# CA378-AOIS for Raspberry Pi 4 Software Setup Guide

Version 2.0.0

Dated: 2024/03/04

Home Page https://centuryarks.com/en/

# History

CenturyArks Co., Ltd.

| Date | Version | Comment |
|---|---|---|
| 2023/06/22 | v1.0.0 | Initial Release |
| 2023/11/13 | v1.0.1 | Updated tuning file.<br>Supported Raspberry Pi OS Debian version 12 (bookworm). |
| 2024/03/04 | v2.0.0 | Supported CA378-AOIS-V2 and CA378-V2wide. |

# Contents

# 1. Environment configuration

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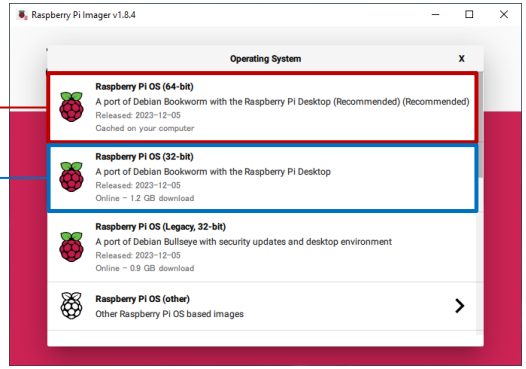
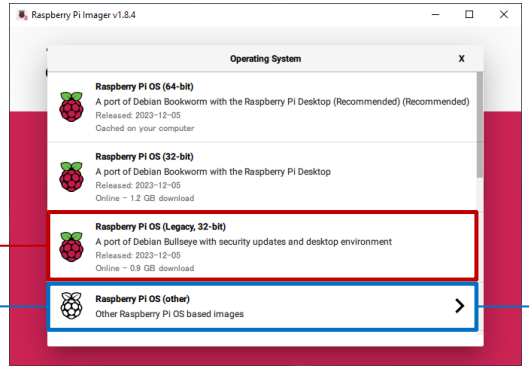
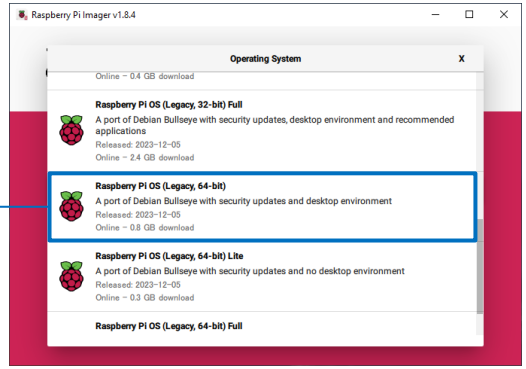
## 1.1. Environment setup

Raspberry Pi 4 Model B
- Raspberry Pi OS with desktop
- Release date: December 5th 2023
- System: 32-bit
  64-bit
- Kernel version: 6.1
- Debian version: 12 (bookworm)




(Legacy)
- Raspberry Pi OS with desktop
- Release date: December 5th 2023
- System: 32-bit
  64-bit
- Kernel version: 6.1
- Debian version: 11 (bullseye)




(1-1) Install Raspberry Pi OS using Raspberry Pi Imager.
https://www.raspberrypi.com/software/

(1-2) Follow the Installing the Operating System.
https://www.raspberrypi.com/documentation/computers/getting-started.html

(1-3) Insert the Micro SD card into the Raspberry Pi 4 Model B and boot.

# 1. Environment configuration

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* Since the architecture and bitness do not match, please follow the steps below for a 32-bit OS.

Add the following line to the end of the config.txt file.

Debian version: 12 (bookworm) /boot/firmware/config.txt

Debian version: 11 (bullseye) /boot/config.txt

```
arm_64bit=0
```

Restart with the following command after setting.

```
$ sudo reboot
```

Before execution

```
$ arch
aarch64
$ getconf LONG_BIT
32
```

After execution

```
$ arch
armv7l
$ getconf LONG_BIT
32
```

# 1. Environment configuration

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(2-1) Extract the setup script to your home directory.

```
$ tar zxvf demo_v2.0.0_pi4_setup_script.tar.gz
$ cd demo_v2.0.0_pi4_setup_script
```

(2-2) Run the setup script as follows.

```
$ ./setup.sh
```

Setup contents

- Install WiringPi(Library for controlling GPIO).
- Install demo software.
- Download, patch and build the kernel of the Tag.
  Debian version: 12 (bookworm) - Tag: stable_20231030
  Debian version: 11 (bullseye) - Tag: 1.20230405
- Edit the /boot/config.txt file.

(2-3) Select the camera module to use.

```
Please select the camera module to use.
 1) CA378-AOIS
 2) CA378-AOIS-V2
 3) CA378-V2wide
Please enter the number and press Enter :
```

(2-4) Reboot after running setup.

