UVC Camera Software Manual

Date	Version	Description
2023-10-19	V1.0	First Released

1 Description

- UVC cameras comply with UVC protocol and work with web-camera applications out-of-box
- UVC Cameras support windows, linux, MacOs Compatible with UVC drivers

1.1 What is UVC Camera

- UVC Camera is camera with a USB interface that meets the standards set for the USB Video Class. This means that every UVC Camera is a USB camera, but not all USB cameras are UVC Cameras, because they might adopt the USB interface without meeting the Video class requirements.
- Therefore, a major advantage of the UVC cameras is their universal compatibility and flexibility. As they meet the video class standard, you can easily use them on different platforms with a USB port without handling the driver issue, like the Raspberry Pi or a smartphone. It also makes it easier for you to migrate your applications from one platform to another.
- At present, our UVC cameras support Windows, Linux, MAC, and Android systems, but do not support the iPhone system.

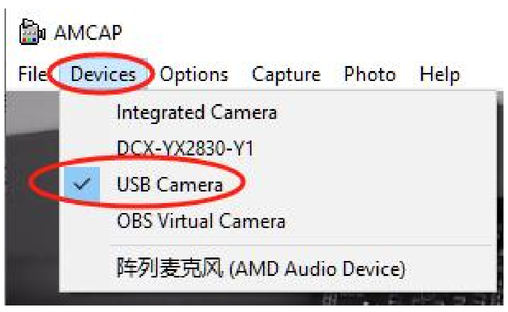
2 Works on Windows

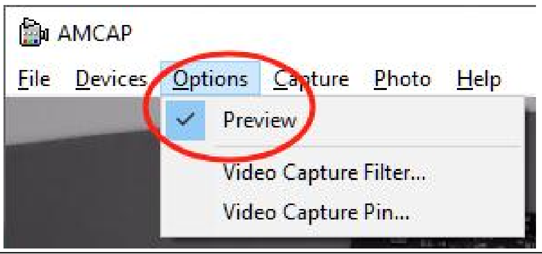
2.1 AMCAP

AMCAP is a free and easily use UVC Camera test tools.

2.1.1 Preview

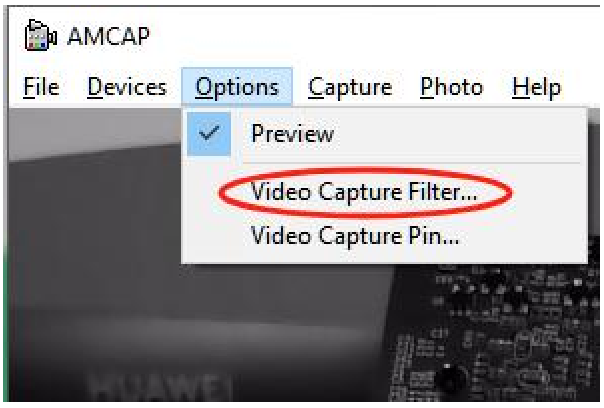
Open AMCAP.EXE, Select USB Camera From "Devices", Select "Preview" from "Options"

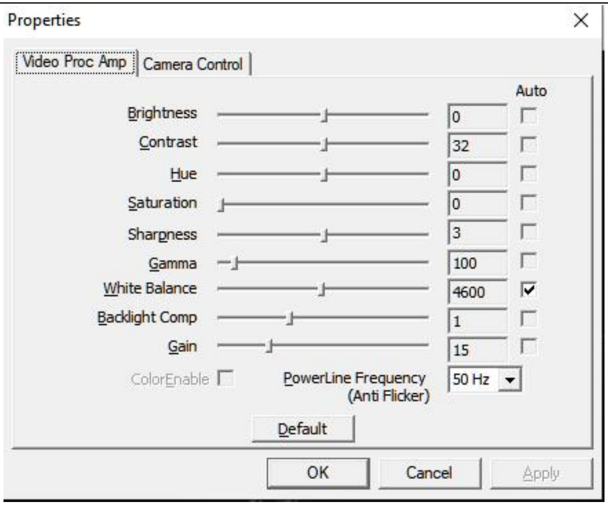




2.1.2 Video Capture Filter

You Can find most of Controllable Parameters from “Options”, “Video Capture Filter”.





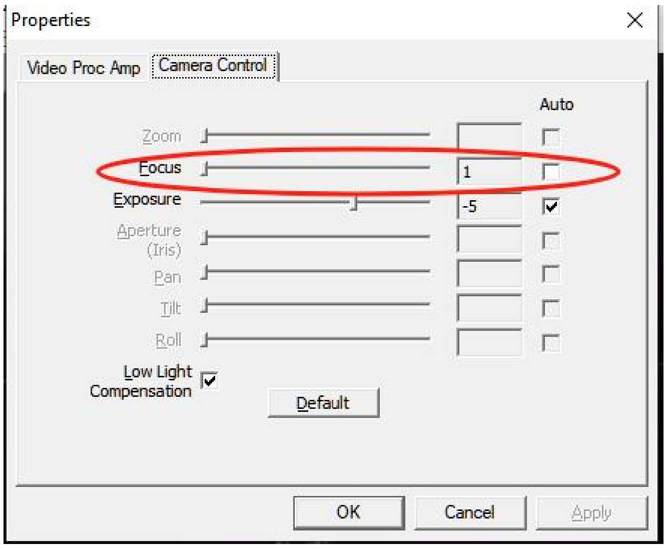
		Auto
Brightness	0	☐
Contrast	32	☐
Hue	0	☐
Saturation	0	☐
Sharpness	3	☐
Gamma	100	☐
White Balance	4600	✓
Backlight Comp	1	☐
Gain	15	☐
ColorEnable ☐	PowerLine Frequency (Anti Flicker)	50 Hz

