RZ/V2L

Simple ISP Sample Application Note Revision.1.30

Introduction

This document will explain about the Simple ISP Sample Application for RZ/V2L.

Target Device

RZ/V2L

Note

This document uses the difference Linux command execution environment.

Each environment will be differentiated by the following notation.

1. Linux PC environment

```
$ <Linux PC Command>
```

2. RZ/V2L Evaluation Board environment

```
# <RZ/V2L Evaluation Board Command>
```

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1. Overview

The RZ/V2L Sample Application provided in this package, captures the Google Coral Camera image via V4L2 and displays on the Video monitor the images in YUYV format using Wayland. This document assumes that users have read the RZ/V2L ISP Support Package Release Note (R11AN0561EJ0130) and already executed the instructions for Boot environment and Compile environment.

This document describes monitoring sample applications. Next section describes Simple ISP (Monitoring) sample application.

1.1 Operating Environment

The connection method to the RZ/V2L evaluation board is shown below.

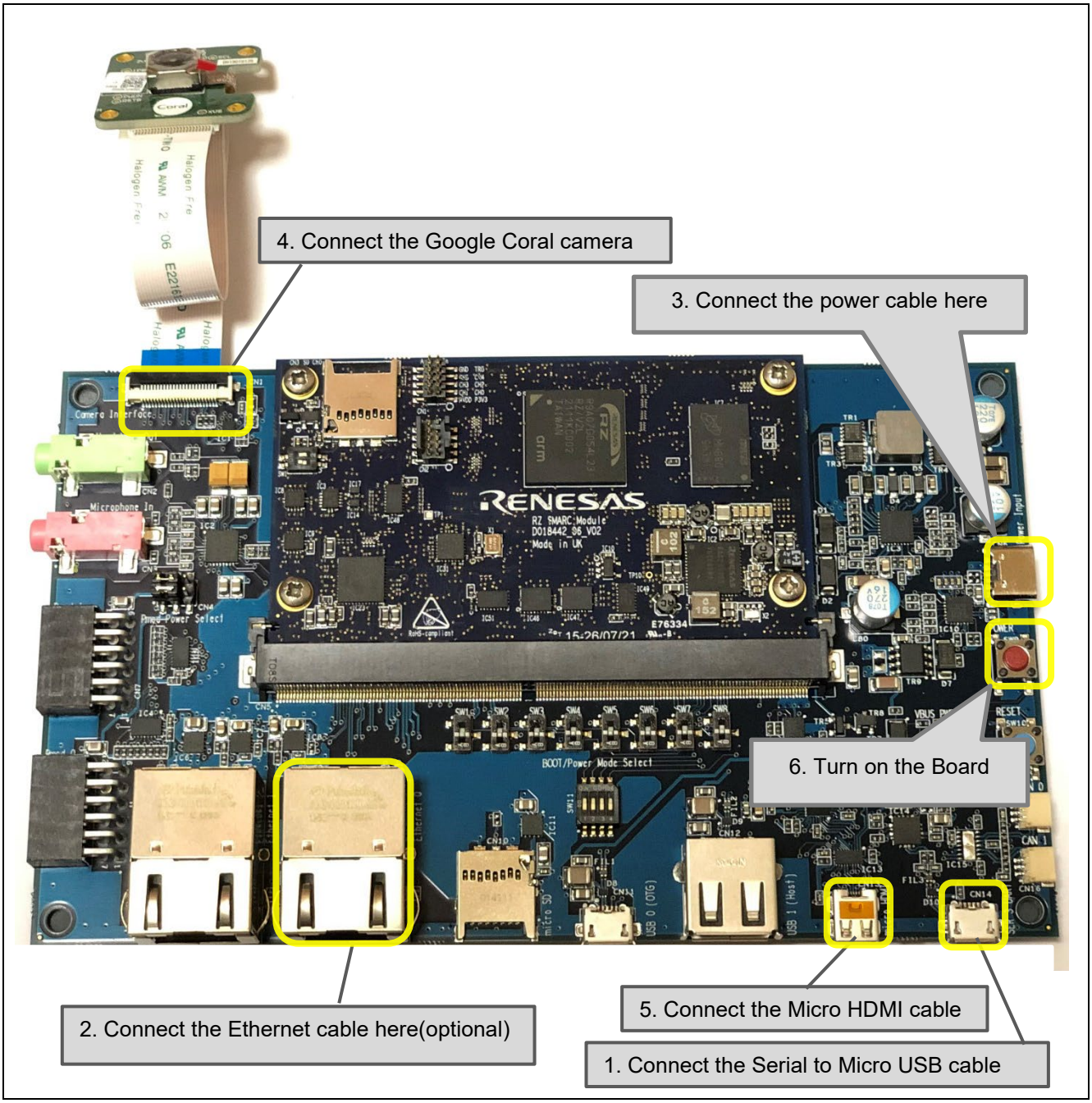

Figure 1-1 Connection of RZ/V2L Evaluation board

1.2 Sample application

1.2.1 Simple ISP (Monitoring)

Simple ISP (Monitoring) sample application displays the results of Simple ISP processing of the data input from the camera on the HDMI monitor. Simple ISP can correct the color and brightness of HD images input from a MIPI camera (RAW10 format) in real time. The correction parameters can be changed by sending a file from a PC.

Figure 1-2 shows the general processing flow of Simple ISP.

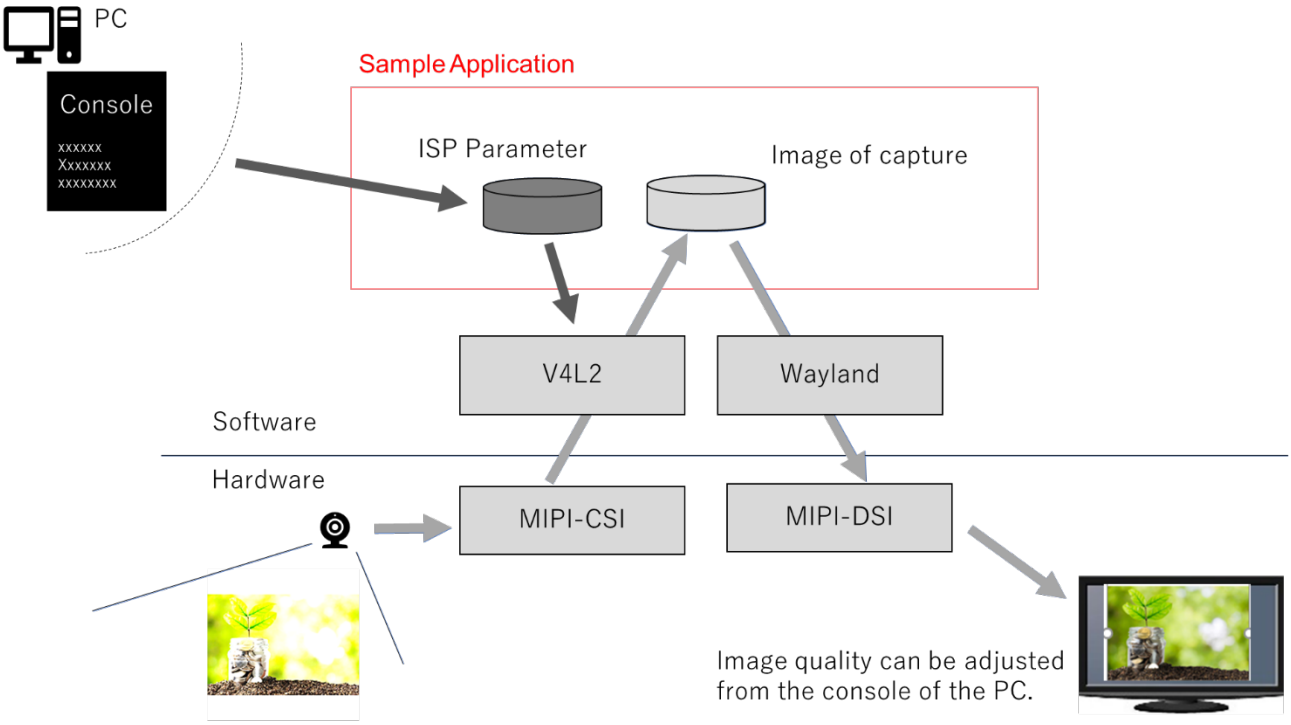

Figure 1-2 Simple ISP (Monitoring) Overview

1.3 Reference Documents

1. RZ/V Verified Linux Package Version 3.0.4 Release Note (R01US0565EJ0104)
2. SMARC EVK of RZ/V2L Linux Start-up Guide (R01US0617EJ0100)
3. RZ/V2L DRP-AI Support Package Release Note(R11AN0549EJ0740)
4. RZ/V2L ISP Support Package Release Note (R11AN0561EJ0130)

1.4 About Simple ISP

1.4.1 Memory Map

The RZ/V2L Sample Application provided in this package, captures the Google Coral Camera image via V4L2 and displays on the Video monitor the images in YUYV format using Wayland.