# 1. Environment configuration

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If you want to change the camera module used after setup:

(3-1) Run the module selection script as follows.

```
$ cd demo_v2.0.0_pi4_setup_script
$ ./select_module.sh
```

(3-2) Select the camera module to use.

```
Please select the camera module to use.
 1) CA378-AOIS
 2) CA378-AOIS-V2
 3) CA378-V2wide
Please enter the number and press Enter :
```

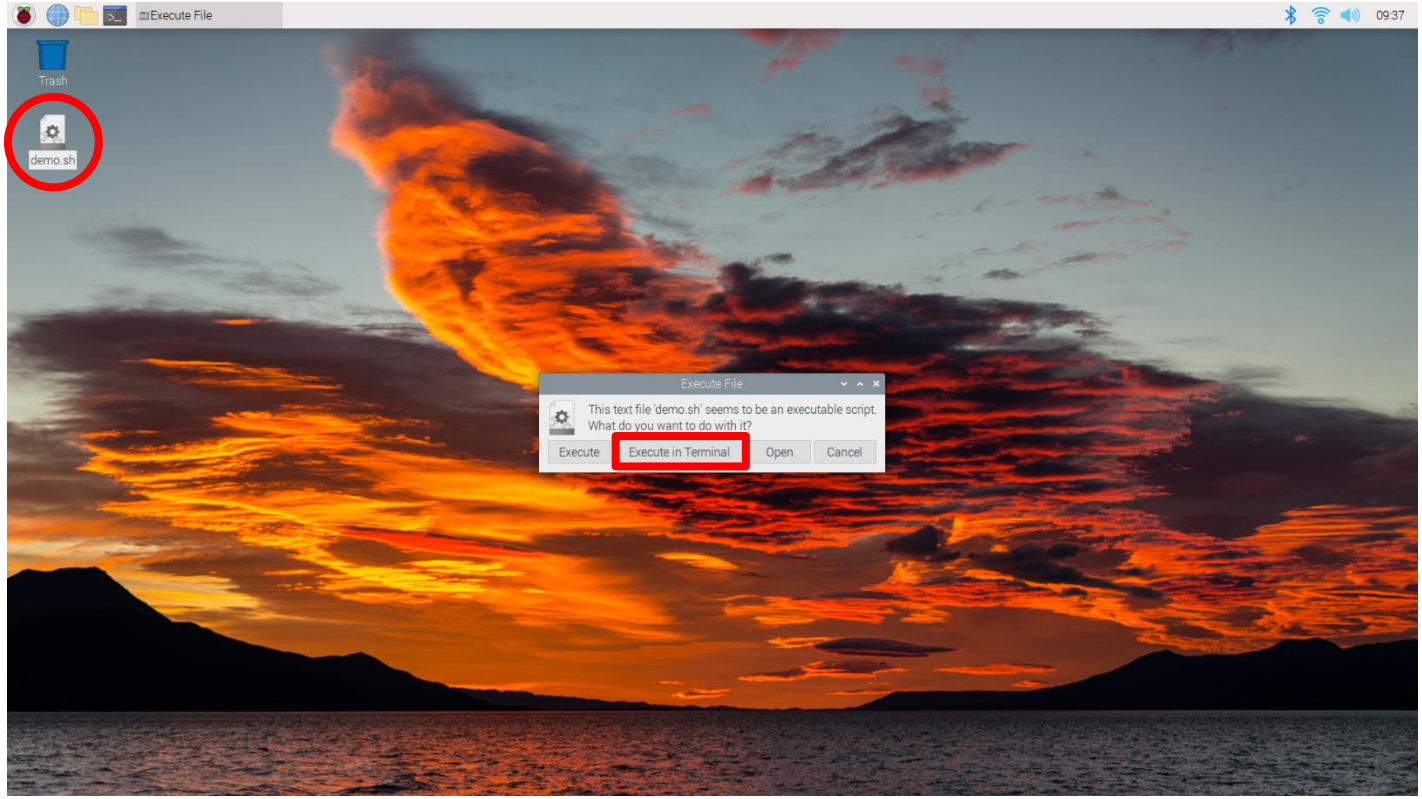
(3-3) Reboot after selecting the camera module.

# 2. Demonstration functions

2.1. Focus & OIS & Camera control
2.2. Still image capturing

# 2.1. Focus & OIS & Camera control

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 13-16.



