

CA378-AOIS for Raspberry Pi 3 Software Setup Guide

Version 1.0.0

Dated: 2017/12/21

Home Page <http://www.centuryarks.com/>

Date	Version	Comment
2017/12/21	v1.0.0	Initial Release

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1. Environment configuration

★ Before installing the CA 378-AOIS software, please implement the following environment.

▪ Prerequisites

1. Basic setting of Rasbian (OS) is complete in your environment
2. SSP Library Install

Installation procedure:

(1) Register as user at Vision Processing Community.

https://www.visionproc.org/login_new_account.php?lang=en

(2) Download “SSP library 1.28” from the following site.

<https://www.visionproc.org/download.php>

(3) Install according to the procedure

https://www.visionproc.org/ssp_usage.php

1. Environment configuration

※ By the following procedure,
Performance such as Start-up time / OIS initialization / Auto focus can be improved.

- Change of I2C communication speed
1. Open "/boot/config.txt" with an editor.

```
$ sudo nano /boot/config.txt
```

2. Add the following parameters.

```
dtparam=i2c_baudrate=400000
```

```
# Uncomment some or all of these to enable the optional hardware interfaces
dtparam=i2c_arm=on
#dtparam=i2s=on
dtparam=i2c_baudrate=400000
#dtparam=spi=on

# Uncomment this to enable the lirc-rpi module
#dtoverlay=lirc-rpi

# Additional overlays and parameters are documented /boot/overlays/README

# Enable audio (loads snd_bcm2835)
dtparam=audio=on
start_x=1
gpu_mem=128
dtoverlay=i2c1-bcm2708,sda1_pin=44,scl1_pin=45,pin_func=6
```

3. Save the file and restart Raspberry Pi.

2. Software install

Please install by the following procedure.

· Installation procedure

1. Download "demo_v1.0.0_pi3.tar.gz" from the following site.

<https://github.com/centuryarks/Sample/releases>

```
$ wget --no-check-certificate https://github.com/centuryarks/Sample/releases/download/v1.0/demo_v1.0.0_pi3.tar.gz
```

2. Unzip the "demo_v1.0.0_pi3.tar.gz" file.

```
$ tar zxvf demo_v1.0.0_pi3.tar.gz
```

3. Execute "Install.sh" in the extracted folder.

```
$ cd demo  
$ ./Install.sh
```

4. A shortcut is created on the desktop.

Demo.sh

Hispeed.sh

3. Demonstration functions

3.1. Focus & OIS

3.2. High-speed video recording

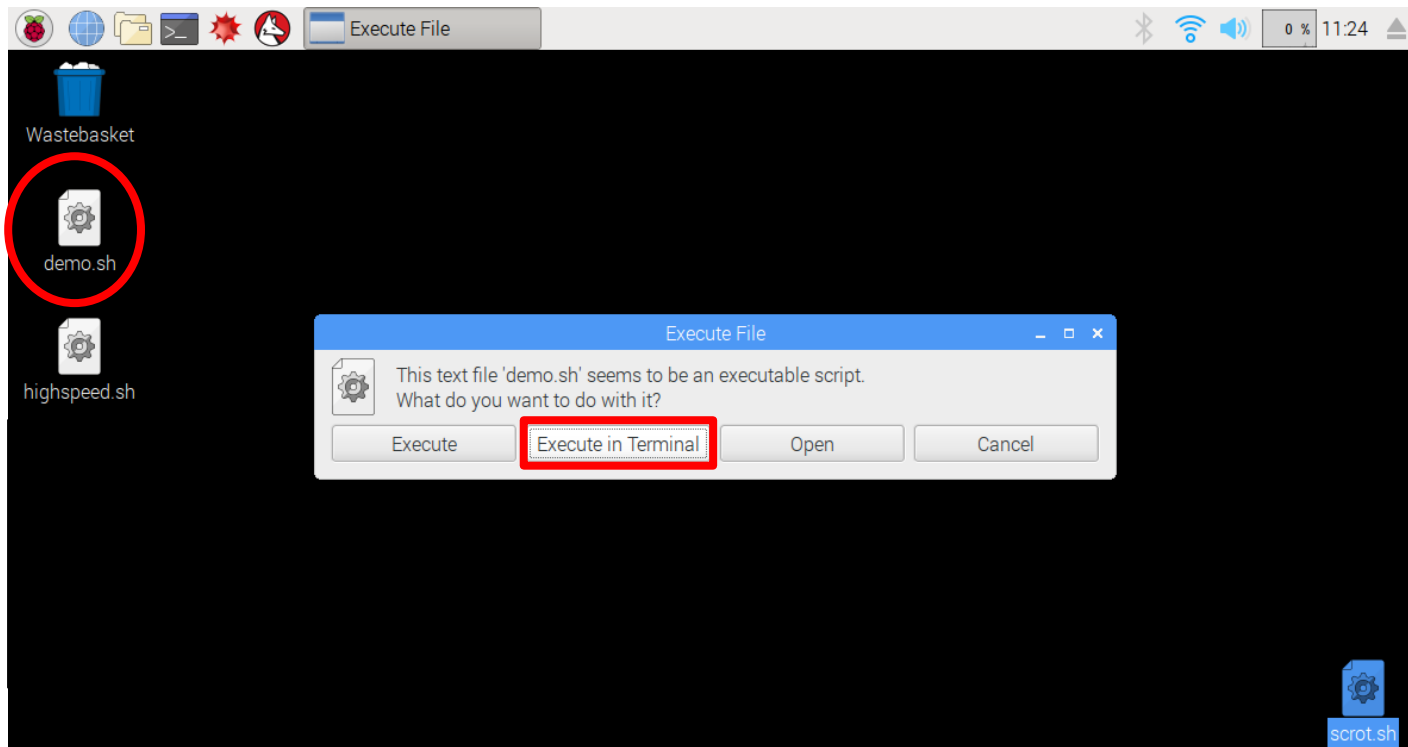
3.3. 4K3K-resolution(12Mpixel) still image capturing