Brightness,Contrast,Hue,Saturation,Sharpness,Gamma,White Balance,Backlight Comp,Gain,Exposure,PowerLine Frequency,Low Light Compensation

2.1.3 External Trigger Parameters

From “Video Capture Filter” “Camera Control” ,The “Focus” Parameter is for external trigger

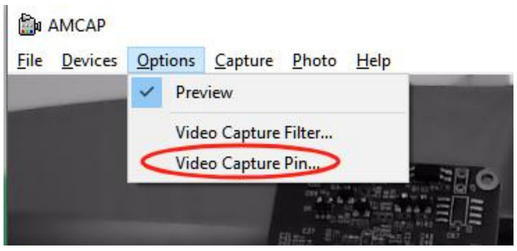
signal Enable.

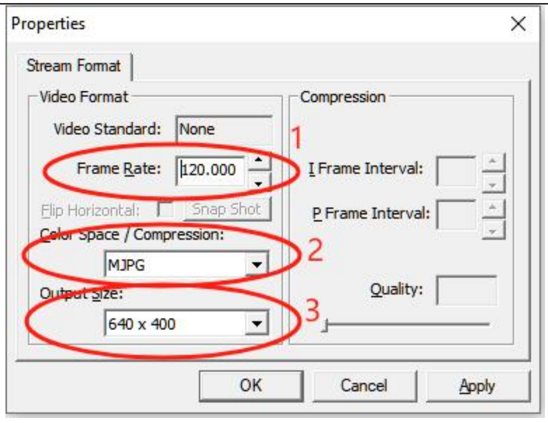


Focus: 1
Exposure: -5 [✓ Auto]
Low Light Compensation [✓]

2.1.3 Video Capture Pin

You Can find most of Controllable Parameters from "Options", "Video Capture Pin".



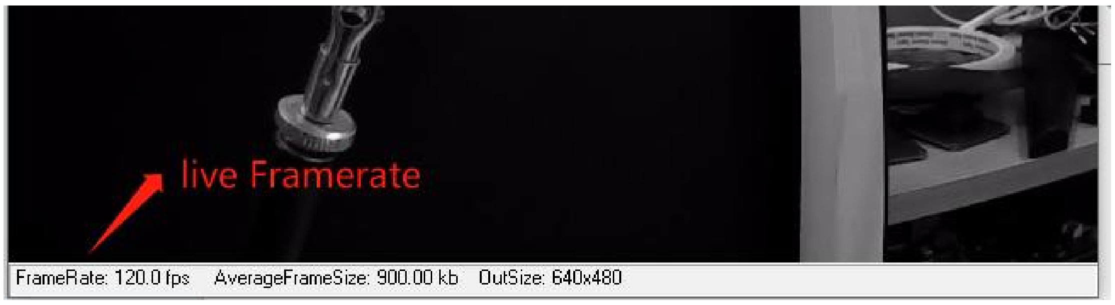


Video Standard: None
Frame Rate: 120.000
Color Space / Compression: MJPG
Output Size: 640 x 400

1	You can chage Frame rate
2	Choose Output format like MJPG/YUV2
3	Choose Resolution Camera

2.1.4 Status Bar

You can find live frame Rate, Output Resolution



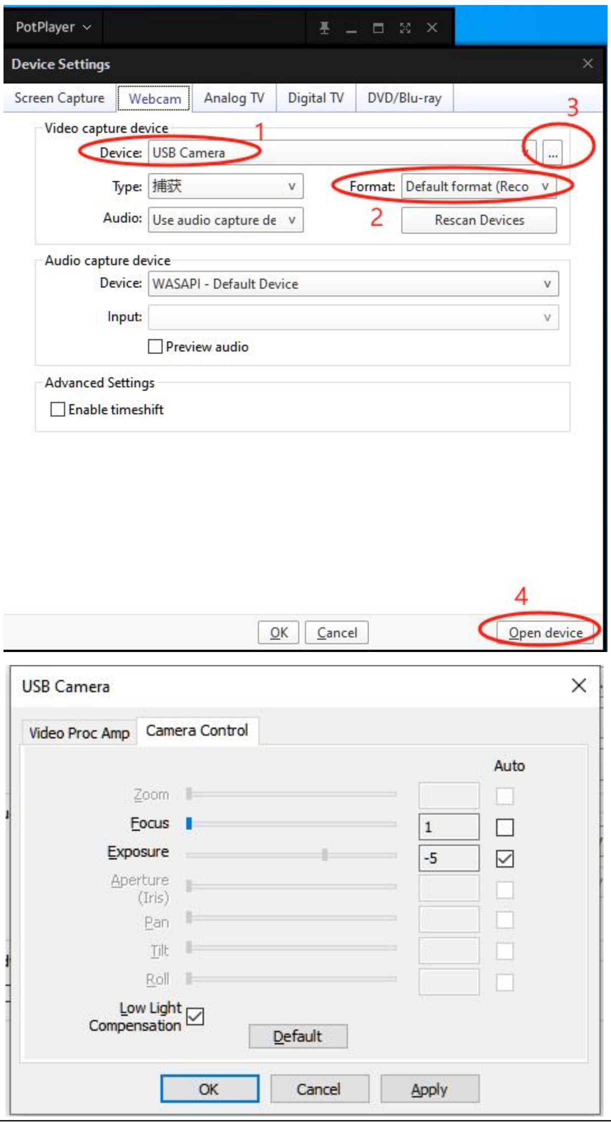
FrameRate: 120.0 fps   AverageFrameSize: 900.00 kb   OutSize: 640x480