# 2.1. Focus & OIS & Camera control

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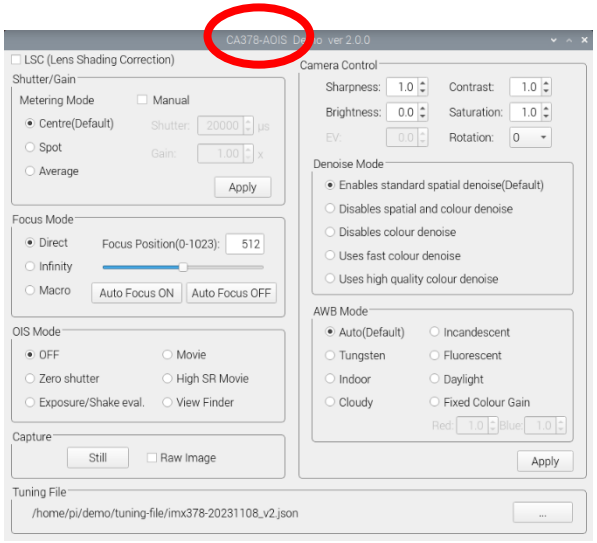
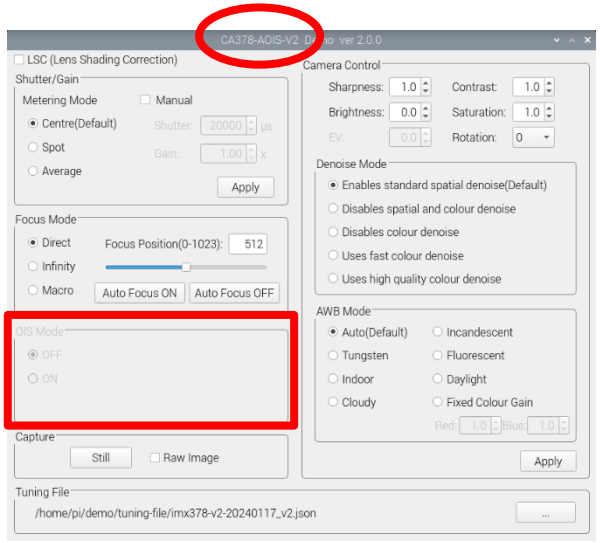
Depending on the camera module used, the text in the title bar of the operation GUI and whether the operation is enabled or disabled will change.