3.4. HDR still image capturing

3.1. Focus & OIS

Procedure of starting Focus & OIS:

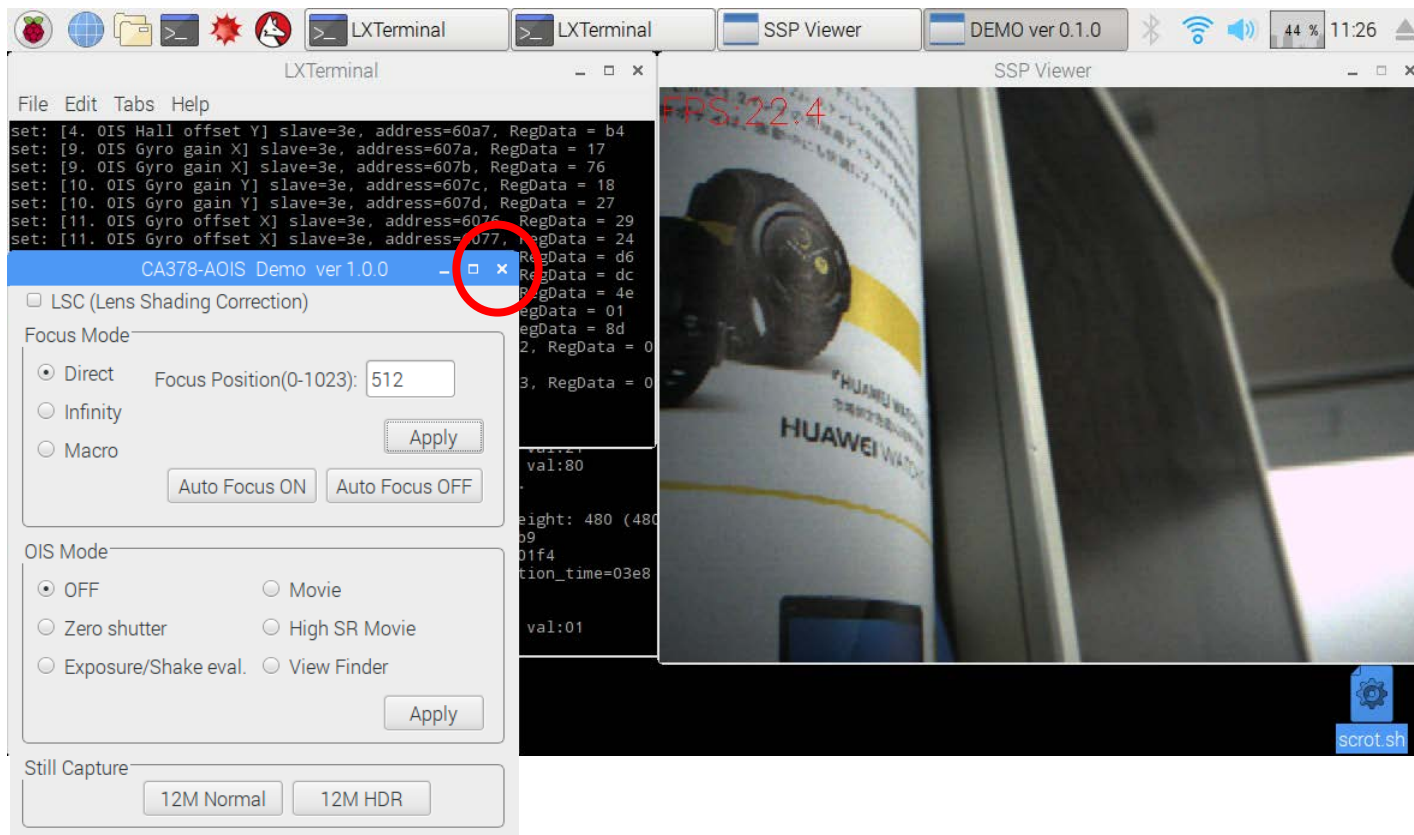
1. Click "demo.sh" on the desktop.
 2. Click [Execute in Terminal].
 3. After a while the GUI screen will be displayed.
 4. Please change the distance of the object, or move the camera, confirm the function.
- * For details of functions, refer to page 10-11.



3.1. Focus & OIS

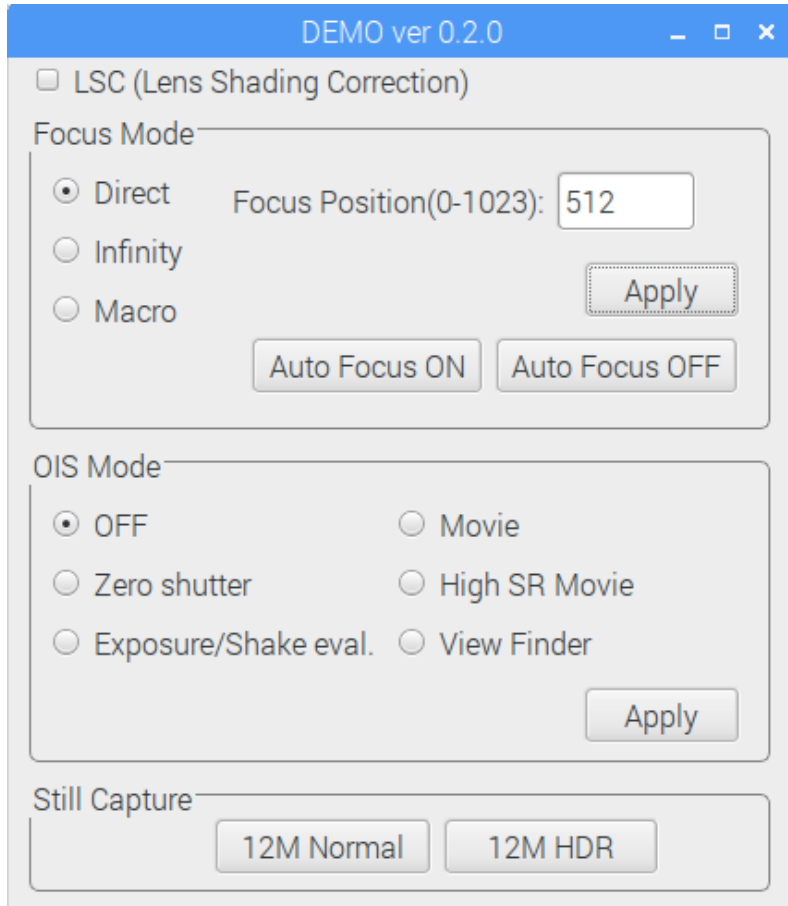
Procedure of finishing Focus & OIS:

1. Click the [x]



3.1. Focus & OIS

The following section describes each function of Focus & OIS.