Figure 1-3 shows DDR memory map when this package is applied to the Linux Package.

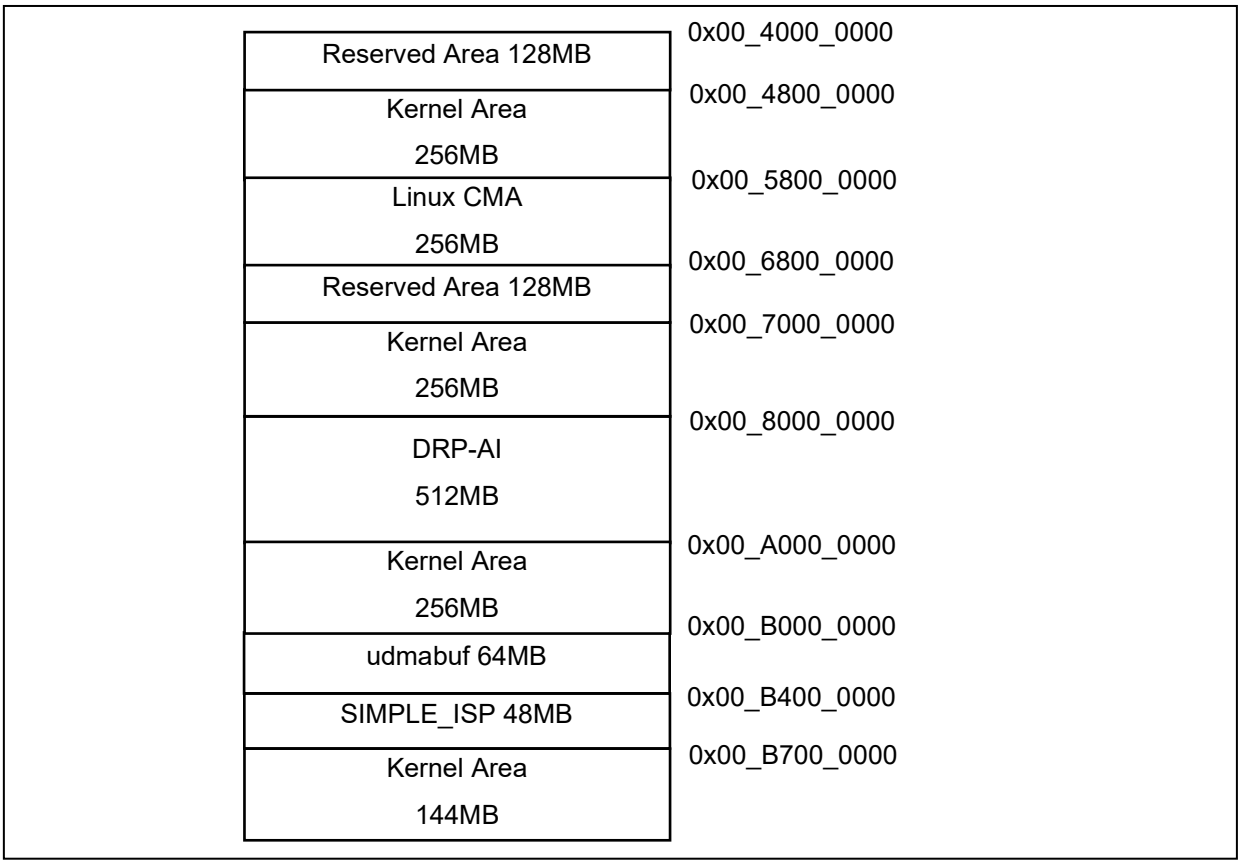

Figure 1-3 Memory map

2. Compile

2.1 Software for Compiling

Table 1 shows the necessary software for compiling.

