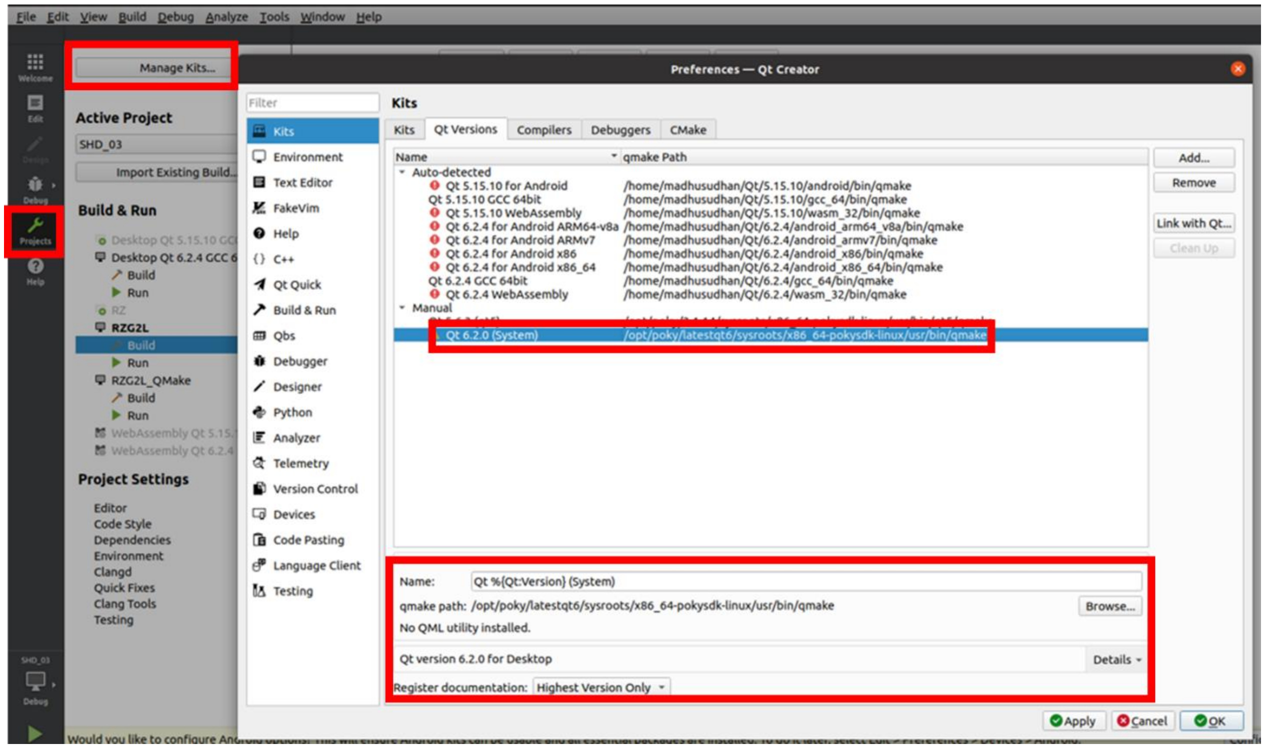
7.1.2 Qt Creator

Setup and configure Qt Creator to build for RZ/G2L platform

a. Tools -> Kits -> Qt Versions -> Add
   - Add Qt included in the SDK

     (e.g***. /opt/poky/latestqt6/sysroots/x86_64-pokysdk-linux/usr/bin/qmake***)

     An instance is shown in below figure for the reference



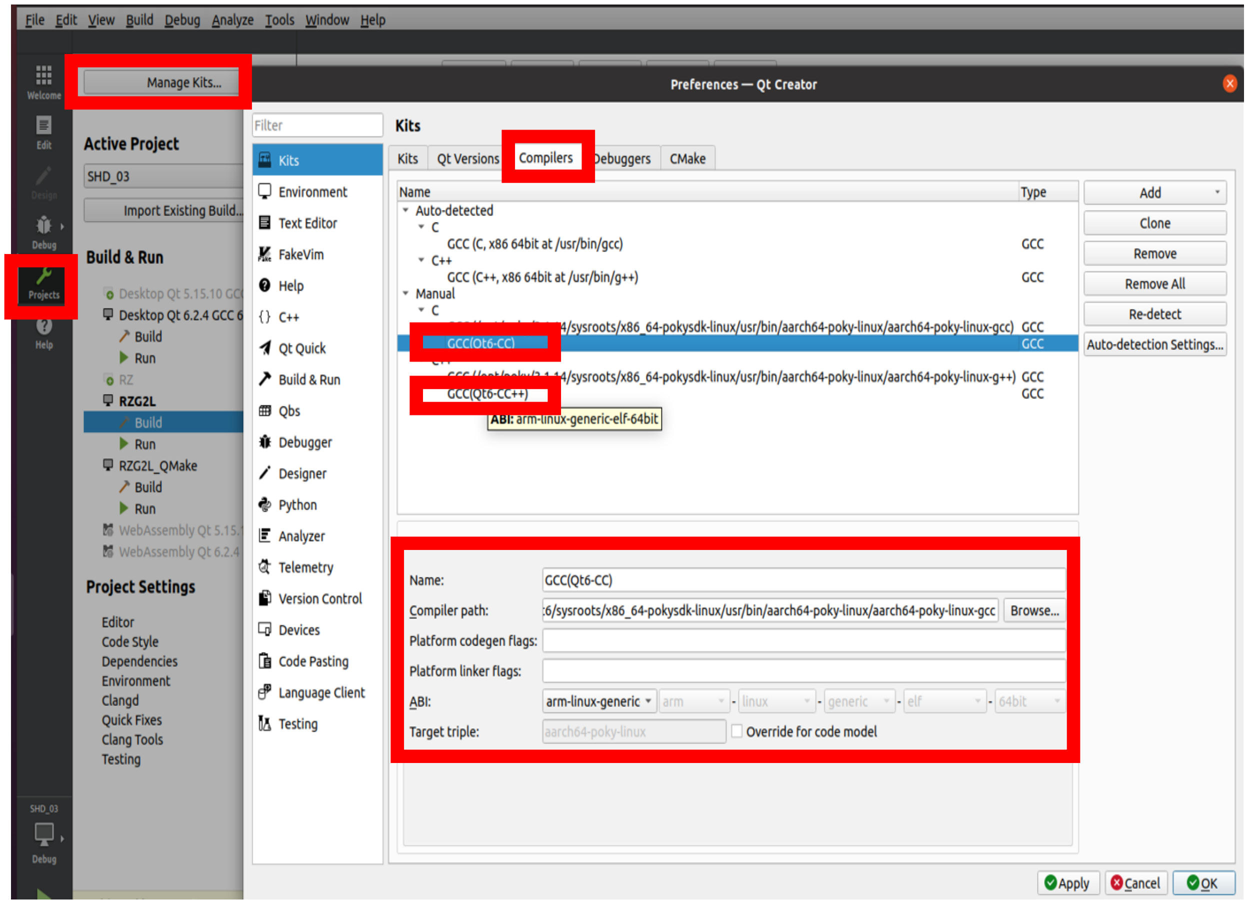
Name	qmake Path
Auto-detected	
Qt 5.15.10 for Android	/home/madhusudhan/Qt/5.15.10/android/bin/qmake
Qt 5.15.10 GCC 64bit	/home/madhusudhan/Qt/5.15.10/gcc_64/bin/qmake
Qt 5.15.10 WebAssembly	/home/madhusudhan/Qt/5.15.10/wasm_32/bin/qmake
Qt 6.2.4 for Android ARM64-v8a	/home/madhusudhan/Qt/6.2.4/android_arm64_v8a/bin/qmake
Qt 6.2.4 for Android ARMv7	/home/madhusudhan/Qt/6.2.4/android_armv7/bin/qmake
Qt 6.2.4 for Android x86	/home/madhusudhan/Qt/6.2.4/android_x86/bin/qmake
Qt 6.2.4 for Android x86_64	/home/madhusudhan/Qt/6.2.4/android_x86_64/bin/qmake
Qt 6.2.4 GCC 64bit	/home/madhusudhan/Qt/6.2.4/gcc_64/bin/qmake
Qt 6.2.4 WebAssembly	/home/madhusudhan/Qt/6.2.4/wasm_32/bin/qmake
Manual	
Qt 6.2.0 (System)	/opt/poky/latestqt6/sysroots/x86_64-pokysdk-linux/usr/bin/qmake