Function	Description
LSC	Check to enable shading correction. ※ Theoretical values have been set.
Focus Mode	Direct: Directly specify the focus position. Infinity: Set the focus position to infinity. Macro: Set the focus position to the short distance. Focus Position: Focus position. Apply: Apply the settings. Auto Focus ON: Enable auto focus. Auto Focus OFF: Disable auto focus. * Current debug control is for demo.
OIS Mode	OFF: Disable OIS. It corresponds to each OIS mode. Zero Shutter Exposure / Shake eval. Movie High SR Movie View Finder Apply: Apply the settings.
Still Capture	12M Normal: Capture 12Mpixel normal still image. 12M HDR: Capture 12Mpixel HDR still image.

3.1. Focus & OIS

Description of the script file:
It describes about the “script/preview.sh”.

```
#!/bin/sh
cd /home/pi/demo
./bin/highspeed ./profile/IMX378_640x480_4x4.xml 953 256 2372 IMX378
```

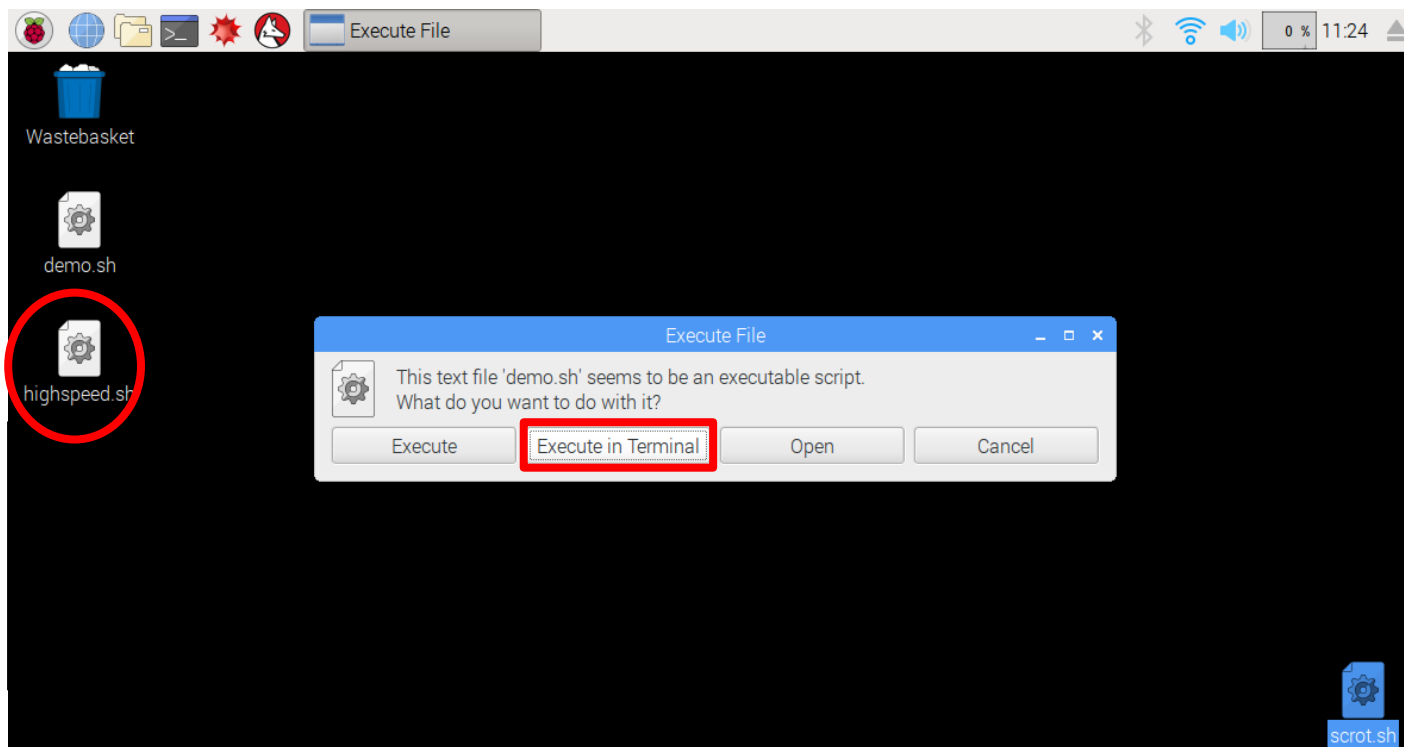
Function	Description
The first argument	Specify the VPF profile.
The second argument	Specify the analog gain. Range: 0 – 978 Analog Gain = $1024 / (1024 - \text{value})$
The third argument	Specify the digital gain. Range: 256 to 4057 Digital gain = $\text{value} / 256$ [times]
The fourth argument	Specify the shutter speed. Conditions: Long exposure: None COARSE_INTEG_TIME = 500 (fourth argument) LINE_LENGTH_PCK = 3000 (specified in the profile of the first argument) Pixel rate [pixels / s] = $210 \text{ [MHz]} * 4$ Example: Exposure time = $(500 * 3000) / (210 \text{ [MHz]} * 4) = 1.785 \text{ [msec]}$ Frame rate = 560 [fps] * Please understand that Frame rate does not rise only by changing shutter speed.
The fifth argument	specify IMX 378

3.2. High-speed video recording

Procedure of starting high-speed video recording:

1. Click "highspeed.sh" on the desktop.
2. Click [Execute in Terminal].
3. Preview will start automatically when you start up.
4. Press the [r] key on the keyboard at the timing you want to shoot.