Table 1 Necessary software for Compiling

No	Items	Filename	Details
1	SDK	-	Generated from using RZ/V2L Linux Package and RZ/V2L ISP Support Package.
2	Simple ISP Sample Application	rzv2l_isp-sample-application_ver1.30.tar.gz	Simple ISP Sample Application source code, executables and related files

2.2 SDK

SDK (Software Development Kit) is a development environment that will allow users to cross-compile the C/C++ source code for RZ/V2L Linux (ARM64).

Prepare the build from chapter 2 of RZ/V2L ISP Support Package Release Note (R11AN0561EJ0130) before installing the SDK.

To install the SDK, please refer to the RZ/V2L DRP-AI Support Package Release Note (R11AN0549EJ0740).

2.3 Setup the Working Directory

Create the working directory for compiling the Simple ISP Sample Application.

1. Set the path of working directory as an environment variable.

   Note: Change the path of working directory accordingly.

```
$ export APP_WORK=~/<WORK>
```

2. Execute the following command to create the working directory.

```
$ mkdir $APP_WORK
```

2.4 Extract the Source Code

Use the following command to extract the DRP-AI Sample Application Package.

Notes :<PATH_to_SRC> is a path to rzv2l_isp-sample-application_ver1.30.tar.gz

```
$ cd <PATH_to_SRC>
$ tar xvzf rzv2l_isp-sample-application_ver1.30.tar.gz -C $APP_WORK
```

After extracted the package, the working directory have the following structure.

```
$APP_WORK
    app_isp_monitoring
        exe
            sample_app_cam
            isp_param_default.txt
            isp_param_sample.txt
        src
            camera.cpp
            camera.h
            define.h
            image.cpp
            image.h
            Makefile
            sample_app_cam.cpp
            wayland.cpp
            wayland.h
```

Figure 2-1 Working Directory Structure

2.5 Simple ISP (Monitoring)

2.5.1 Set SDK Environment Variable

To cross-compile the application, the environment variables need to be changed for SDK.

Execute following command to set the SDK environment variable.

Note: 1. The environment variable will be reset if the Linux terminal is closed.

2. Following command assumes the SDK is installed under the path "/opt/poky/3.1.21".

```
$ source /opt/poky/3.1.21/environment-setup-aarch64-poky-linux
```

2.5.2 Cross-Compile

After the environment variable is set, execute following commands to compile the source code.

```
$ cd $APP_WORK/app_isp_monitoring/src
$ make
```

Command "`make`" will execute the commands stated in Makefile.

For the details of compilation command, see the each Makefile.

After the `make`, the binary file will be generated in the application source code directory.

```
$APP_WORK
    app_isp_monitoring
        exe
            sample_app_cam
            isp_param_default.txt
            isp_param_sample.txt
        src
            camera.cpp
            camera.h
            define.h
            image.cpp
            image.h
            Makefile
            sample_app_cam.cpp
            wayland.cpp
            wayland.h
            sample_app_cam              Generated binary file
```

Figure 2-2 Directory Structure of `app_isp_monitoring`

3. Setup the Execution Environment for Simple ISP Sample Application

This chapter will explain how to deploy the execution environment for Simple ISP Sample Application.

3.1 Deploy the execution environment

Please copy the previously compiled application or the pre-compiled sample application to the root filesystem of RZ/V2L Linux.

Directory structure of root filesystem will be as follows. (`Applications` are copied to `/home/root/exe`).

Note: when using SD card, please use the “sync” command after copying the file.

```
usr
bin
lib
…
home
root
exe
sample_app_cam          Copied file
```

4. Execute Sample Application

4.1 Execute the application

This section assumes the RZ/V2L Evaluation Kit is successfully booted and will explain how to execute RZ/V2L Sample Application.

1. Move to the directory where the application is stored.

Note: <PATH_to_FILE> is a path to the directory that the application is stored.

For the example in 3.1 Deploy the execution environment, this would be "`/home/root/exe`".

```
# cd <PATH_to_FILE>
```

2. Run the following command to execute the application.

```
# ./sample_app_cam
```

Note:

If the application is copied to the execution environment from the Ubuntu PC, the file **permission may not allow** the application to be run.

In this case, please run the following command on RZ/V2L Evaluation Board to allow the file execution.

```
# chmod +x sample_app_cam
```

3. Simple ISP (Monitoring) Sample Application can be changed ISP parameter. Please refer to Appendix 2. Explanation file of parameters.

4. Press this key of 'Q' to stop the execution.

5. Application Contents

This chapter described application contents.