Name: Qt %{Qt:Version} (System)
qmake path: /opt/poky/latestqt6/sysroots/x86_64-pokysdk-linux/usr/bin/qmake
No QML utility installed.
Qt version 6.2.0 for Desktop
Register documentation: Highest Version Only

Figure 11. Qt Creator – Qt Version

b. Tools -> Kits -> Compilers -> Add
- Add gcc & g++ in the SDK
  - **gcc**: /pot/poky/latestqt6 /sysroots/x86_64-pokysdk-linux/usr/bin/aarch64-poky-linux/aarch64-poky-linux-gcc
  - **g++**: /pot/poky/latestqt6/sysroots/x86_64-pokysdk-linux/usr/bin/aarch64-poky-linux/aarch64-poky-linux-g++

An instance is shown in below figure for the reference



Name	Type
Auto-detected	
C	
GCC (C, x86 64bit at /usr/bin/gcc)	GCC
C++	
GCC (C++, x86 64bit at /usr/bin/g++)	GCC
Manual	
C	
…4/sysroots/x86_64-pokysdk-linux/usr/bin/aarch64-poky-linux/aarch64-poky-linux-gcc)	GCC
GCC(Qt6-CC)	GCC
GCC (/opt/poky/3.1.14/sysroots/x86_64-pokysdk-linux/usr/bin/aarch64-poky-linux/aarch64-poky-linux-g++)	GCC
GCC(Qt6-CC++)	GCC

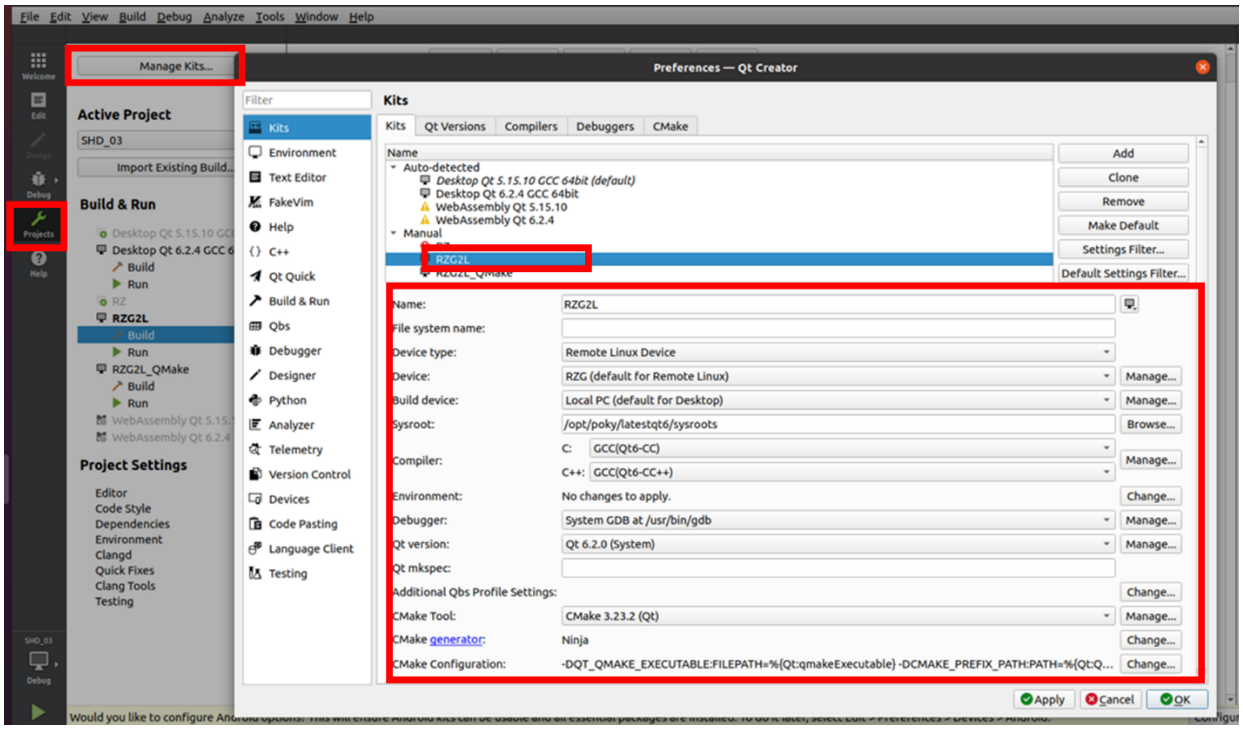
ABI: arm-linux-generic-elf-64bit

Name:	GCC(Qt6-CC)
Compiler path:	:6/sysroots/x86_64-pokysdk-linux/usr/bin/aarch64-poky-linux/aarch64-poky-linux-gcc
Platform codegen flags:	
Platform linker flags:	
ABI:	arm-linux-generic arm - linux - generic - elf - 64bit
Target triple:	aarch64-poky-linux ☐ Override for code model

Figure 12. Qt Creator – Compiler

c. Toos -> Kits -> Add
- Device type: Remote Linux Device
- Sysroot: /opt/poky/latestqt6/sysroots
- Compiler: The added compilers in step b
- Qt version: The added Qt in step b