2.2 PotPlayer

Potplayer is another free Windows Tools which easily get video and images of UVC and U3V,UVC3.0 Cameras.

2.2.1 Open UVC Camera

Use Shortcut Key **ALT+D** open window as above



Device Settings

Video capture device

Device: USB Camera

Type: 捕获

Format: Default format (Reco

Audio: Use audio capture de

Audio capture device

Device: WASAPI - Default Device

Input:

☐ Preview audio

Advanced Settings

☐ Enable timeshift

USB Camera

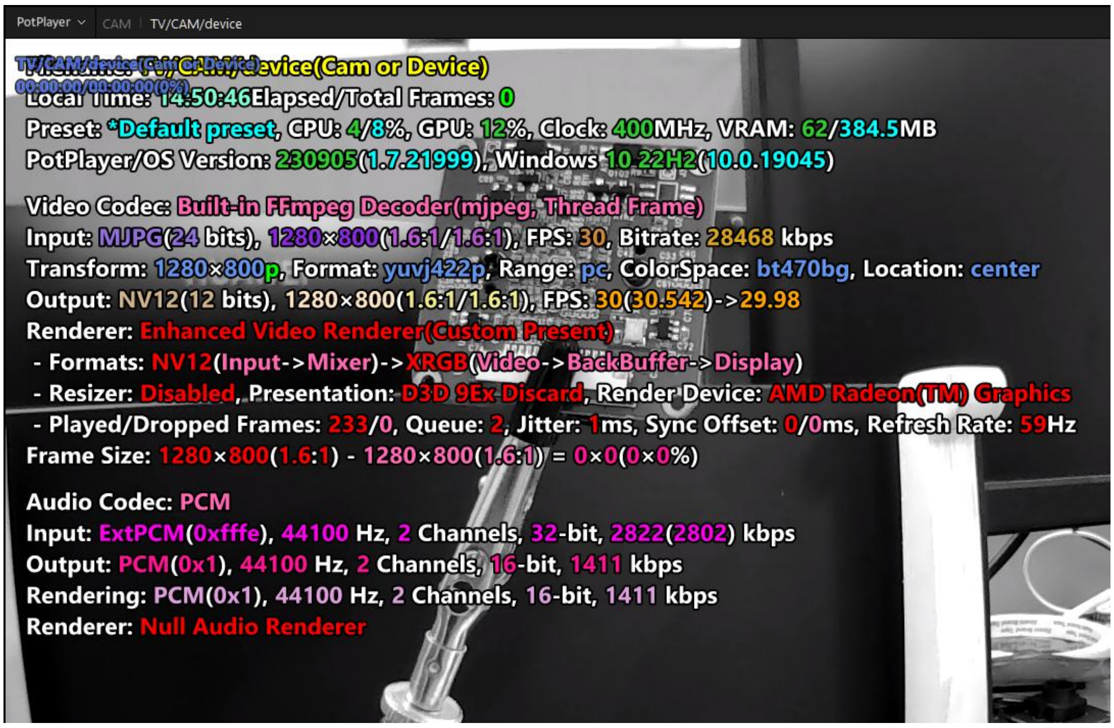
		Auto
Zoom		
Focus	1	☐
Exposure	-5	☑
Aperture (Iris)		
Pan		
Tilt		
Roll		