5.1 Simple ISP (Monitoring)

5.1.1 Application Flow Chart

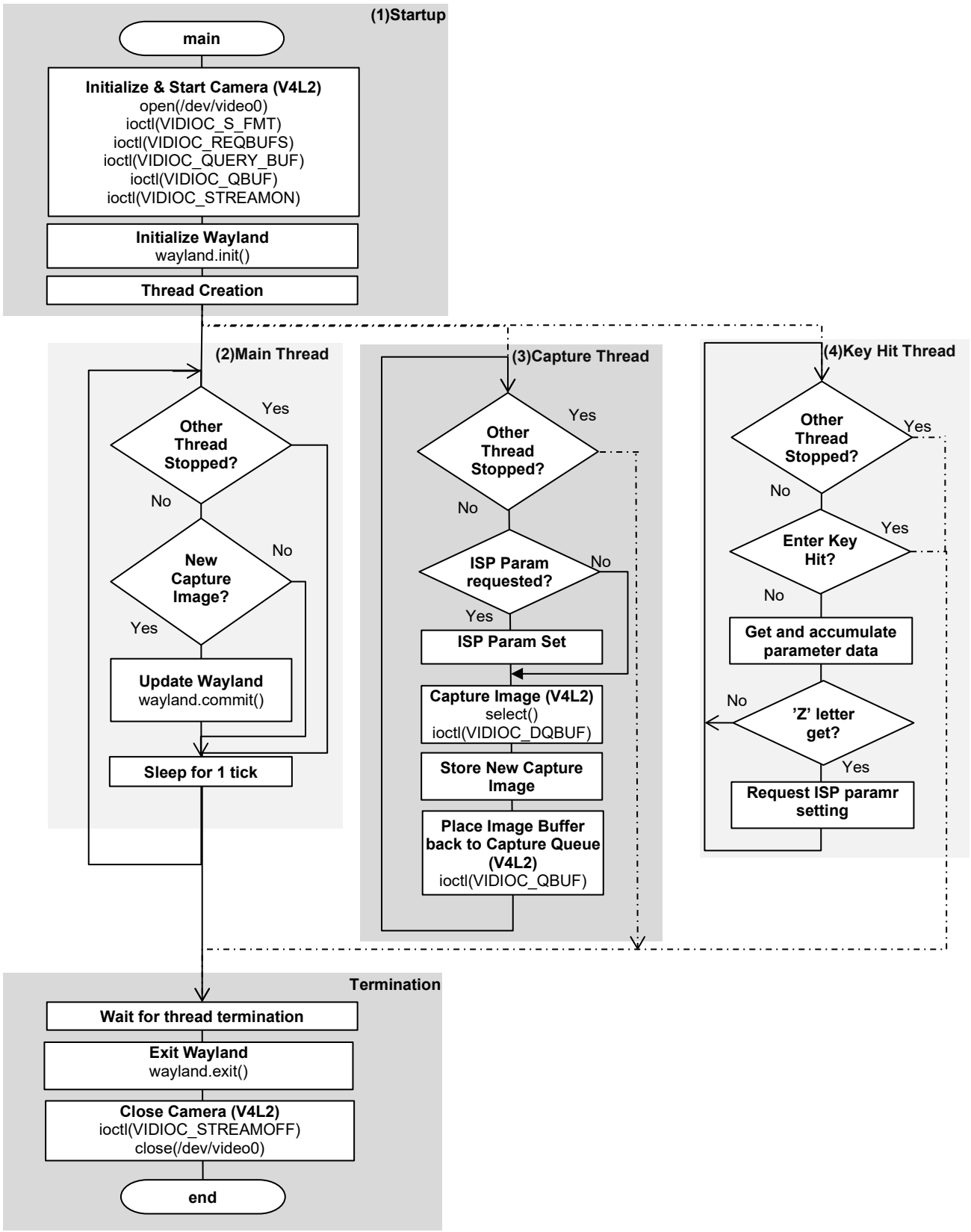

Figure 5-1 Simple ISP (Monitoring) Flow Chart

5.1.2 Application Operating Sequence

Figure 5-2 shows the operating sequence of startup processing shown in Figure 5-1.