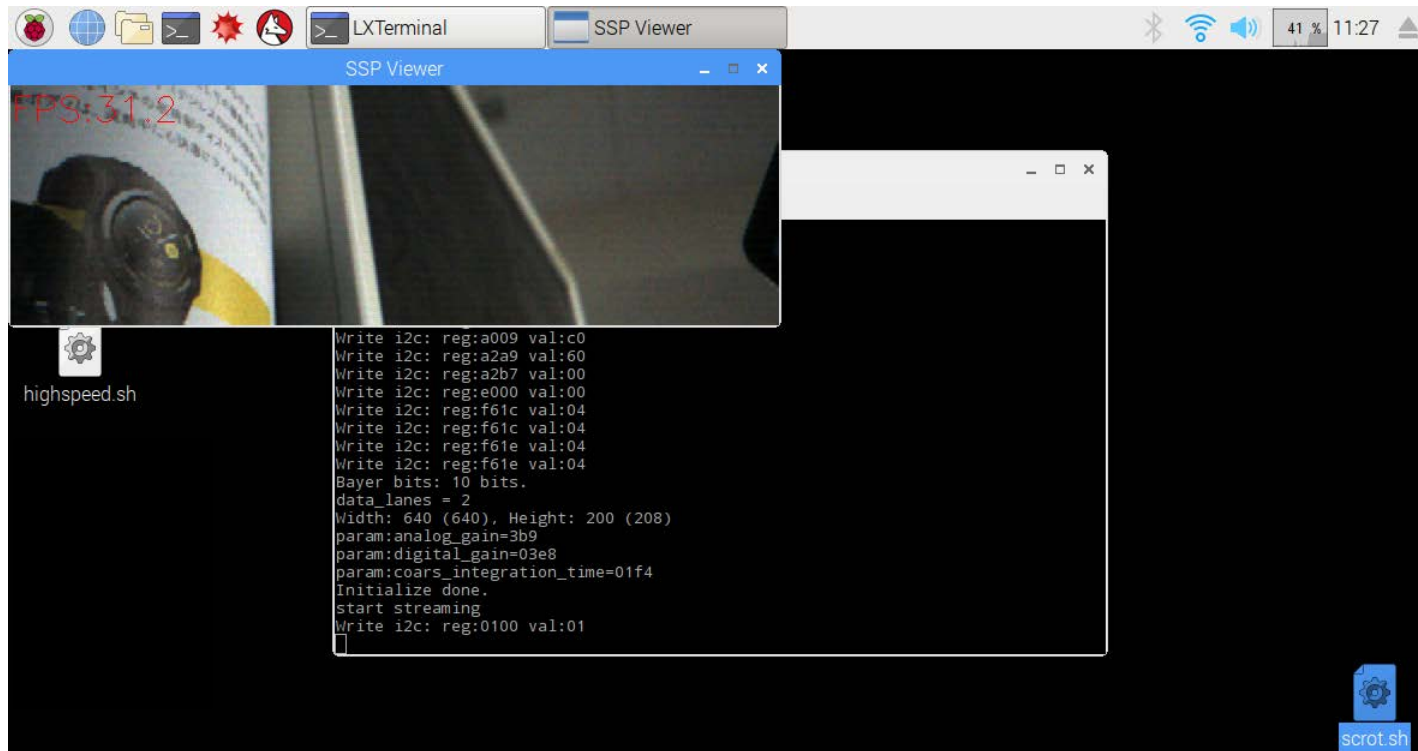
* For detailed operation, refer to page 15



3.2. High-speed video recording

Procedure of finishing high-speed video recording:

- (1) If you press any of [w], [W], [a] on the keyboard, you can save captured data in the specified format.
([w]: uncompressed, [W]: Motion JPEG, [a]: MP 4)
- (2) Press [q] on the keyboard.
(* It does not exit even if clicking the [x] button.)
- (3) Saved image data can be edited / played with general software.



3.2. High-speed video recording

Description of the script file:
It describes about the “script/highspeed.sh”.

By exchanging the third and fourth rows,
You can change the image size and frame rate.

```
#!/bin/sh
cd /home/pi/demo
#./bin/highspeed ./profile/IMX378_640x480_250fps_10bit_2lane.xml 978 384 1000 IMX378
./bin/highspeed ./profile/IMX378_640x200_500fps_10bit_2lane.xml 978 768 500 IMX378
```

Function	Description
The first argument	Specify the VPF profile.
The second argument	Specify the analog gain. Range: 0 – 978 Analog Gain = $1024 / (1024 - \text{value})$
The third argument	Specify the digital gain. Range: 256 to 4057 Digital gain = $\text{value} / 256$ [times]
The fourth argument	Specify the shutter speed. Conditions: Long exposure: None COARSE_INTEG_TIME = 500 (fourth argument) LINE_LENGTH_PCK = 3000 (specified in the profile of the first argument) Pixel rate [pixels / s] = $210 \text{ [MHz]} * 4$ Example: Exposure time = $(500 * 3000) / (210 \text{ [MHz]} * 4) = 1.785$ [msec] Frame rate = 560 [fps] * Please understand that Frame rate does not rise only by changing shutter speed.
The fifth argument	specify IMX 378

3.2. High-speed video recording

The following section describes the functions of high-speed video recording. Activate SSP Viewer and correspond to the following key command.