Low Light Compensation ☑

1	Choose UVC Camera Deivce
2	Choose Output format ,resolution,frame rate
3	Camera Parameters Settings
4	Open Device

2.2.2 Live Working Status

Use shortkey TAB Open window as below



```
TV/CAM/device(Cam or Device)
00:00:00/00:00:00(0%)
Filename: TV/CAM/device(Cam or Device)
Local Time: 14:50:46Elapsed/Total Frames: 0
Preset: *Default preset, CPU: 4/8%, GPU: 12%, Clock: 400MHz, VRAM: 62/384.5MB
PotPlayer/OS Version: 230905(1.7.21999), Windows 10 22H2(10.0.19045)

Video Codec: Built-in FFmpeg Decoder(mjpeg, Thread Frame)
Input: MJPG(24 bits), 1280×800(1.6:1/1.6:1), FPS: 30, Bitrate: 28468 kbps
Transform: 1280×800p, Format: yuvj422p, Range: pc, ColorSpace: bt470bg, Location: center
Output: NV12(12 bits), 1280×800(1.6:1/1.6:1), FPS: 30(30.542)->29.98
Renderer: Enhanced Video Renderer(Custom Present)
 - Formats: NV12(Input->Mixer)->XRGB(Video->BackBuffer->Display)
 - Resizer: Disabled, Presentation: D3D 9Ex Discard, Render Device: AMD Radeon(TM) Graphics
 - Played/Dropped Frames: 233/0, Queue: 2, Jitter: 1ms, Sync Offset: 0/0ms, Refresh Rate: 59Hz
Frame Size: 1280×800(1.6:1) - 1280×800(1.6:1) = 0×0(0×0%)

Audio Codec: PCM
Input: ExtPCM(0xfffe), 44100 Hz, 2 Channels, 32-bit, 2822(2802) kbps
Output: PCM(0x1), 44100 Hz, 2 Channels, 16-bit, 1411 kbps
Rendering: PCM(0x1), 44100 Hz, 2 Channels, 16-bit, 1411 kbps
Renderer: Null Audio Renderer
```

2.3 OpenCV Python

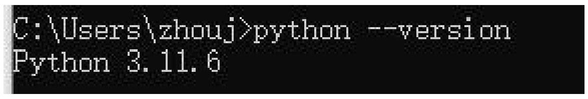
2.3.1 Install Python3

Download from below link,check from cmd.exe after install successfully

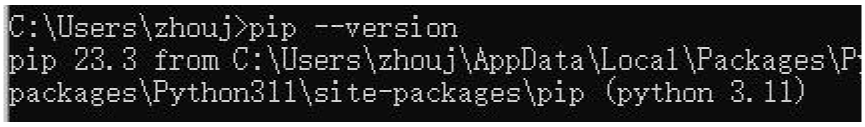
https://www.python.org/downloads/release/

```
python --version
```

```
pip --version
```



```
C:\Users\zhouj>python --version
Python 3.11.6
```



```
C:\Users\zhouj>pip --version
pip 23.3 from C:\Users\zhouj\AppData\Local\Packages\P
packages\Python311\site-packages\pip (python 3.11)
```

2.3.2 Install numpy

```
pip install numpy
```

2.3.3 Install Opencv

```
pip install opencv-python
```

If you have error for installing, update your pip by below command:

```
python -m pip install --upgrade pip
```

2.3.4 Run OpenCV Python

Example1:

```
import cv2

cv2.namedWindow("preview")
vc = cv2.VideoCapture(0)

if vc.isOpened(): # try to get the first frame
    rval, frame = vc.read()
else:
    rval = False

while rval:
    cv2.imshow("preview", frame)
```

```
        rval, frame = vc.read()
        key = cv2.waitKey(20)
        if key == 27: # exit on ESC
                break

vc.release()
cv2.destroyWindow("preview")
```

Example2：

```
# import the opencv library
import cv2


# define a video capture object
vid = cv2.VideoCapture(0)

while(True):

        # Capture the video frame
        # by frame
        ret, frame = vid.read()

        # Display the resulting frame
        cv2.imshow('frame', frame)

        # the 'q' button is set as the
        # quitting button you may use any
        # desired button of your choice
        if cv2.waitKey(1) & 0xFF == ord('q'):
                break

# After the loop release the cap object
vid.release()
# Destroy all the windows
cv2.destroyAllWindows()
```

2.3.5 Cited information

You can refer to the below link for any updates:

https://stackoverflow.com/a/606154
https://www.geeksforgeeks.org/python-opencv-capture-video-from-camera/