An instance is shown in below figure for the reference



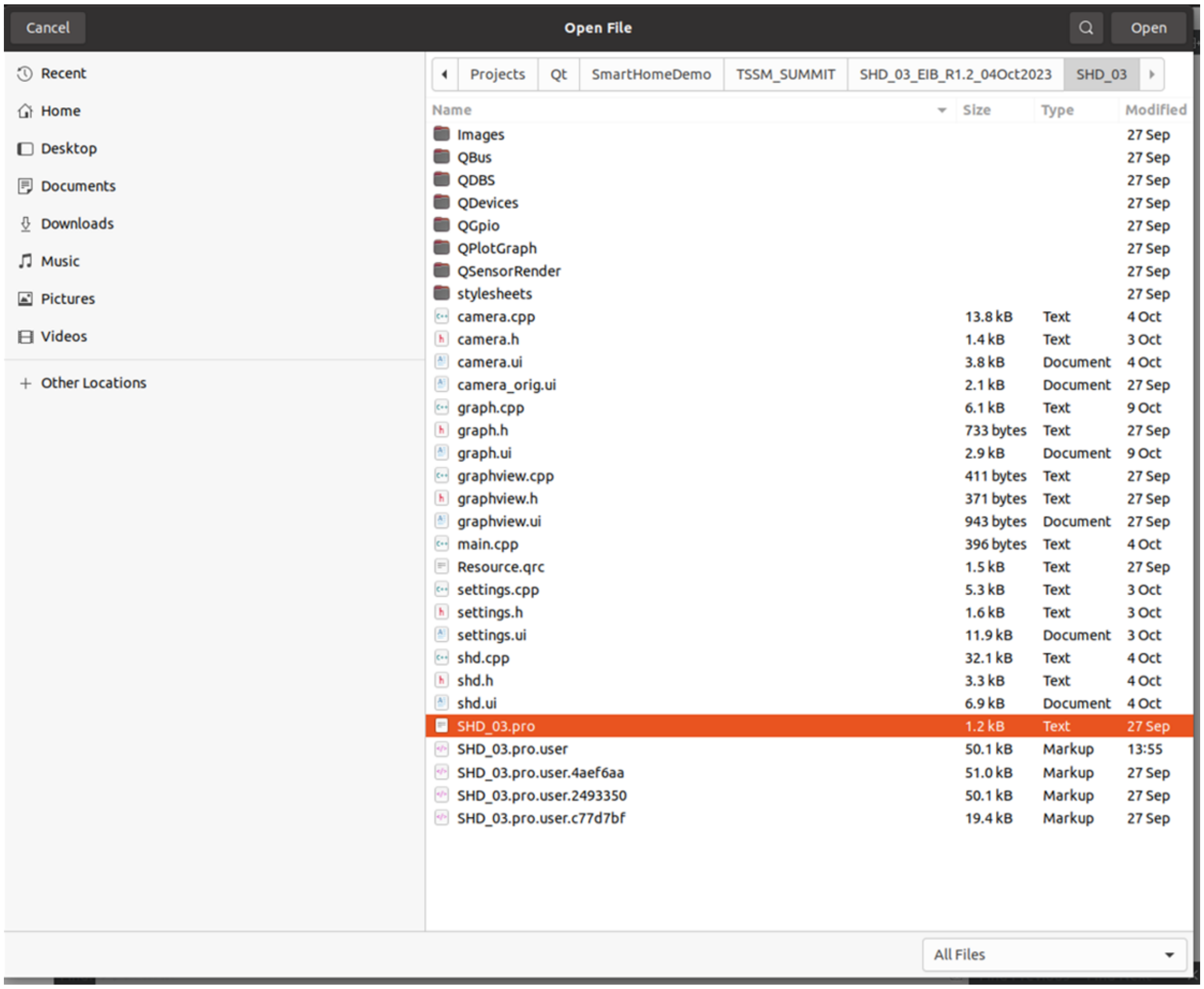
Name
- Auto-detected
  - Desktop Qt 5.15.10 GCC 64bit (default)
  - Desktop Qt 6.2.4 GCC 64bit
  - WebAssembly Qt 5.15.10
  - WebAssembly Qt 6.2.4
- Manual
  - RZG2L

Name:	RZG2L
File system name:	
Device type:	Remote Linux Device
Device:	RZG (default for Remote Linux)
Build device:	Local PC (default for Desktop)
Sysroot:	/opt/poky/latestqt6/sysroots
Compiler:	C: GCC(Qt6-CC) C++: GCC(Qt6-CC++)
Environment:	No changes to apply.
Debugger:	System GDB at /usr/bin/gdb
Qt version:	Qt 6.2.0 (System)
Qt mkspec:	
Additional Qbs Profile Settings:	
CMake Tool:	CMake 3.23.2 (Qt)
CMake generator:	Ninja
CMake Configuration:	-DQT_QMAKE_EXECUTABLE:FILEPATH=%{Qt:qmakeExecutable} -DCMAKE_PREFIX_PATH:PATH=%{Qt:Q...

Figure 13. Qt Creator – Kits

7.1.3 Open the project and build the application.

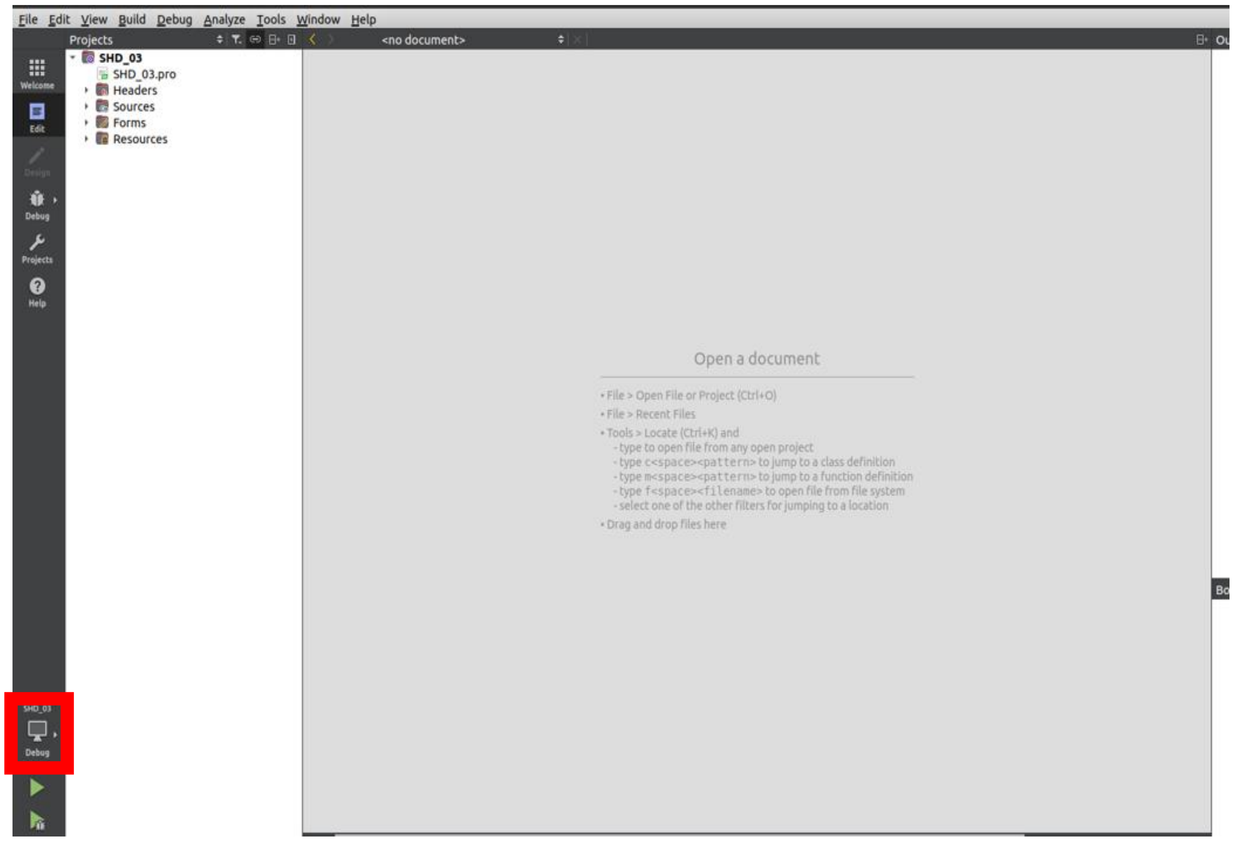
Configure the Qt creator as described in section 7.1.2. Open the project File -> Open File or Project (^O). An instance is shown below figure for the reference