Command	Description
q	Quit
r	Go to recording mode
v	Go to real-time preview mode
w	Movie file output (uncompressed)
W	Movie file output (Motion JPEG format)
a	Movie file output (MP4 format)
p	Pause
s	Jump to start frame
e	Jump to end frame
z	Export current frame
x	Export entire frames
t	Toggle show / hide message

Command	Description
0 to 5	Adjust preview speed
9	Play with skipping 5 frames
8	Play without skipping
[Space]	Show next frame
m	Show back frame
f	Forward 100 frames
b	Back 100 frames
F	Forward 200 frames
B	Back 200 frames
c	Perform simple white balance gain adjustment

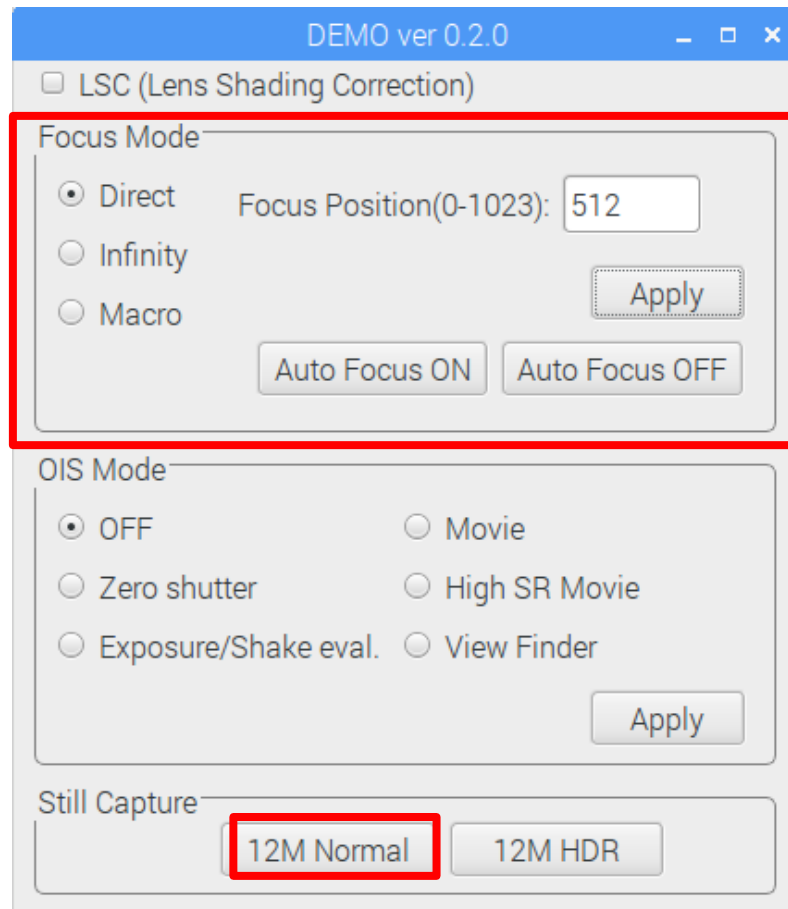
3.3. 12Mpixel still image capturing

Procedure of capturing 12Mpixel still image:

1. Adjust the focus.

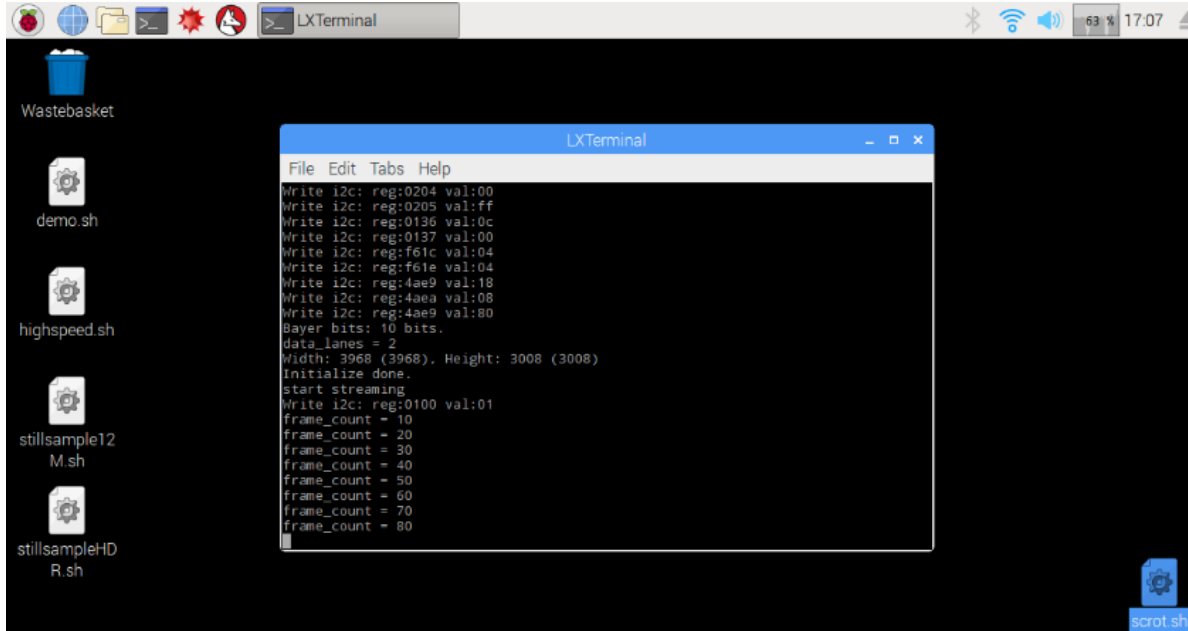
(It is useful to turn on Auto Focus and turn Auto Focus OFF when focus is on)

2. Click the [12M Normal] button



3.3. 12Mpixel still image capturing

3. The image is taken at the timing when Frame count becomes 20 (initial setting).
(Currently you can use only in the countdown system, manual push is planned for the future.)



```
Wastebasket
demo.sh
highspeed.sh
stillsample12
M.sh
stillsampleHD
R.sh

LXTerminal
File Edit Tabs Help
Write i2c: reg:0204 val:00
Write i2c: reg:0205 val:ff
Write i2c: reg:0136 val:0c
Write i2c: reg:0137 val:00
Write i2c: reg:f61c val:04
Write i2c: reg:f61e val:04
Write i2c: reg:4ae9 val:18
Write i2c: reg:4aea val:08
Write i2c: reg:4ae9 val:80
Bayer bits: 10 bits.
data_lanes = 2
Width: 3968 (3968), Height: 3008 (3008)
Initialize done.
start streaming
Write i2c: reg:0100 val:01
frame_count = 10
frame_count = 20
frame_count = 30
frame_count = 40
frame_count = 50
frame_count = 60
frame_count = 70
frame_count = 80
scrot.sh
```

4. The display method is explained in the following two procedures.
- (1) How to display still images with Raspberry Pi
 - (2) How to display still images in environments such as PCs and smartphones.