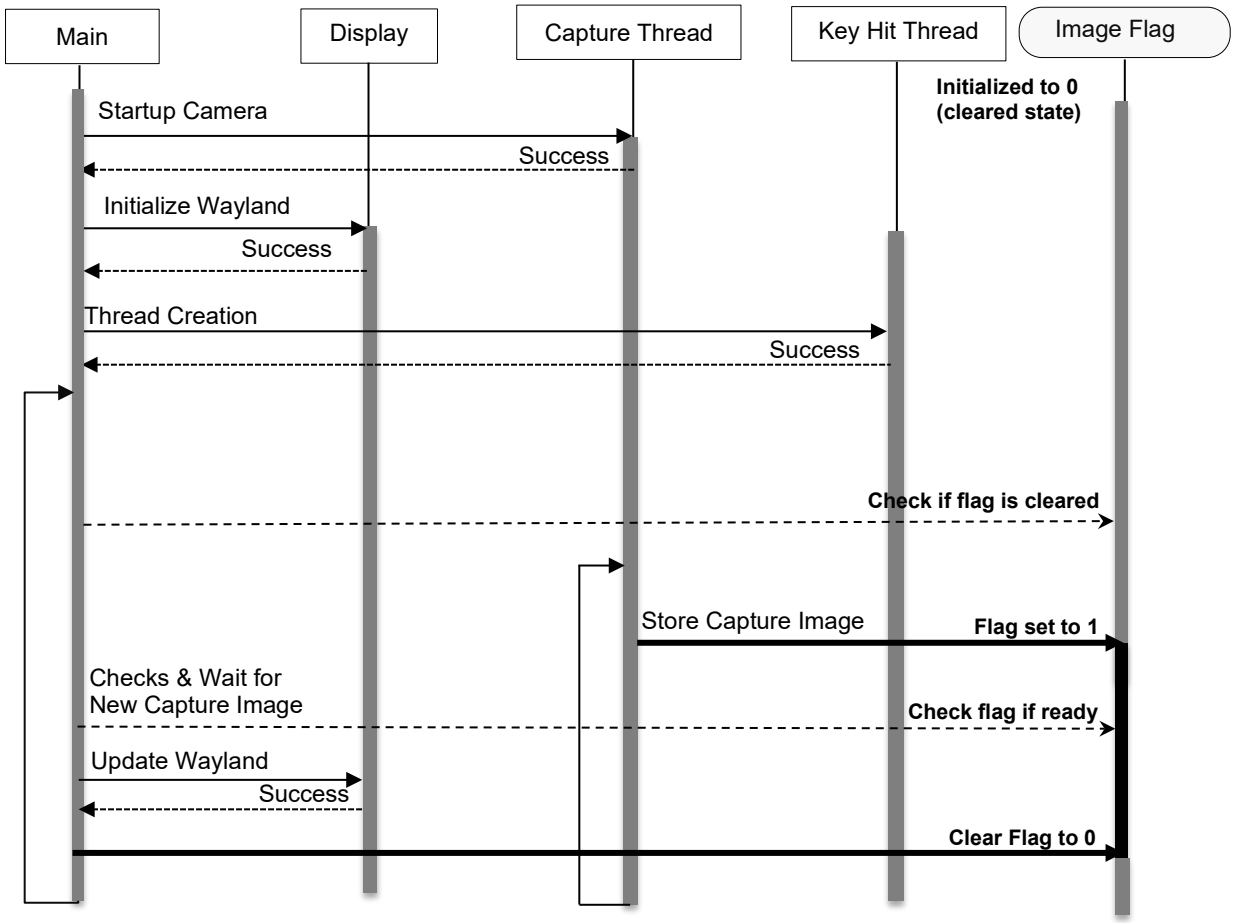

Figure 5-2 Simple ISP (Monitoring) Operating Sequence

Appendix

1 How to change camera driver

This section describes how to change the camera driver that captured RAW10 format to capture RAW8 format.

1) Compile in reference to the chapter 2.

2) Create the configuration file <meta-rz-features\recipes-isp\recipes-linux\linux\linux-renesas\change-camera-config.cfg>

```
#<Using RAW8>
CONFIG_VIDEO_OV5645=n
CONFIG_VIDEO_OV5645_RAW8=y
CONFIG_VIDEO_OV5645_RAW10=n
```

3) Change file (meta-rz-features\recipes-isp\recipes-linux\linux\linux-renesas_*.*.bbappend) referring to the following part of recipe.