3 Works on Linux

3.1 Guvcview

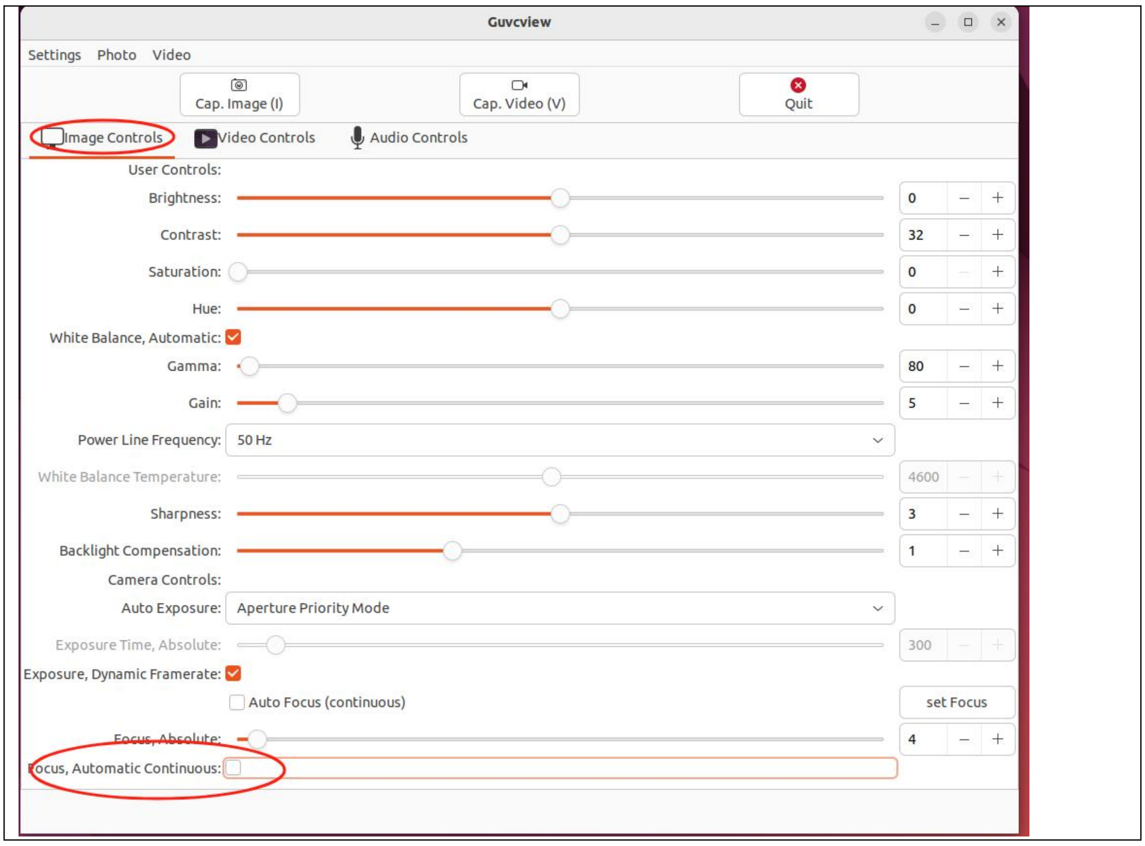
3.1.1 Install

Guvcview is free and easy operation tools for linux, Install and run :

```
sudo apt install guvcview
```

```
sudo guvcview
```

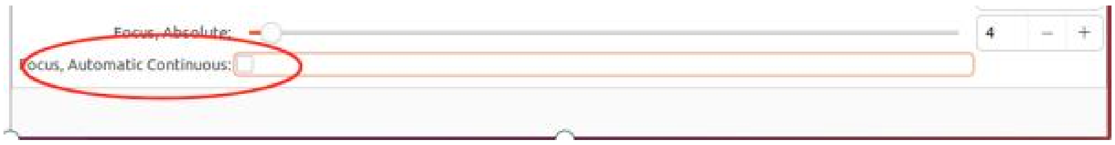
3.1.2 Image Controls



User Controls:
Brightness: 0
Contrast: 32
Saturation: 0
Hue: 0
White Balance, Automatic: ✓
Gamma: 80
Gain: 5
Power Line Frequency: 50 Hz
White Balance Temperature: 4600
Sharpness: 3
Backlight Compensation: 1
Camera Controls:
Auto Exposure: Aperture Priority Mode
Exposure Time, Absolute: 300
Exposure, Dynamic Framerate: ✓
Auto Focus (continuous)
Focus, Absolute: 4
Focus, Automatic Continuous:

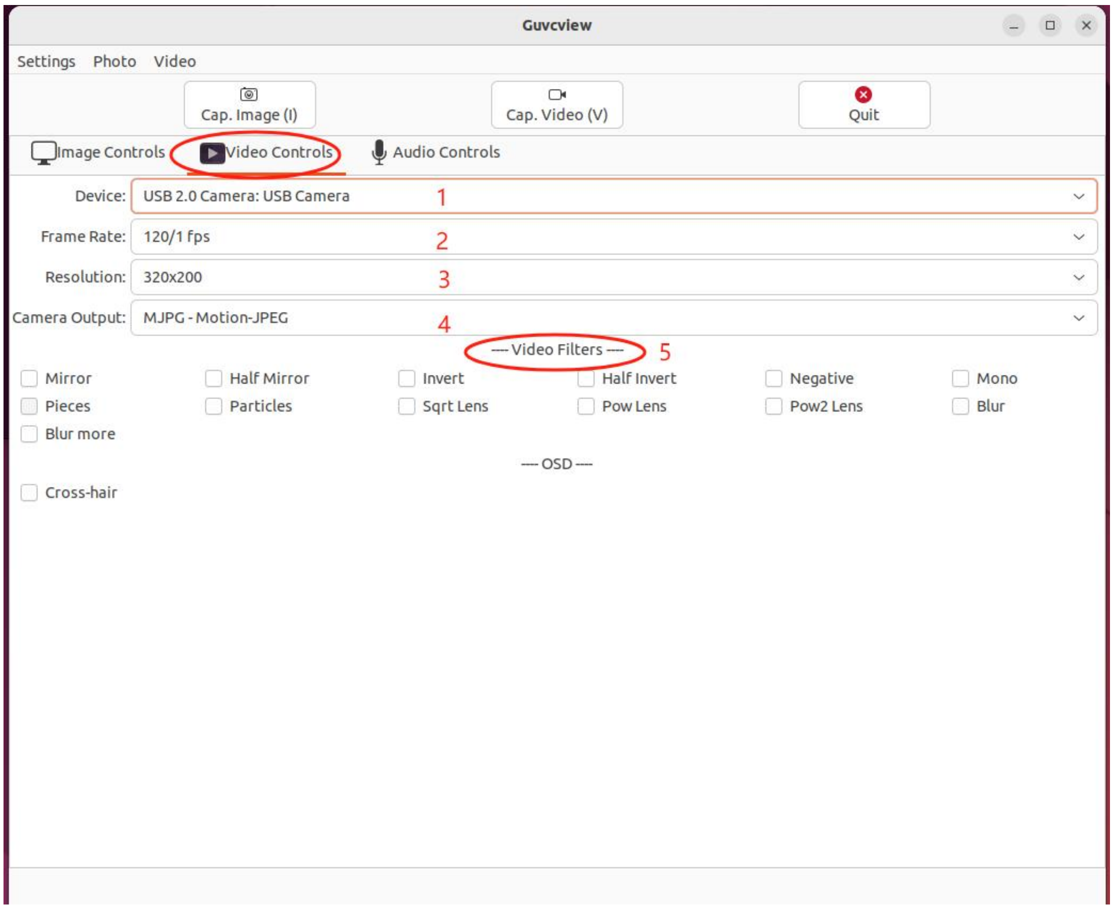
You can find the control parameters from Image Controls.