3.3. 12Mpixel still image capturing

(1) How to display still images with Raspberry Pi:

1. Install UFRaw.

```
$ sudo apt-get update  
$ sudo apt-get install ufraw
```

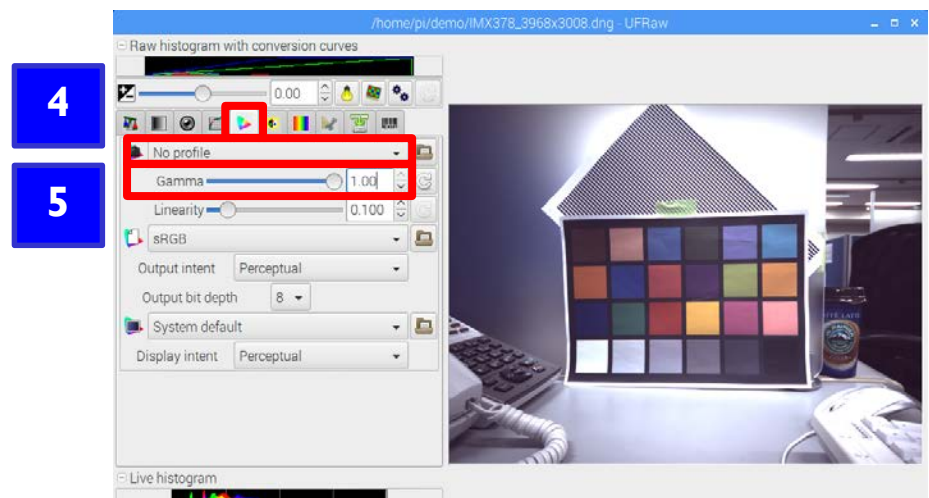
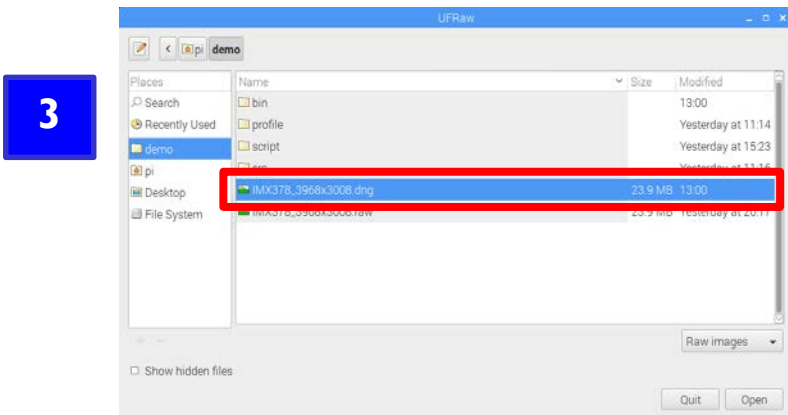
2. Start UFRaw.

```
$ ufraw
```

3. Select "/home/pi/demo/IMX378_3968x3008.dng".

4. Set the color management Camera profile to "No profile".

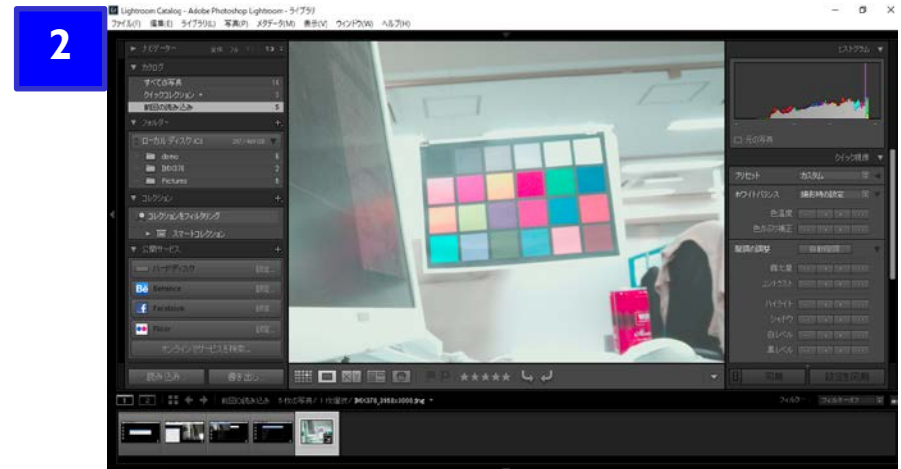
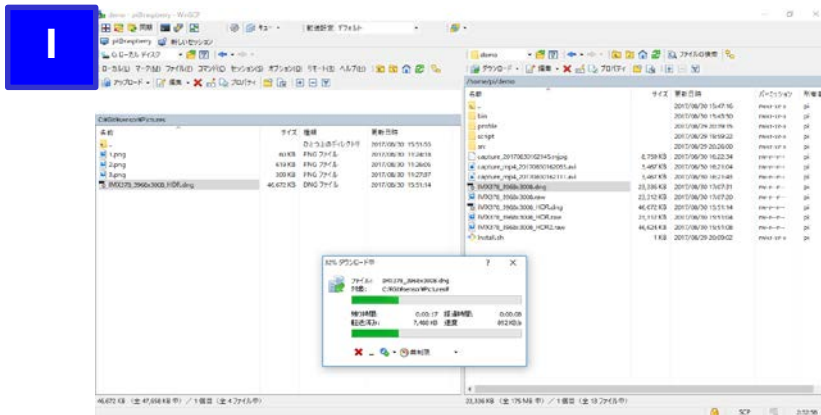
5. Set Gamma to "1.0".