Before

```
:
SRC_URI_append += " \
file://0001-add-ov5645-raw8-raw10-drivers.patch \
file://0002-add-simple-isp-library.patch \
file://0003-add-v4l2-drivers.patch \
"
```

After

```
:
SRC_URI_append += " \
file://0001-add-ov5645-raw8-raw10-drivers.patch \
file://0002-add-simple-isp-library.patch \
file://0003-add-v4l2-drivers.patch \
file://change-camera-config.cfg \
"
```

Note: Add the red letters.

4) Execute the following command.

```
$ cd USER_WORK
$ source poky/oe-init-build-env
$ bitbake linux-renesas
```

5) After the Build, the files will be generated under `$USER_WORK/build/tmp/deploy/images/smarc-rzv2l`. (refer to section 2.5 of RZ/V2L ISP Support Package Release Note (R11AN0561EJ0130))

2 Explanation file of parameters

This sample program can change ISP setting by sending parameter file which is converted ISP parameter (refer. section 2.3.2 of the RZ/V2L ISP user's manual) from decimal number to hexadecimal text from terminal software. Do not set values out of the range. A sample parameter file is included app_isp_monitoring/exe folder. The sample parameter reverses luminance. The parameter file is recognized as a comment from '' to the end of the line and is not recognized as data. Also, characters excluding 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F, Z, a, b, c, d, e, f, and z are ignored. When you create a parameter file, please input 4 bytes of checksum data after inputting 429 bytes of ISP parameters. Then, enter the character 'Z' or 'z' at the end and press the enter key to start a new line.

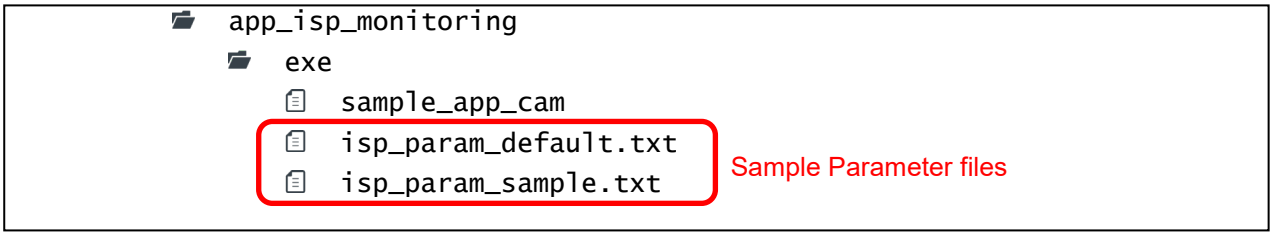

Figure A- 1 Position of sample parameter files in app_isp_monitoring directory

3 What is Wayland?

Wayland is both a display server protocol and a library that implements the protocol for Linux. For more information, please visit the following URL

https://wayland.freedesktop.org/docs/html/

The following table shows Wayland APIs that are checked the operation in the RZ/V2L Linux Package.

Table A- 1 System calls using Wayland

Categories	System call
wl_display	wl_display_connect
	wl_display_get_registry
	wl_display_roundtrip
	wl_display_dispatch
	wl_display_disconnect
wl_registry	wl_registry_bind
	wl_registry_add_listener
	wl_registry_destroy
wl_compositor	wl_compositor_create_surface
	wl_compositor_destroy
wl_shm	wl_shm_add_listener
	wl_shm_create_pool
	wl_shm_pool_create_buffer
	wl_shm_pool_destroy
	wl_shm_destroy
wl_buffer	wl_buffer_destroy
wl_shell	wl_shell_surface_pong
	wl_shell_get_shell_surface
	wl_shell_surface_set_toplevel
	wl_shell_surface_set_user_data
	wl_shell_surface_destroy
	wl_shell_destroy
wl_surface	wl_surface_set_user_data
	wl_surface_attach
	wl_surface_damage
	wl_surface_commit
	wl_surface_destroy

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	24, Dec, 2021	-	Issued.
1.10	28, April 2022	ALL 5 6 15	Deleted explanation of Tinyyolov2 sample application Modified number of reference documents Modified memory map Modified explanation of "how to change camera driver"
1.20	29, July 2022	5 6 15	Modified number of reference documents Modified memory map Modified directory path
1.21	31, Jan 2023	5, 7, 15 9	Modified number of reference documents Modified directory path
1.30	31, july 2023	3, 5, 7, 15 9	Modified title and number of reference documents Modified directory path

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2. Processing at power-on
   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state
   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins
   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals
   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin
   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
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