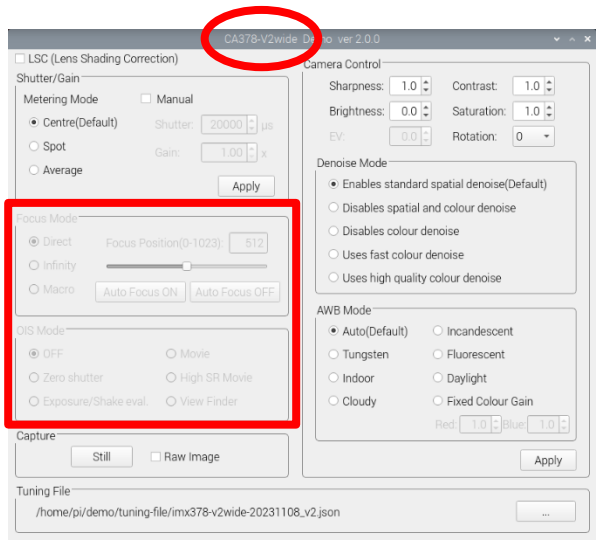
CA378-AOIS




CA378-AOIS-V2




CA378-V2wide

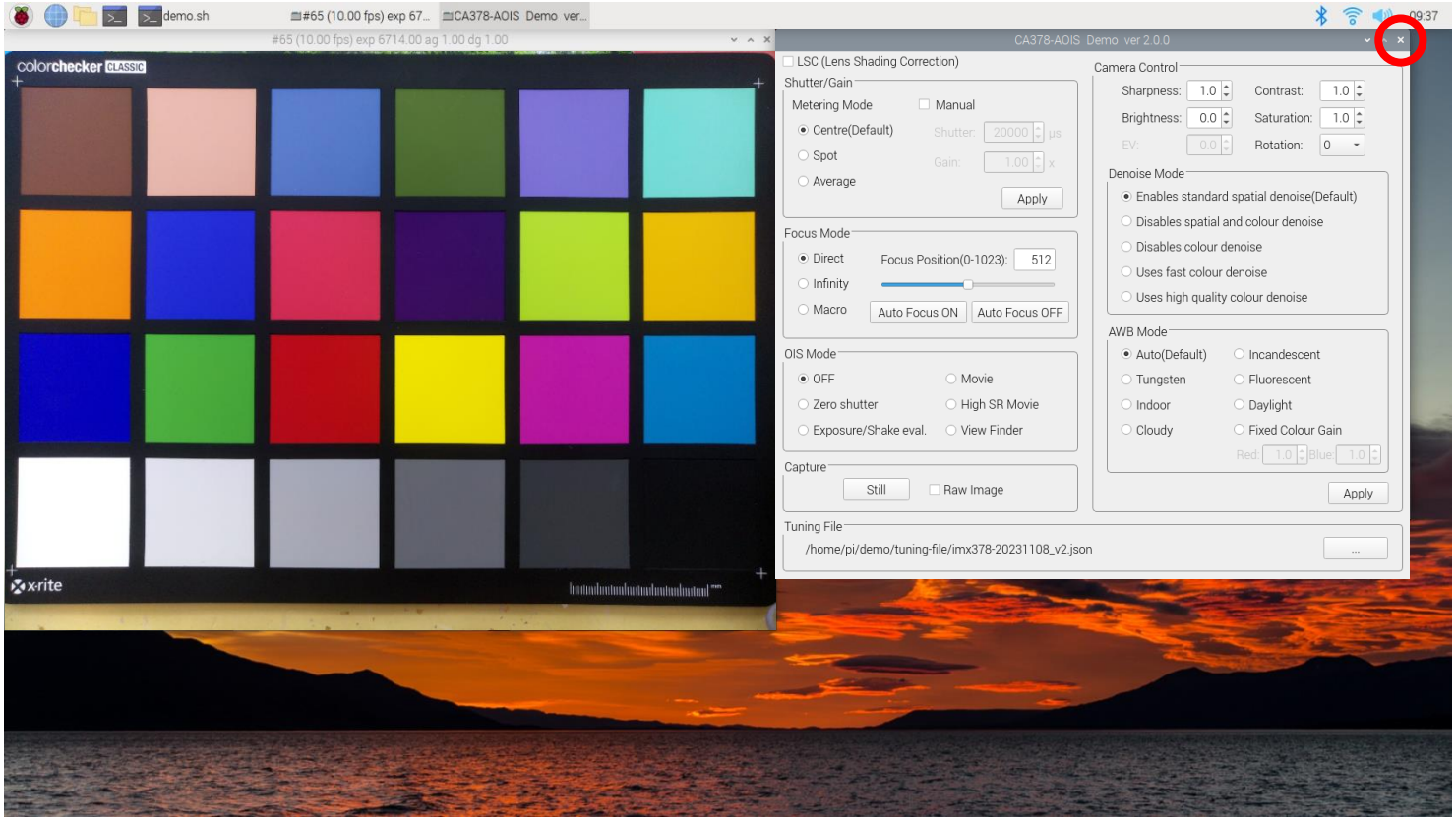



OIS mode cannot be operated.

Focus mode & OIS mode cannot be operated.

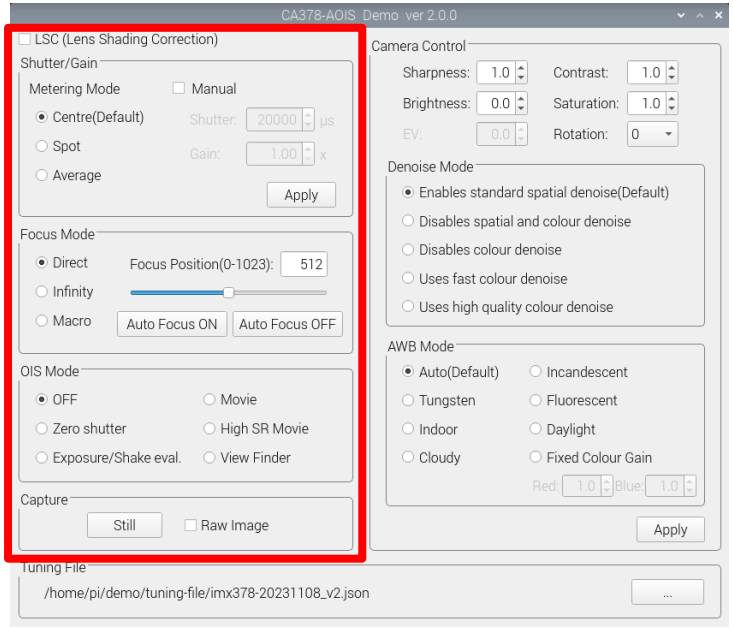
# 2.1. Focus & OIS & Camera control

Procedure of finishing Focus & OIS:
1. Click the [x]



# 2.1. Focus & OIS & Camera control

The following section describes each function of Focus & OIS.

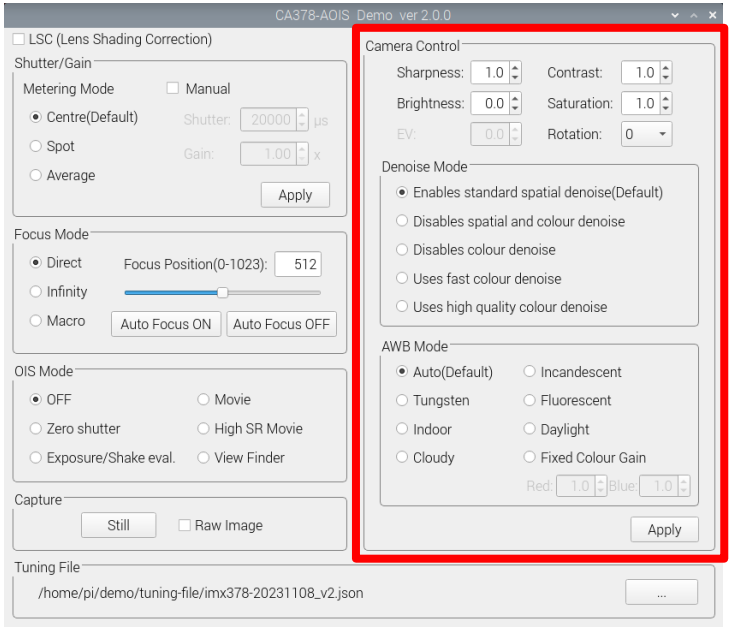



| Function | Description |
|---|---|
| LSC | Check to enable shading correction.<br>※ Theoretical values have been set. |
| Shutter/Gain | Metering Mode: Select the Sets the metering mode of the AEC/AGC algorithm.<br>Shutter: Specify the shutter speed (microseconds).<br>The maximum value depends on the length of frame.<br>Gain: Specify the combined analogue and digital gains.<br>* It may not match the value specified in the libcamera-apps command line option.<br>Apply: Apply the settings. |
| Focus Mode | Direct: Directly specify the focus position.<br>Infinity: Set the focus position to infinity.<br>Macro: Set the focus position to the short distance.<br>Focus Position: Focus position.<br>Auto Focus ON: Enable auto focus.<br>Auto Focus OFF: Disable auto focus.<br>* Current debug control is for demo. |
| OIS Mode | OFF: Disable OIS.<br>It corresponds to each OIS mode.<br>Zero Shutter<br>Exposure / Shake eval.<br>Movie<br>High SR Movie<br>View Finder |
| Capture | Still: Capture normal still image (JPEG format).<br>Raw Image: Save a raw Bayer file in DNG format alongside the usual output image. |

# 2.1. Focus & OIS & Camera control

The following section describes each function of Camera control.