3.3. 12Mpixel still image capturing

(2) How to display still images in environments such as PCs and smartphones:

1. Please download "/home/pi/demo/IMX378_3968x3008.dng" on PC or smartphone with WinSCP etc.
2. Display dng file with Adobe Photoshop Lightroom etc.
※ Please set the color management function to none.



*** In order to perform accurate color management, adjustment of color management is required separately.**

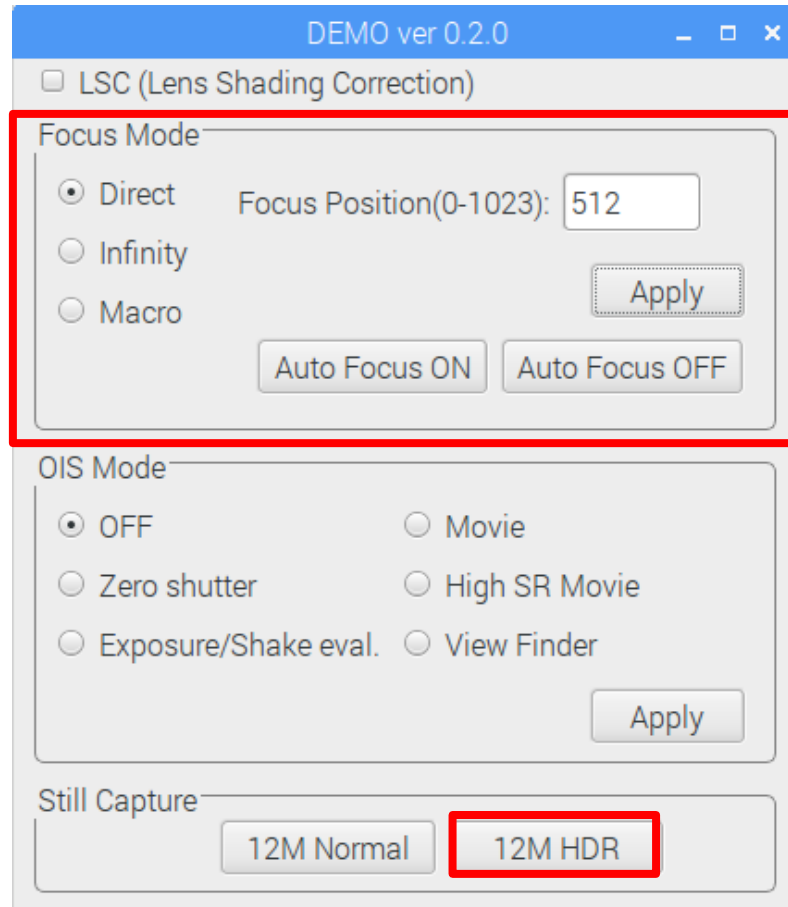
3.4. HDR still image capturing

Procedure of capturing HDR still image:

1. Adjust the focus.

(It is useful to turn on Auto Focus and turn Auto Focus OFF when focus is on)

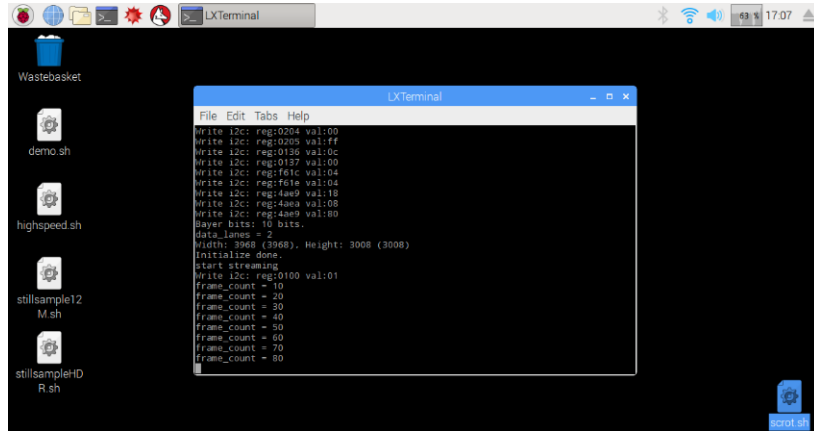
2. Click the [12M HDR] button.



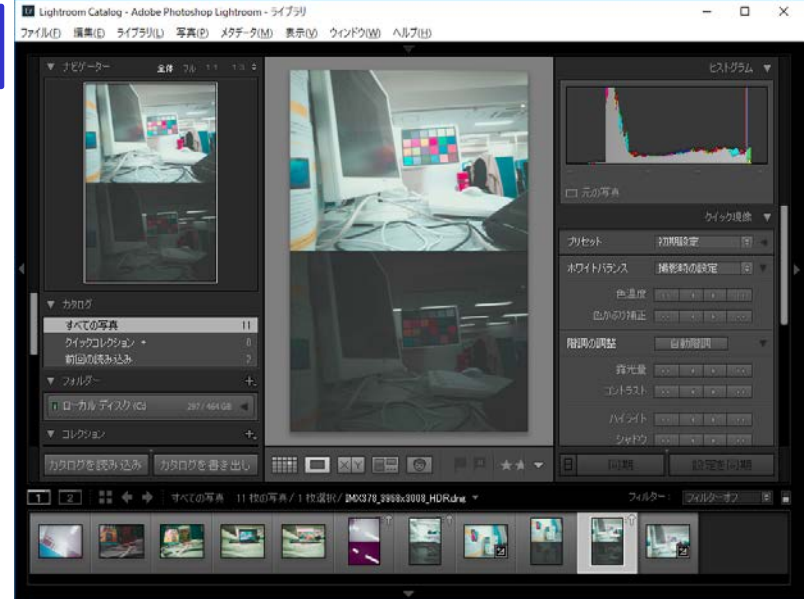
3.4. HDR still image capturing

- 3. The image is taken at the timing when Frame count becomes 10.
(Currently you can use only in the countdown system, manual push is planned for the future.)
- 4. The display method is the same as 12M still image shooting.
* Refer to the procedure of page 18-19.