Name	Size	Type	Modified
Images			27 Sep
QBus			27 Sep
QDBS			27 Sep
QDevices			27 Sep
QGpio			27 Sep
QPlotGraph			27 Sep
QSensorRender			27 Sep
stylesheets			27 Sep
camera.cpp	13.8 kB	Text	4 Oct
camera.h	1.4 kB	Text	3 Oct
camera.ui	3.8 kB	Document	4 Oct
camera_orig.ui	2.1 kB	Document	27 Sep
graph.cpp	6.1 kB	Text	9 Oct
graph.h	733 bytes	Text	27 Sep
graph.ui	2.9 kB	Document	9 Oct
graphview.cpp	411 bytes	Text	27 Sep
graphview.h	371 bytes	Text	27 Sep
graphview.ui	943 bytes	Document	27 Sep
main.cpp	396 bytes	Text	4 Oct
Resource.qrc	1.5 kB	Text	27 Sep
settings.cpp	5.3 kB	Text	3 Oct
settings.h	1.6 kB	Text	3 Oct
settings.ui	11.9 kB	Document	3 Oct
shd.cpp	32.1 kB	Text	4 Oct
shd.h	3.3 kB	Text	4 Oct
shd.ui	6.9 kB	Document	4 Oct
SHD_03.pro	1.2 kB	Text	27 Sep
SHD_03.pro.user	50.1 kB	Markup	13:55
SHD_03.pro.user.4aef6aa	51.0 kB	Markup	27 Sep
SHD_03.pro.user.2493350	50.1 kB	Markup	27 Sep
SHD_03.pro.user.c77d7bf	19.4 kB	Markup	27 Sep

Figure 14. Qt Creator – Open Project

Compile the project by clicking the build button as shown in the below figure. Copy the Qt application in SD Card as explained in the section 5.2.3, SD Card Load/Program.



Open a document

- File > Open File or Project (Ctrl+O)
- File > Recent Files
- Tools > Locate (Ctrl+K) and
  - type to open file from any open project
  - type c<space><pattern> to jump to a class definition
  - type m<space><pattern> to jump to a function definition
  - type f<space><filename> to open file from file system
  - select one of the other filters for jumping to a location
- Drag and drop files here

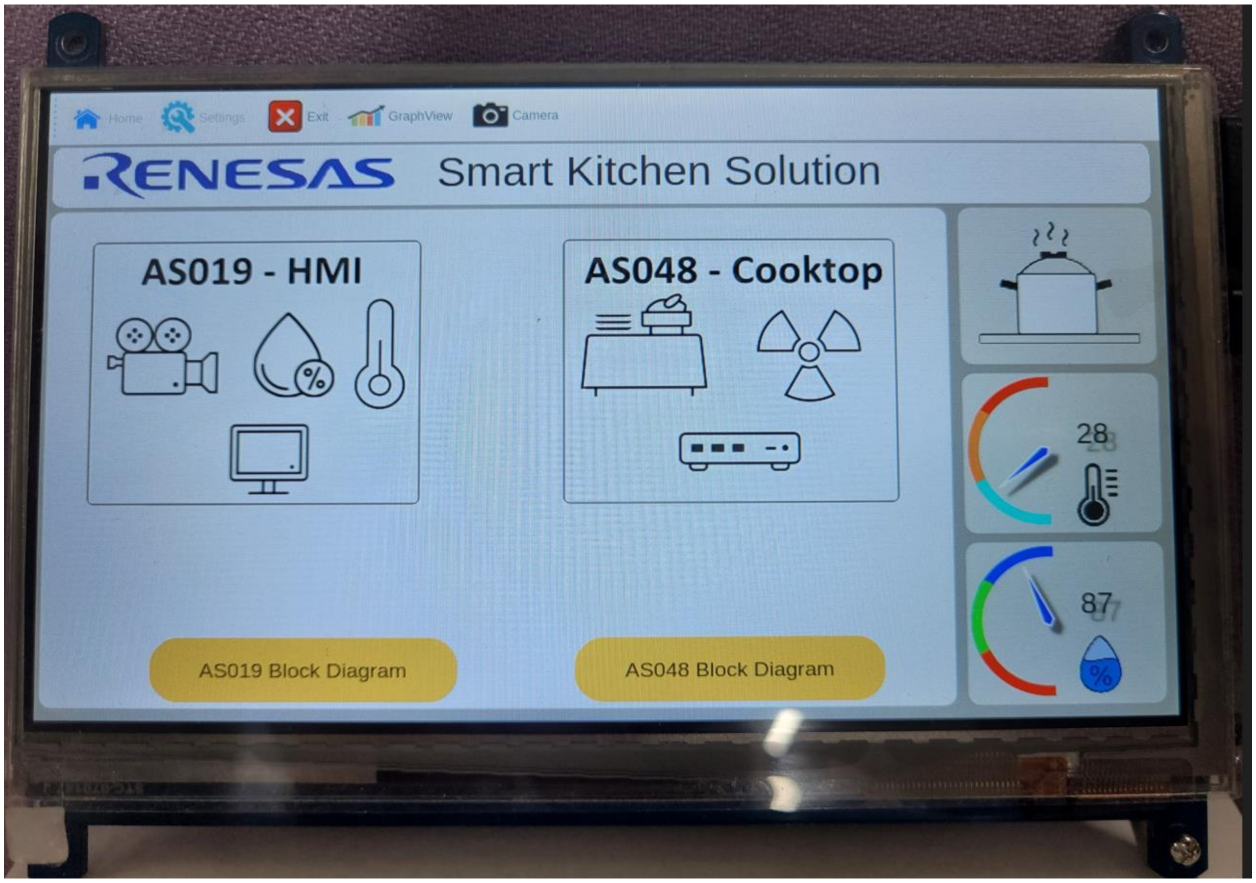
Figure 15. Qt Creator – Build

7.2 UI Screens

This section explains the various GUI screens in the Qt application and its usage

7.2.1 Home Screen

When Qt application is loaded and executed, when system is powered on, below screen appears. This is the home screen.