3.1.3 External Trigger Control


Focus, Absolute: 4
Focus, Automatic Continuous:

Focus,Automatic Continuous is for external trigger. Uncheck it to enable external trigger mode.

3.1.4 Video Controls



From Video Controls,

1	Select Device
2	Select Frame Rate
3	Select Resolution
4	Select Output format
5	Video Filters

3.2 qv4l2

3.2.1 Install

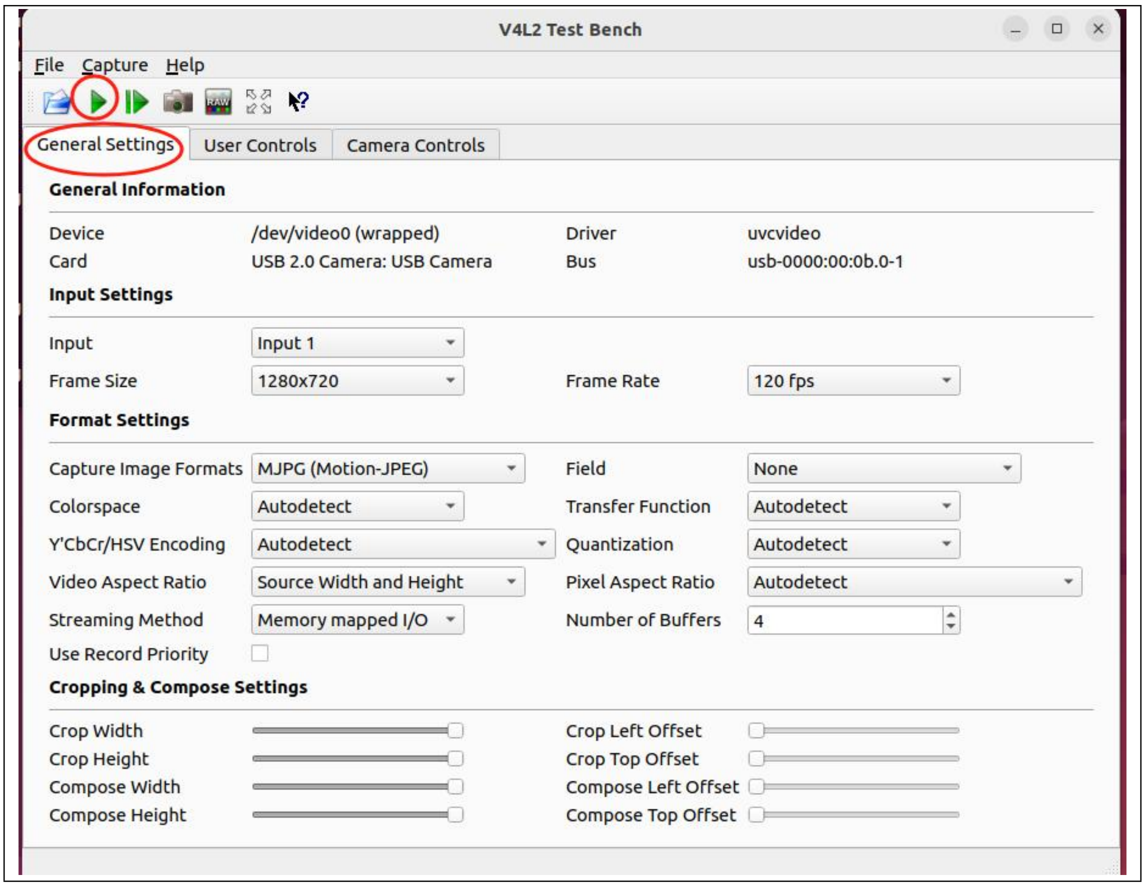
qv4l2 is free and easy operation tools for linux, Install and run :

```
sudo apt install qv4l2
```

```
sudo qv4l2
```