3



4



*** Only with extracting long storage and short storage, HDR setting and tone mapping method will be described in separate document.**

Appendix

A.1. About the directory structure

The following section describes the directory structure of the software.

```
demo
├── bin
│   ├── DemoGUI
│   ├── demo.ini
│   ├── highspeed
│   ├── raw2dng
│   ├── raw2hdr
│   └── stillsampleRAW16
├── Install.sh
├── profile
│   ├── IMX378_1920x1080_2x2.xml
│   ├── IMX378_3840x2160.xml
│   ├── IMX378_3968x3008_HDR.xml
│   ├── IMX378_3968x3008.xml
│   ├── IMX378_640x200_500fps_10bit_2lane.xml
│   ├── IMX378_640x480_250fps_10bit_2lane.xml
│   └── IMX378_640x480_4x4.xml
├── script
│   ├── demo.sh
│   ├── highspeed.sh
│   ├── preview.sh
│   ├── stillCapture12M_HDR.sh
│   └── stillCapture12M_Normal.sh
└── src
    ├── GUI
    │   ├── af_control.c
    │   ├── af_control.h
    │   ├── communication.h
    │   ├── communication_raspberry.c
    │   ├── debug_util.h
    │   ├── demo_control.c
    │   └── DemoGUI.pro
```

Function	Description
bin	DemoGUI: Demonstration software Demo.ini: Demonstration software setting file Highspeed: High-speed video recording program raw2dng: RAW to dng file converting program raw2hdr: Program that extracts HDR long storage and short storage from RAW stillsampleRAW 16: Still image capturing program
profile	This is a profile describing register values to send to the sensor. You can use the profile used in VPF as it is.
script	Script files are described. It can be customized according to specifications. demo.sh highspeed.sh preview.sh stillCapture12M_HDR.sh stillCapture12M_Normal.sh
src	It is a set of demo software source code.

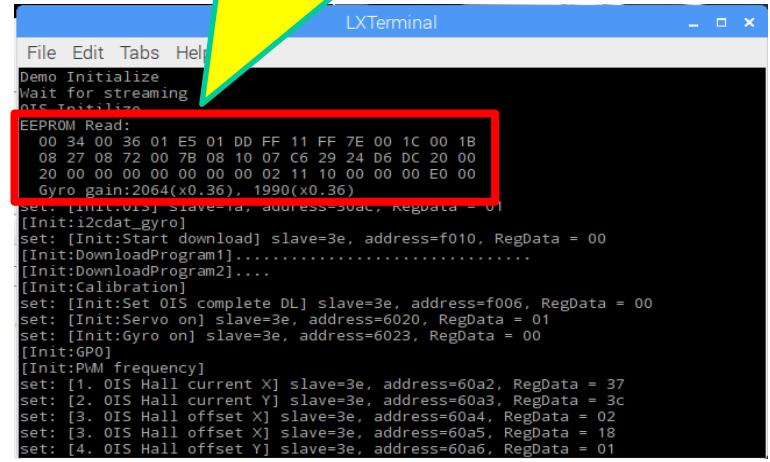
A.2. About the setting file

The following section describes the "demo.ini" of the setting file.

```
# DEMO Setting
preview = /home/pi/demo/script/preview.sh
stillCapture12M_Normal = /home/pi/demo/script/stillCapture12M_Normal.sh
stillCapture12M_HDR = /home/pi/demo/script/stillCapture12M_HDR.sh
stillCaptureFrame = 20
gyroGainRateX=1.0
gyroGainRateY=1.0
autoFocusGain=2.0
autoFocusConfidenceThreshold=10
autoFocusMoveLimit=100
```

Function	Description
preview	Script path for preview
stillCapture12M_Normal	Script path for capturing 12M normal still images
stillCapture12M_HDR	Script path for capturing 12M HDR still image
stillCaptureFrame	You can specify the countdown frame for still image capturing. * If it is set to 10 or less, it is possible to fail.
gyroGainRateX gyroGainRateY	It is valid only when OIS calibration result is written in EEPROM. Currently, since the value of Gyro gain is too effective, the rate is adjusted.
autoFocusGain	Adjust the autofocus gain.
autoFocusConfidenceThreshold	Specify the threshold value of the confidence level of Phase Difference.
autoFocusMoveLimit	Limit the amount of focus movement at one time.

If OIS calibration is already done, The following log is output to Terminal.



```
File Edit Tabs Help
Demo Initialize
Wait for streaming
OIS Initialize
EEPROM Read:
00 34 00 36 01 E5 01 DD FF 11 FF 7E 00 1C 00 1B
08 27 08 72 00 78 08 10 07 C6 29 24 D6 DC 20 00
20 00 00 00 00 00 00 02 11 10 00 00 00 E0 00
Gyro_gain:2064(x0.36), 1990(x0.36)
set: [Init:VLS] slave=3e, address=30a7, RegData = 01
[Init:i2cdat_gyro]
set: [Init:Start download] slave=3e, address=f010, RegData = 00
[Init:DownloadProgram1].....
[Init:DownloadProgram2]....
[Init:Calibration]
set: [Init:Set OIS complete DL] slave=3e, address=f006, RegData = 00
set: [Init:Servo on] slave=3e, address=6020, RegData = 01
set: [Init:Gyro on] slave=3e, address=6023, RegData = 00
[Init:GPO]
[Init:PHM frequency]
set: [1. OIS Hall current X] slave=3e, address=60a2, RegData = 37
set: [2. OIS Hall current Y] slave=3e, address=60a3, RegData = 3c
set: [3. OIS Hall offset X] slave=3e, address=60a4, RegData = 02
set: [3. OIS Hall offset X] slave=3e, address=60a5, RegData = 18
set: [4. OIS Hall offset Y] slave=3e, address=60a6, RegData = 01
```