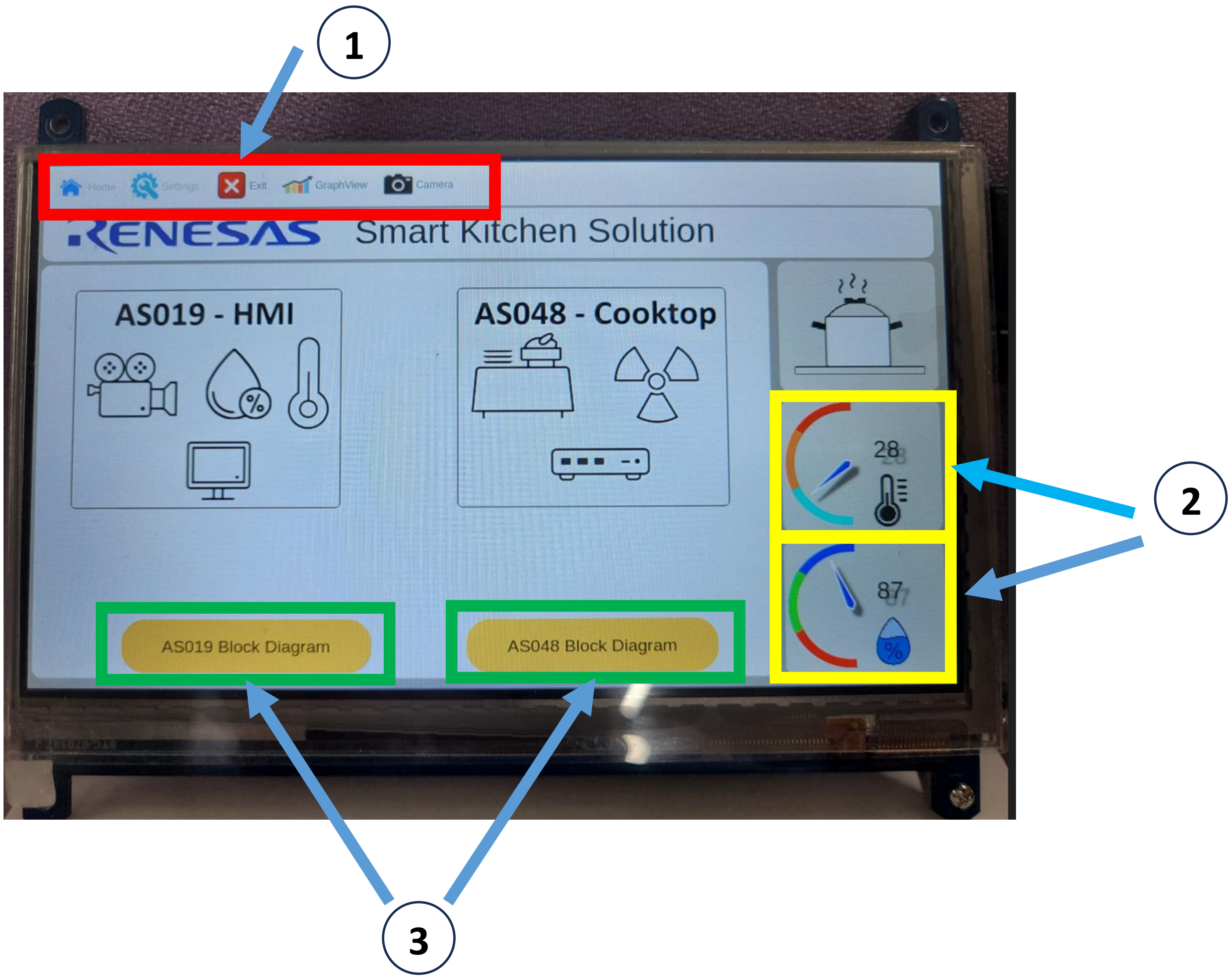


Figure 16. Home Screen

1. The menu tool bar is in the top left corner highlighted in red color.
    a. Clicking home icon will navigate to home screen
    b. Clicking setting icon will navigate to setting screen, please refer section 7.1.2
    c. Clicking graphical icon will navigate to graphical screen, please refer section 7.1.3
    d. Clicking camera icon will navigate to camera screen, please refer section 7.1.4
    e. Clicking exit icon will close Qt application.

2. The live sensor data appears in bottom left corner of the home screen, highlighted in yellow color.

3. Navigation to AS048INDCKTP-D-POCZ and AS019PMODEXP-POCZ system block diagram is highlighted in green color at the bottom of the home screen.
   a. Clicking “**AS048 Block Diagram**” button will navigate to AS048INDCKTP-D-POCZ system diagram, as below

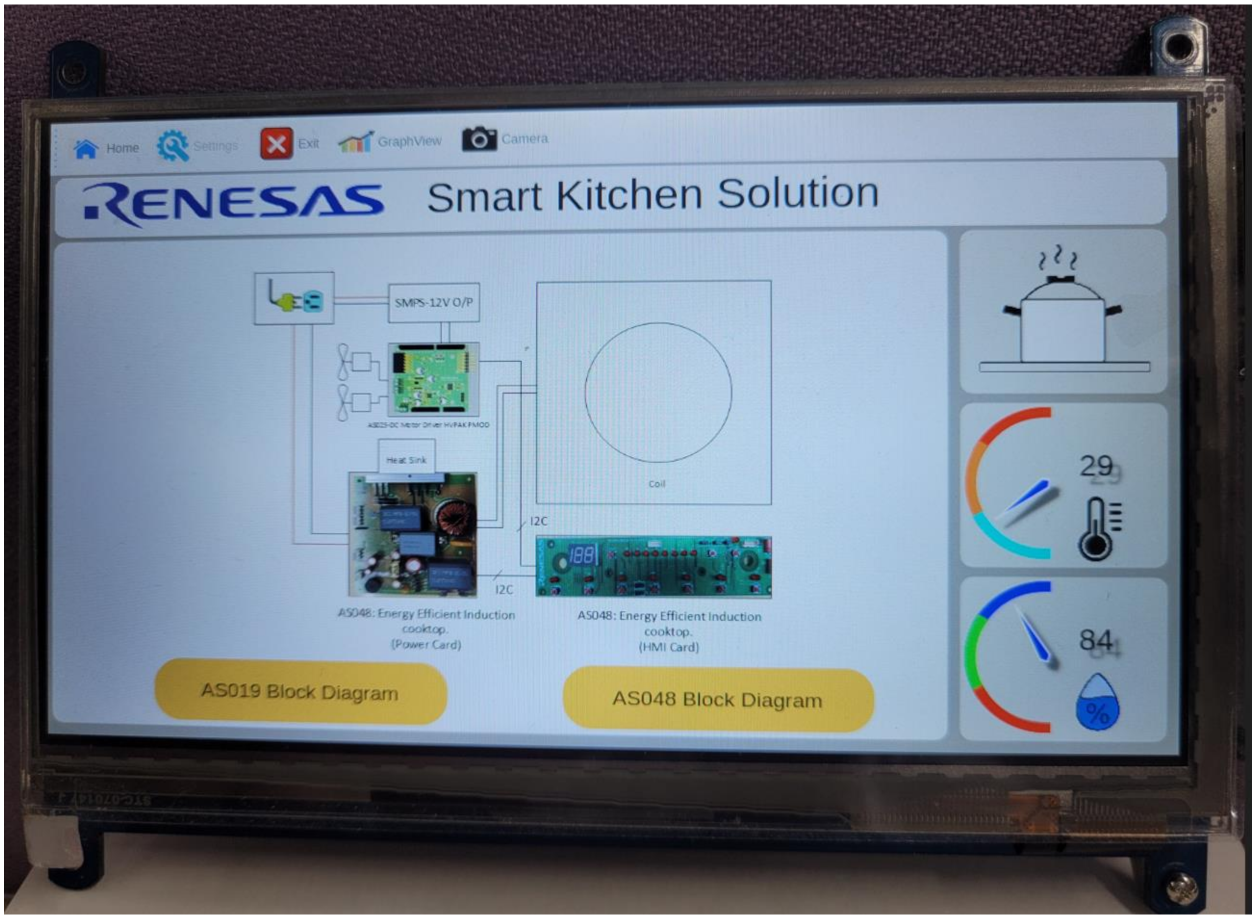

Home
Settings
Exit
GraphView
Camera
RENESAS Smart Kitchen Solution
SMPS-12V O/P
Heat Sink
Coil
I2C
I2C
AS048: Energy Efficient Induction cooktop. (Power Card)
AS048: Energy Efficient Induction cooktop. (HMI Card)
AS019 Block Diagram
AS048 Block Diagram
29
84
%