Press the Apply button to apply the settings.

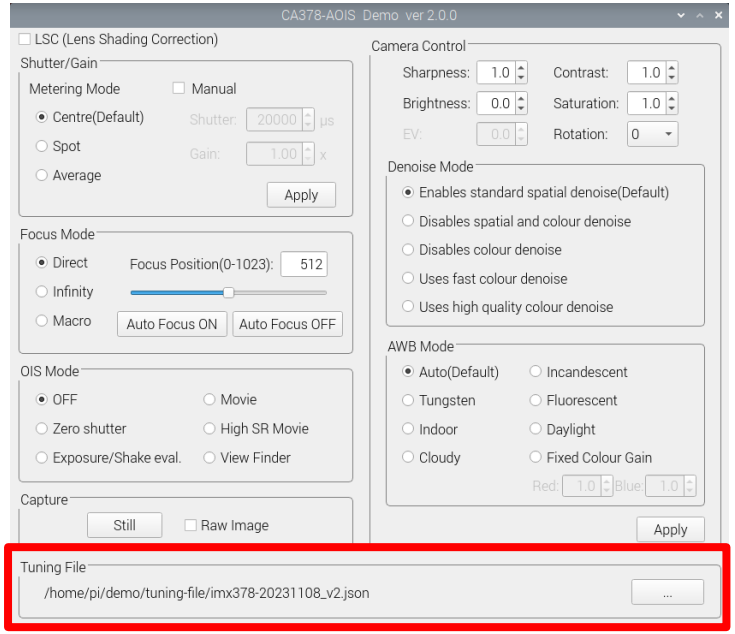



| Function | Description |
|---|---|
| Sharpness | The given number adjusts the image sharpness. |
| Contrast | The given number adjusts the image contrast. |
| Brightness | The given number adjusts the image brightness. |
| Saturation | The given number adjusts the colour saturation. |
| EV | Sets the EV compensation of the image in units of stops, in the range -10 to 10. |
| Rotation | Rotates the image by the given rotation angle. |
| Denoise Mode | Select the denoise mode.<br>It corresponds to each denoise mode.<br>Enables standard spatial denoise.<br>It uses extra fast colour denoise for video, and high quality colour denoise for stills capture. Preview does not enable any extra colour denoise at all.<br>Disables spatial and colour denoise.<br>Disables colour denoise.<br>Uses fast color denoise.<br>Uses high quality colour denoise. |
| AWB Mode | Select the AWB mode.<br>This option sets the AWB algorithm into the named AWB mode.<br><br>If you select Fixed colour gain, specify the red and blue gains. |

* The shutter/gain and camera control functions each correspond to libcamera-apps command line options.
https://www.raspberrypi.com/documentation/computers/camera_software.html#camera-control

# 2.1. Focus & OIS & Camera control

The following section describes each function of Tuning file.




| Function | Description |
|---|---|
| Tuning File | Press the file selection button and select the tuning file. |

| Camera module | Tuning file |
|---|---|
| CA378-AOIS | imx378-20231108_v2.json |
| CA378-AOIS-V2 | imx378-v2-20240117_v2.json |
| CA378-V2wide | imx378-v2wide-20231108_v2.json |

# 2.1. Focus & OIS & Camera control

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

```
#!/bin/sh
cd /home/pi/demo
libcamera-hello -t 0 --viewfinder-width ${1} --viewfinder-height ${2} --framerate ${3} --tuning-file ${4} ${5}
```

libcamera-hello
https://www.raspberrypi.com/documentation/computers/camera_software.html#libcamera-hello

| Option | Description |
|---|---|
| -t or --timeout | Delay before application stops automatically <milliseconds><br>The value zero causes the application to run indefinitely. |
| --viewfinder-width ${1}* | Capture image width |
| --viewfinder-height ${2}* | Capture image height |
| --framerate ${3}* | Frame rate |
| --tuning-file ${4} | Tuning file (json format) specified in the demo.ini configuration file |
| ${5} | Options set with values selected/entered in the GUI |

https://www.raspberrypi.com/documentation/computers/camera_software.html#common-command-line-options

* The argument of the script file will be the argument specified in demo.sh.