3.2.2 General Settings

Choose Output Devices, Resolution, Frame Rate



General Information

Device	/dev/video0 (wrapped)	Driver	uvcvideo
Card	USB 2.0 Camera: USB Camera	Bus	usb-0000:00:0b.0-1

Input Settings

Input	Input 1		
Frame Size	1280x720	Frame Rate	120 fps

Format Settings

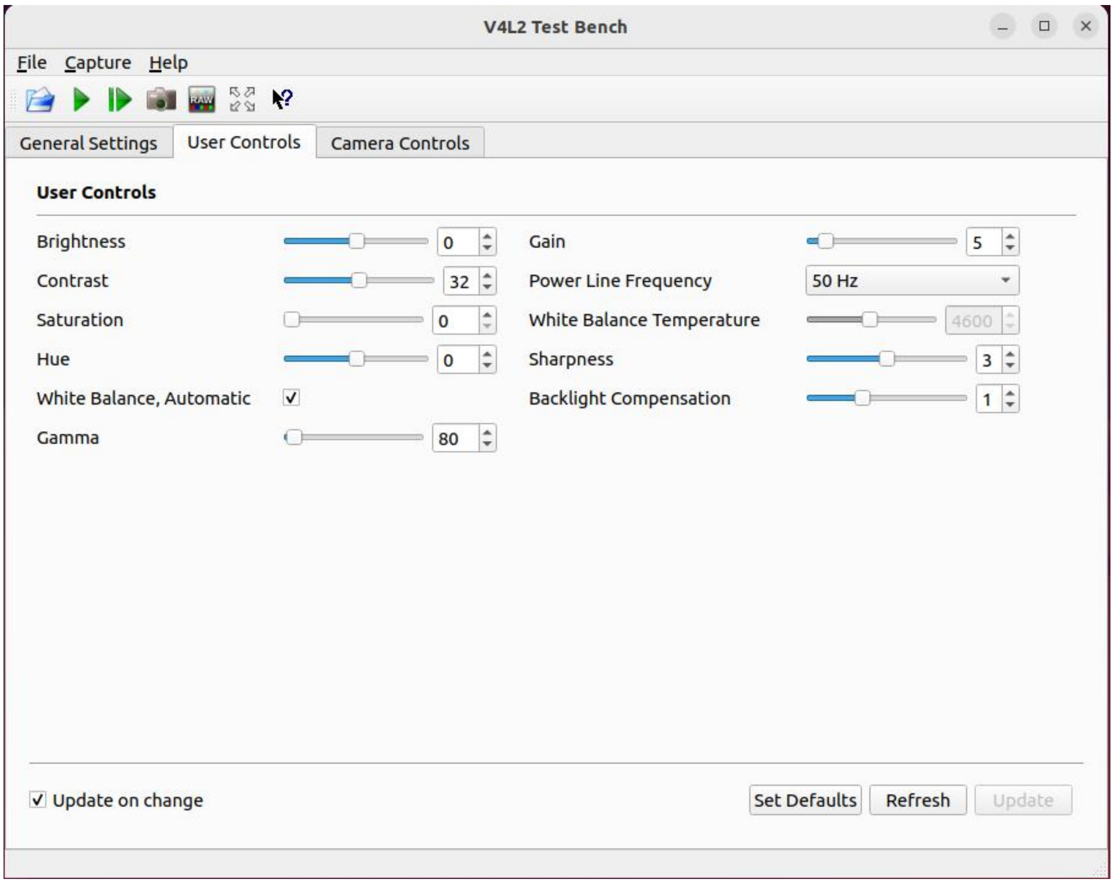
Capture Image Formats	MJPG (Motion-JPEG)	Field	None
Colorspace	Autodetect	Transfer Function	Autodetect
Y'CbCr/HSV Encoding	Autodetect	Quantization	Autodetect
Video Aspect Ratio	Source Width and Height	Pixel Aspect Ratio	Autodetect
Streaming Method	Memory mapped I/O	Number of Buffers	4
Use Record Priority	☐		

Cropping & Compose Settings

Crop Width	Crop Left Offset
Crop Height	Crop Top Offset
Compose Width	Compose Left Offset
Compose Height	Compose Top Offset