Figure 17. AS048INDCKTP-D-POCZ Block Diagram

   b. Clicking “**AS019 Block Diagram**” button will navigate to AS019PMODEXP-POCZ system diagram, as below

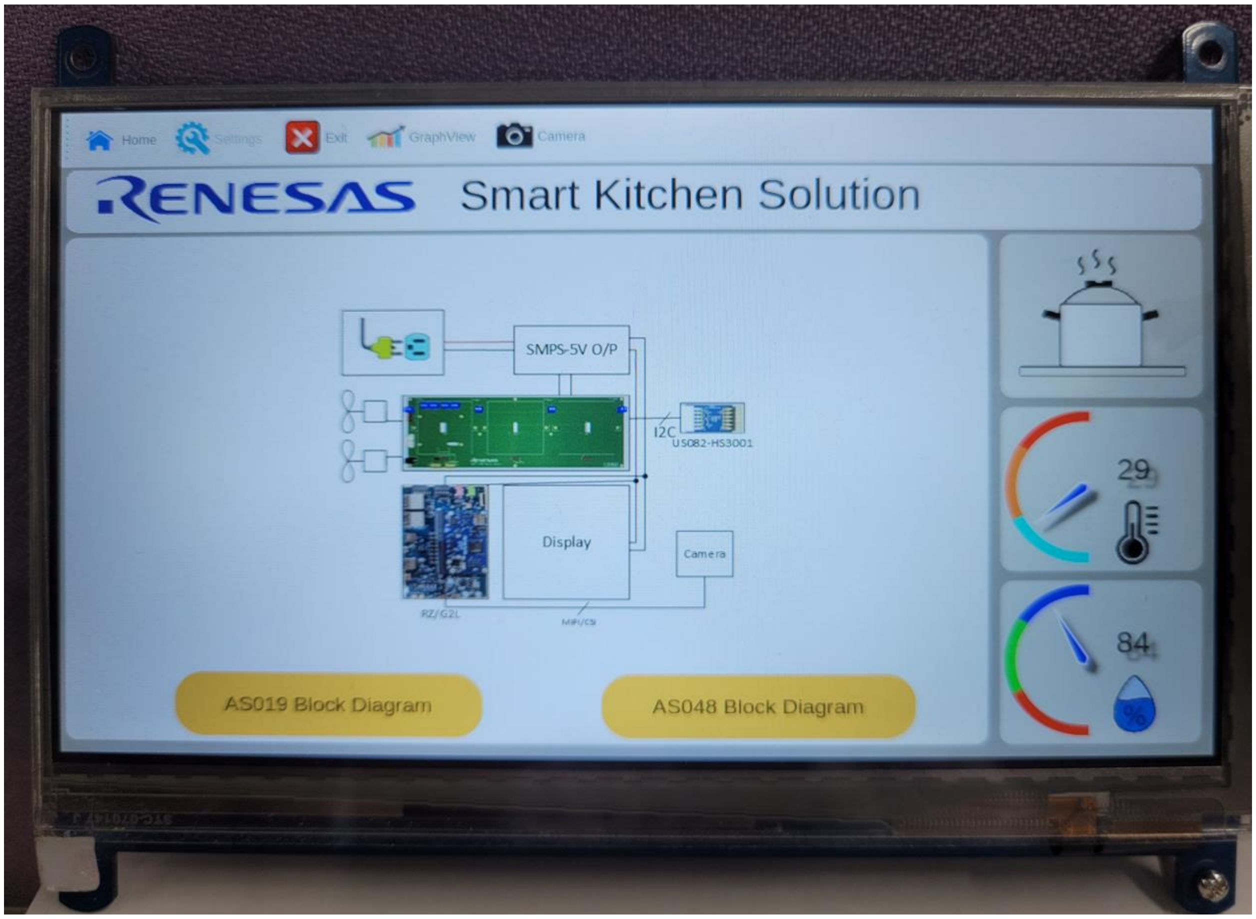
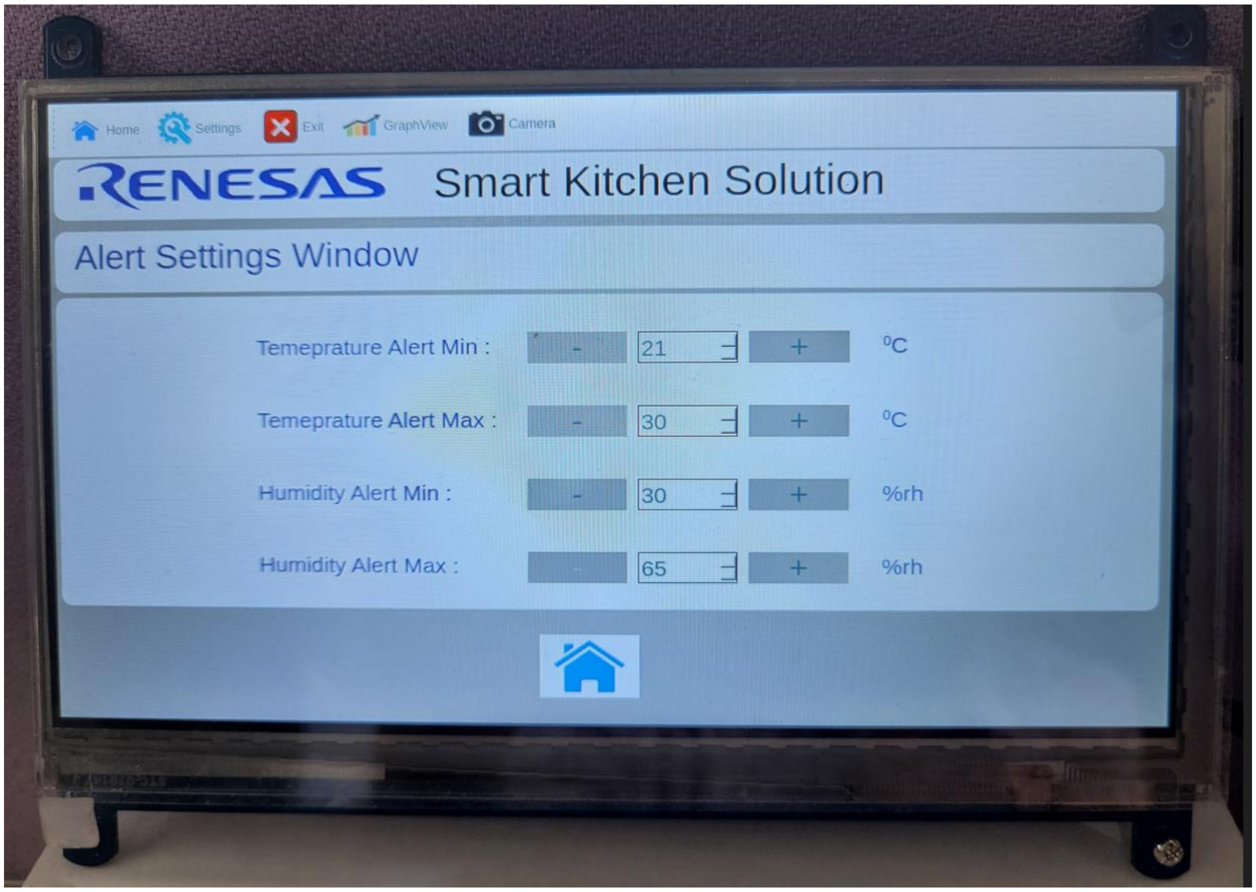