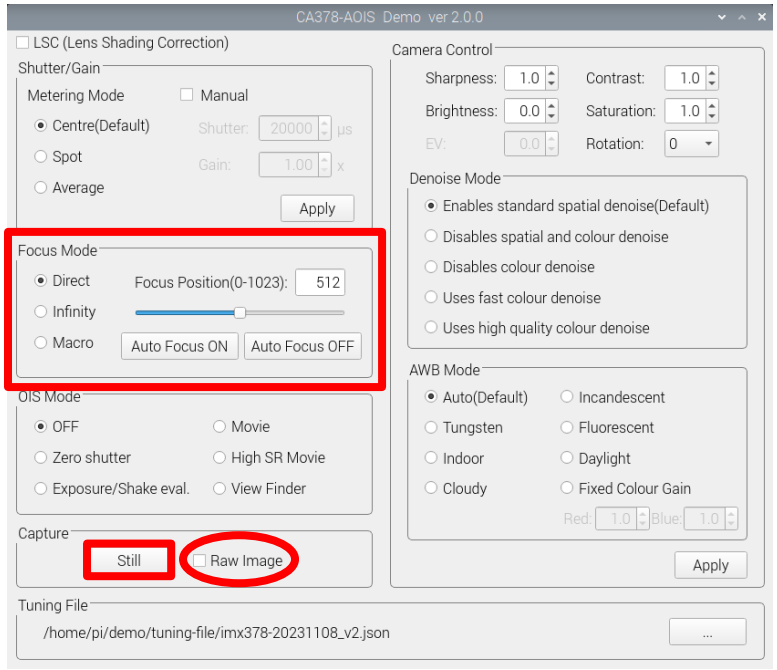
```
#!/bin/sh
cd /home/pi/demo
./bin/DemoGUI -w 4056 -h 3040 -fps 10
```

The following Bayer modes are currently available:
4056x3040 12-bit @ 10fps
2028x1520 12-bit (binned) @ 40fps
2028x1050 12-bit (cropped/binned) @ 50fps

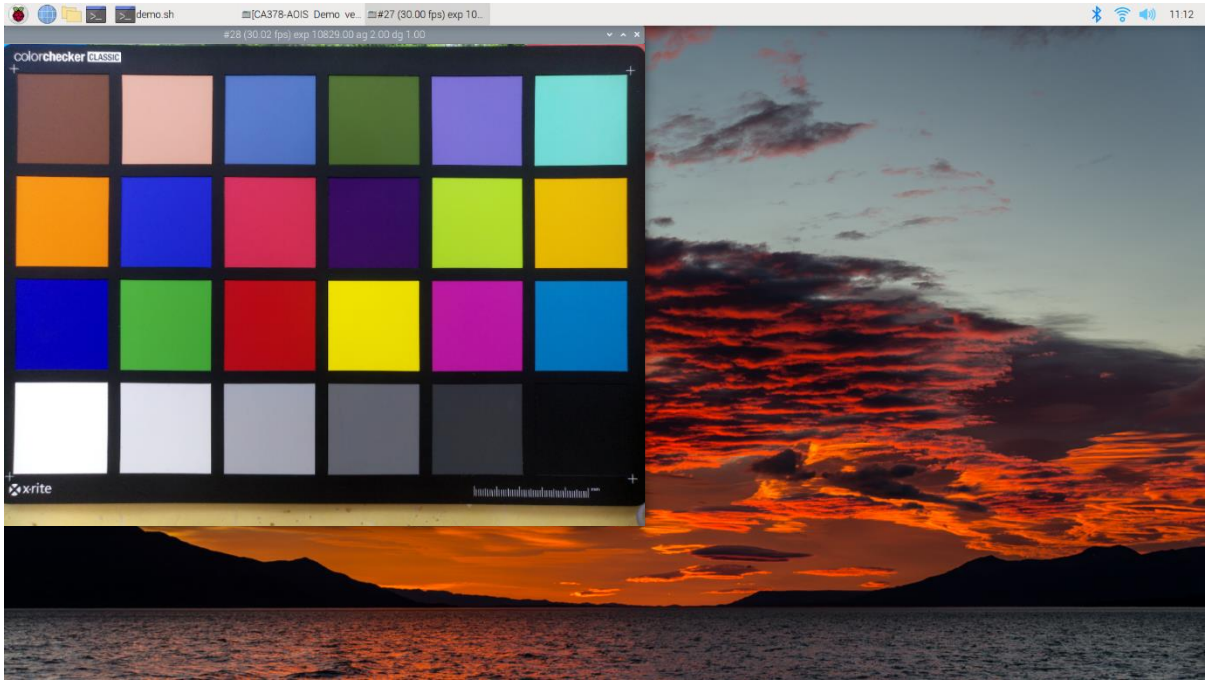
# 2.2. Still image capturing

Procedure of capturing 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 [Still] button
   If you want to save a Raw image (DNG format) at the same time, check the [Raw Image] checkbox.