Figure 18. AS019PMODEXP-POCZ Block Diagram

7.2.2 Settings Screen



Temeprature Alert Min :	-	21	+	0C
Temeprature Alert Max :	-	30	+	0C
Humidity Alert Min :	-	30	+	%rh
Humidity Alert Max :	-	65	+	%rh

Figure 19. Settings Screen

Th screen in the figure 14, allows you to set the maximum and minimum settings for temperature and humidity, which will trigger the alarm/alert event logic to execute.

- On clicking **"+"** button will increase the corresponding parameter value by one
- On clicking **"-"** button will decrease the corresponding parameter value by one

Clicking on the home button will navigate to home screen.

7.2.3 Graphical Screen

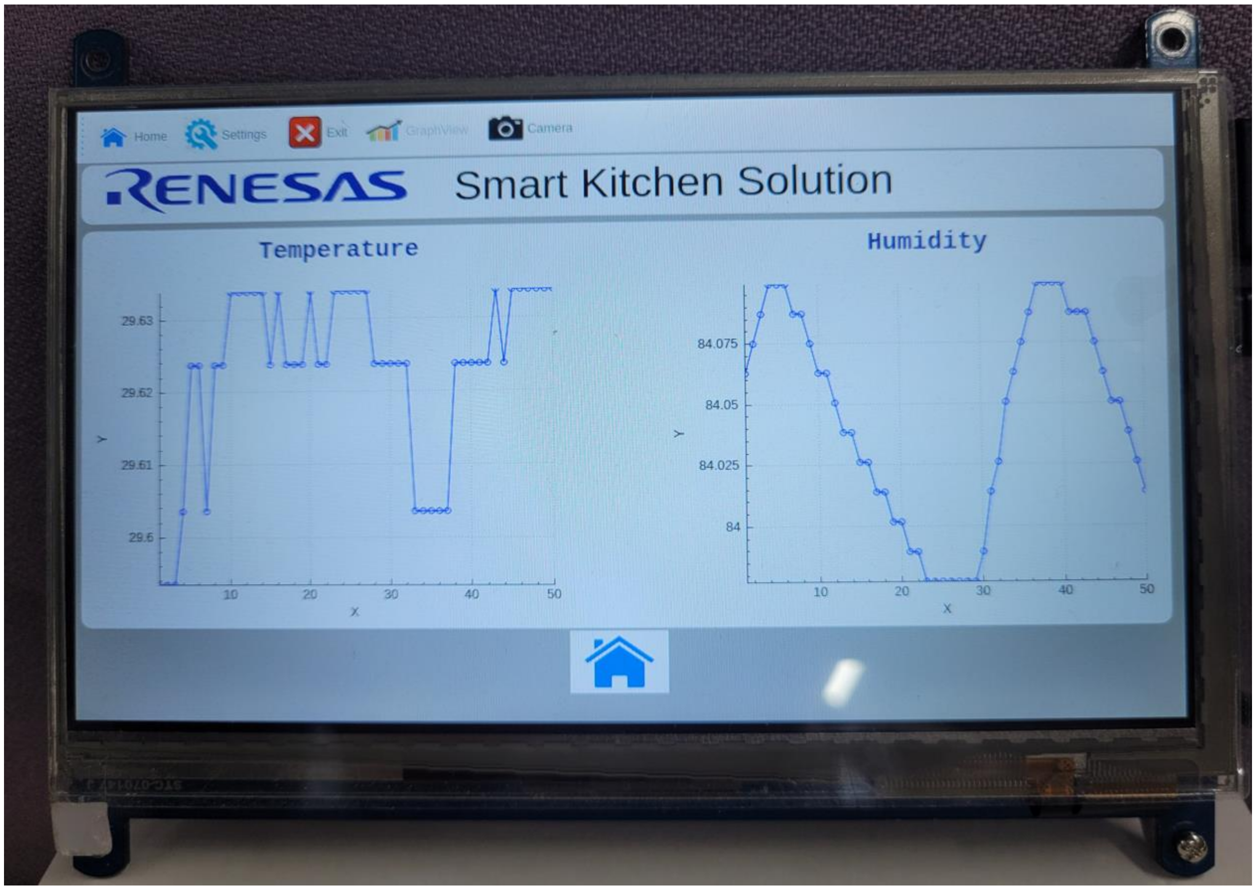


Figure 20. Graphical View Screen

The screen in figure 15, will plot the latest live sensor data on y-axis and sample numbers on x-axis. The temperature plot is on the left side of the screen, The humidity plot on right side of the screen.

Clicking on the home button in the graphical screen will navigate to home screen.

7.2.4 Alarm/Alert Screen

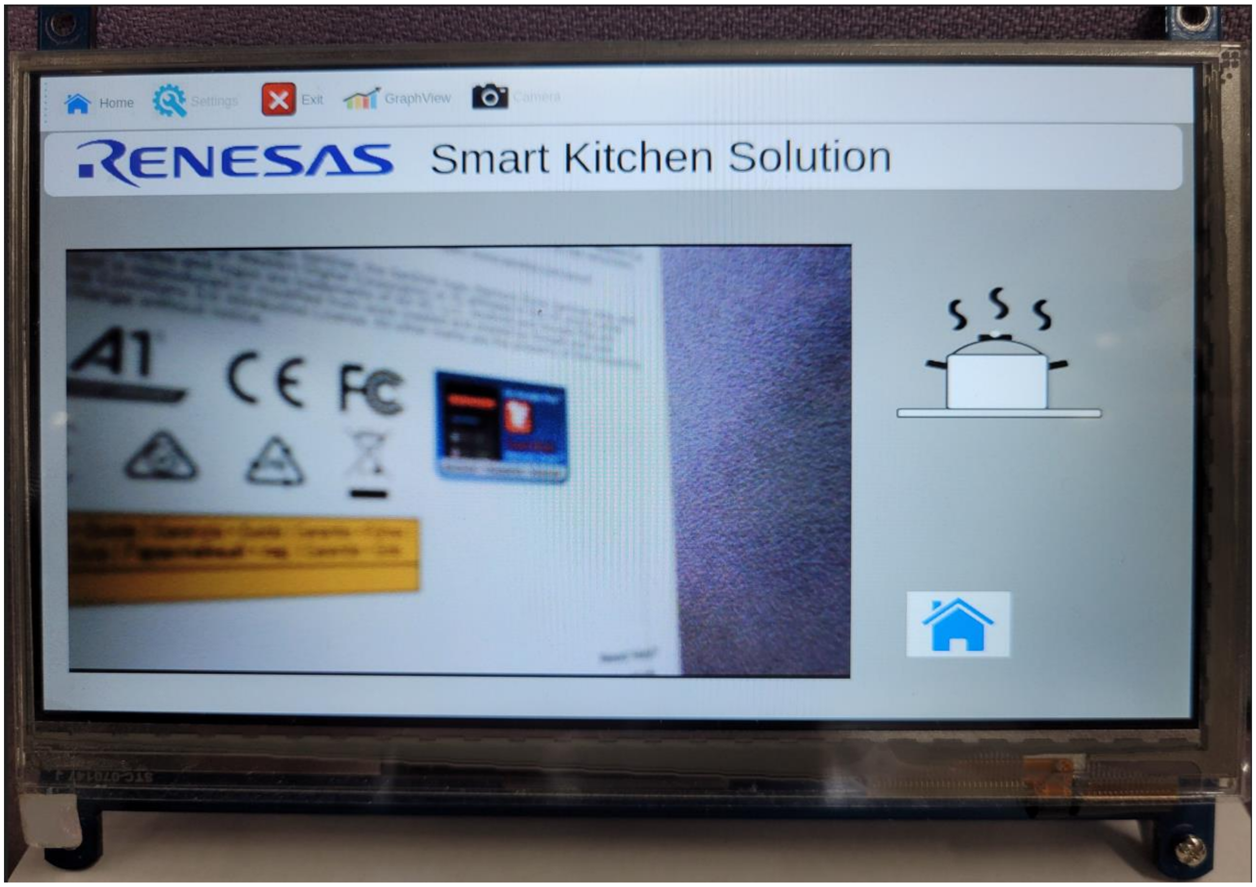


Figure 21. Alert Screen – Normal Condition

The screen in Figure 16, will appear when the alarm/alert icon is clicked in the menu tool bar. The normal cooking image will be displayed on right top corner of the screen. The camera live streaming data will appear on the left side of the screen.

Clicking on the home button in the Alert screen will navigate to home screen.

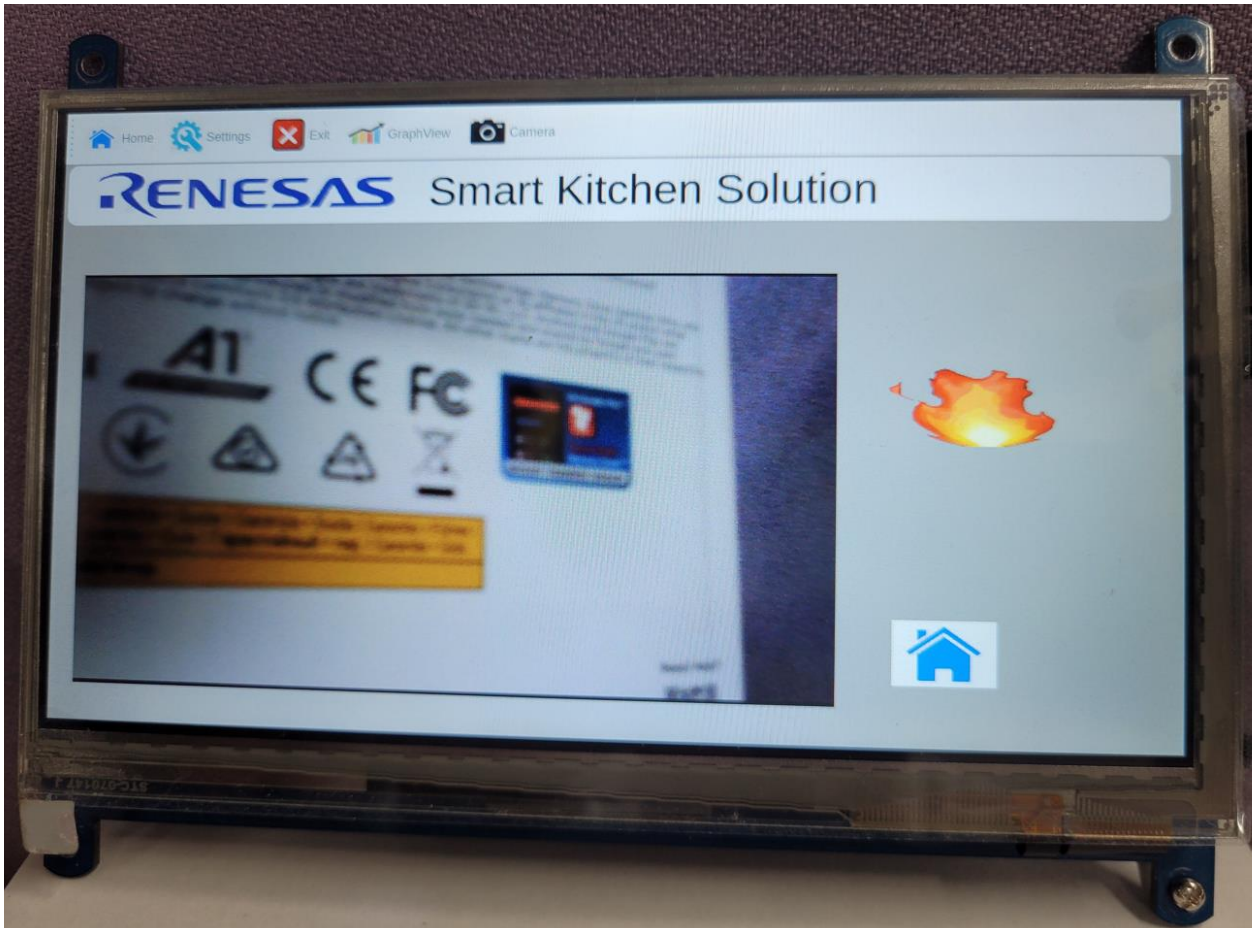


Figure 22. Alert Screen – Alert Condition

The screen in Figure 17, will appear when the alarm/alert event occurs. The alarm/alert event occurs when live current sensor data is more than the maximum value set in the setting screen of either temperature or humidity. The camera live streaming data will appear on the left side of the screen. And fire image will appear on the top right corner of the screen.

The PMOD1's PIN#7 voltage level is changed for temperature alarm/alert event. The PMOD1's PIN#8 voltage level is changed for humidity alarm/alert event

Clicking on the home button in the Alert screen will navigate to home screen.

8 Limitation & Know Issues

- The graphics and video encoder library are evaluation version, there is a time restriction on its execution.
- Occasionally when switching to camera screen under normal or alarm/alert condition the camera streaming sometimes doesn’t happen. Under this scenario, if we navigate between camera screen and home screen once, the streaming will continue/resume.