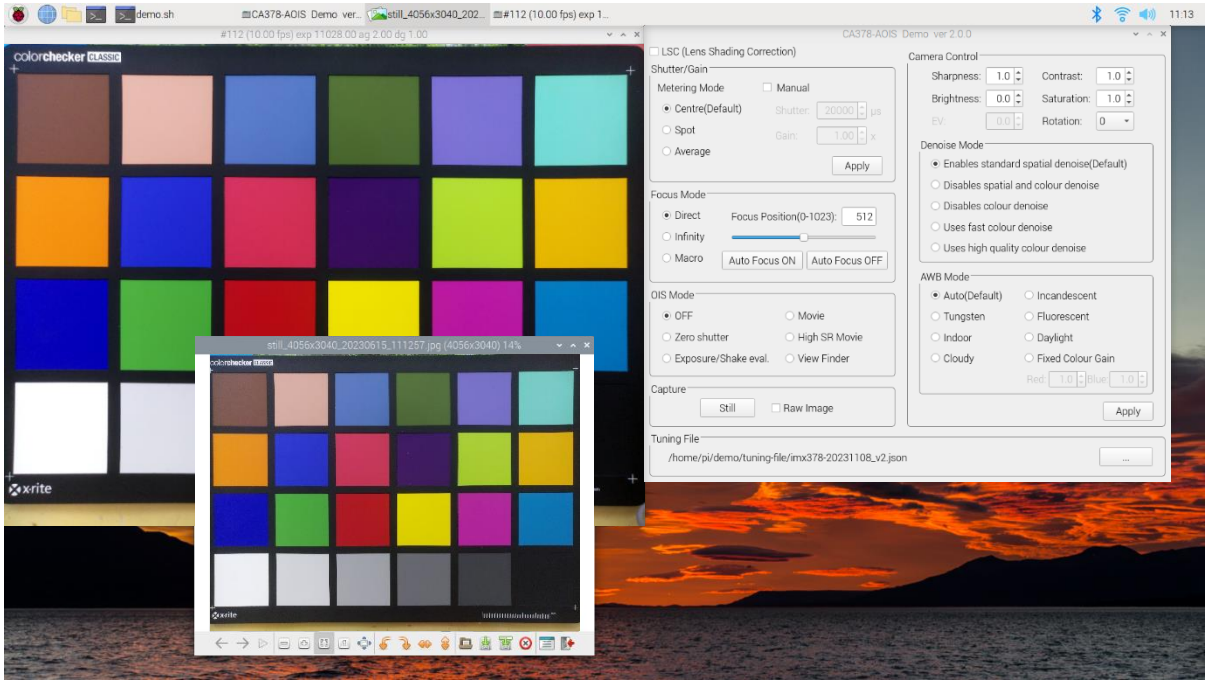


3. Wait until the still image capturing is finished.

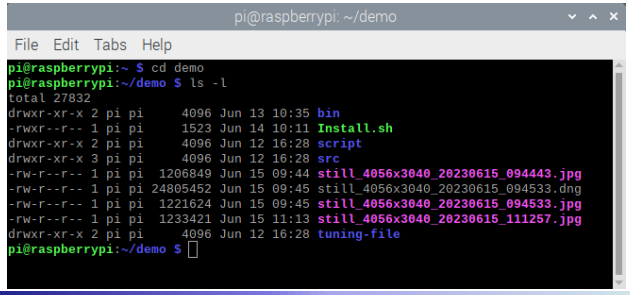


# 2.2. Still image capturing

4. When the still image capturing is finished, the preview display is restored.




5. Still images are saved in the demo directory.



# 2.2. Still image capturing

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Description of the script file:
It describes about the “script/stillCapture.sh".

```
#!/bin/sh
cd /home/pi/demo
DATETIME=`date "+%Y%m%d_%H%M%S"`
FILENAME=still_${1}x${2}_${DATETIME}
libcamera-still --width ${1} --height ${2} -o ${FILENAME}.jpg --tuning-file ${3} ${4}
```

libcamera-still
https://www.raspberrypi.com/documentation/computers/camera_software.html#libcamera-still

| Option | Description |
|---|---|
| --width ${1}* | Capture image width |
| --height ${2}* | Capture image height |
| -o or –output | Output file name |
| --tuning-file ${3} | Tuning file (json format) specified in the demo.ini configuration file |
| ${4} | Options set with values selected/entered in the GUI |

https://www.raspberrypi.com/documentation/computers/camera_software.html#common-command-line-options

* The argument of the script file will be the argument specified in demo.sh.

```
#!/bin/sh
cd /home/pi/demo
./bin/DemoGUI -w 4056 -h 3040 -fps 10
```

The following Bayer modes are currently available:
4056x3040 12-bit @ 10fps
2028x1520 12-bit (binned) @ 40fps
2028x1050 12-bit (cropped/binned) @ 50fps

# Appendix

# A.1. About the directory structure

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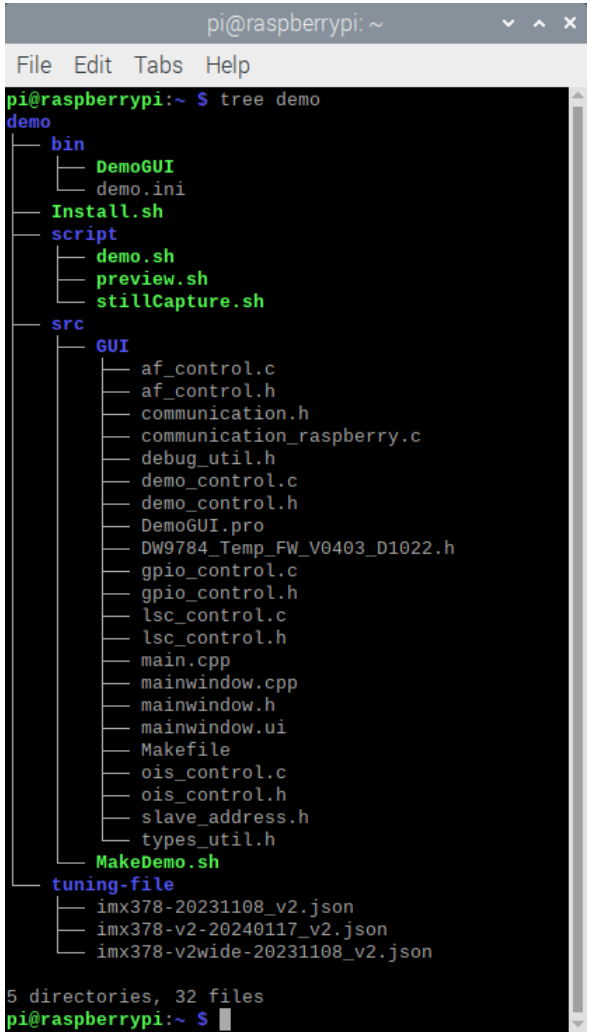
The following section describes the directory structure of the software.




| Function | Description |
|---|---|
| bin | DemoGUI: Demonstration software<br>demo.ini: Demonstration software setting file |
| script | Script files are described.<br>It can be customized according to specifications.<br>demo.sh<br>preview.sh<br>stillCapture.sh |
| src | It is a set of demo software source code. |
| tuning-file | It is a tuning file (json format). |

https://www.raspberrypi.com/documentation/computers/camera_software.html#the-camera-tuning-file

# A.2. About the setting file

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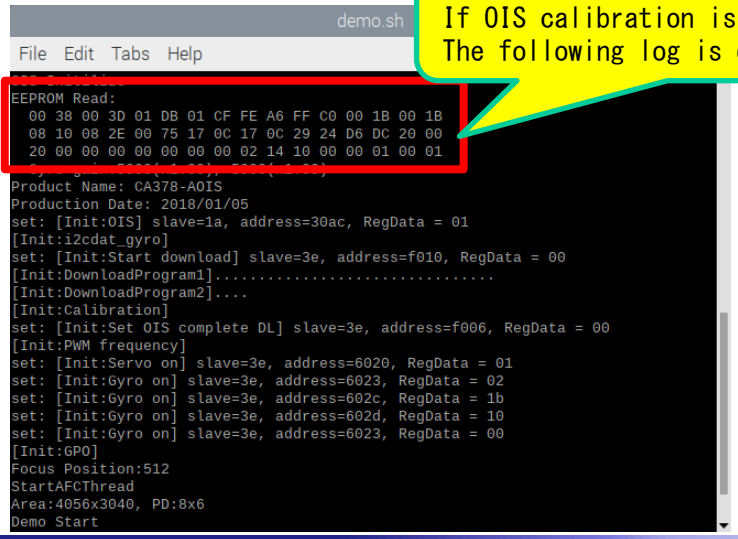
The following section describes the "demo.ini" of the setting file.

```
# DEMO Setting
preview=/home/pi/demo/script/preview.sh
stillCapture=/home/pi/demo/script/stillCapture.sh
tuning-file=/home/pi/demo/tuning-file/imx378-20231108_v2.json
gyroGainRateX=1.00
gyroGainRateY=1.00
autoFocusGain=2.0
autoFocusConfidenceThreshold=10
autoFocusMoveLimit=100
autoFocusFrameSyncMode=0
gain=1.0
shutter=20000
FocusControlMode=0
UseCenter4PointsOfPDdata=0
rotation=0
```

CA378-AOIS only
If OIS calibration is already done,
The following log is output to Terminal.




| Function | Description |
|---|---|
| preview | Script path for preview |
| stillCapture | Script path for capturing still images |
| tuning-file | Tuning file (json format) path |
| gyroGainRateX<br>gyroGainRateY | It is valid only when OIS calibration result is written in EEPROM.<br>Currently, since the value of Gyro gain is too effective, the rate is adjusted. |
| autoFocusGain | Adjust the autofocus gain. |
| autoFocusConfidence Threshold | Specify the threshold value of the confidence level of Phase Difference. |
| autoFocusMoveLimit | Limit the amount of focus movement at one time. |
| autoFocusFrameSync Mode | 0 : Frame async<br>1 : Frame sync(Use XVS/GPIO)* |
| gain | Specify the combined analogue and digital gains. |
| shutter | Specify the shutter speed. |
| FocusControlMode | 0 : CLAF Calibration mode<br>1 : CLAF Servo ON(for CA378-AOIS-C) |
| UseCenter4PointsOf PDdata | 0: Read all PD data<br>1: Read PD data at the center 4 points |
| rotation | Specify the rotation angle.<br>0 : 0 degree<br>1 : 180 degree |

* A wire connection to GPIO is required hen synchronizing to the XVS signal.