3.2.3 User Controls

control parameters


V4L2 Test Bench

File Capture Help

General Settings | User Controls | Camera Controls

User Controls

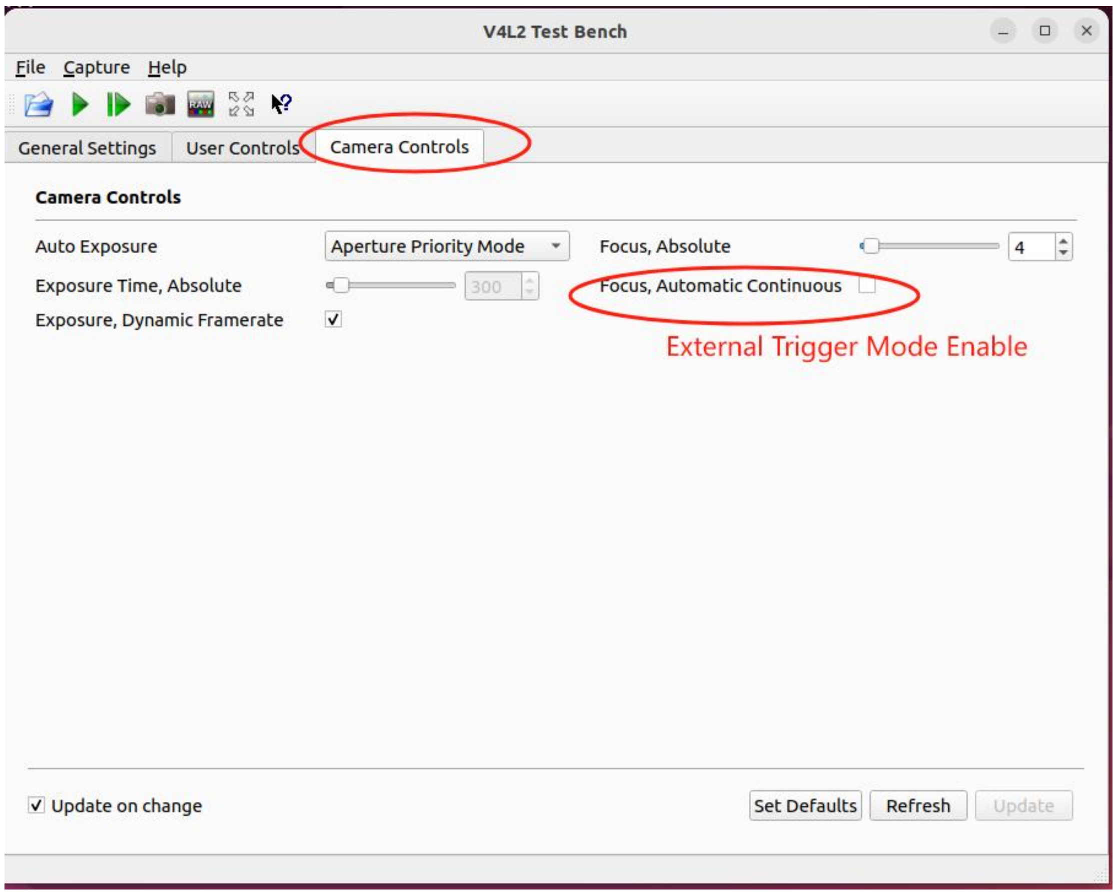
Brightness	0	Gain	5
Contrast	32	Power Line Frequency	50 Hz
Saturation	0	White Balance Temperature	4600
Hue	0	Sharpness	3
White Balance, Automatic	✓	Backlight Compensation	1
Gamma	80		

✓ Update on change

Set Defaults | Refresh | Update

3.2.4 Camera Controls

You can uncheck the External Trigger from this options.



Camera Controls

Auto Exposure: Aperture Priority Mode
Exposure Time, Absolute: 300
Exposure, Dynamic Framerate: ✓
Focus, Absolute: 4
Focus, Automatic Continuous: ☐
External Trigger Mode Enable
✓ Update on change

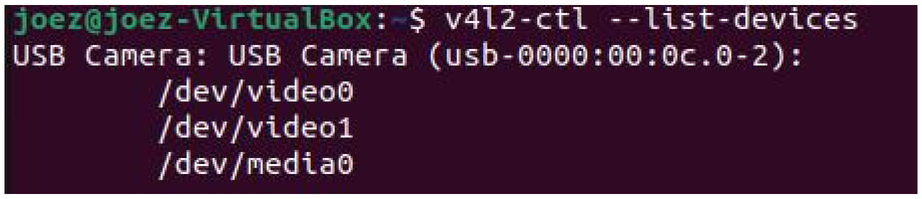
3.3 V4L utility Tools

3.3.1 Install V4L utility packages

```
sudo apt-get update
sudo apt-get install v4l-utils
```

3.3.2 List UVC devices

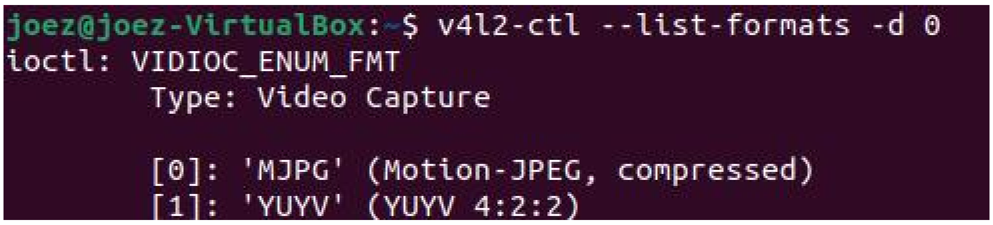
```
v4l2-ctl --list-devices
```



```
joez@joez-VirtualBox:~$ v4l2-ctl --list-devices
USB Camera: USB Camera (usb-0000:00:0c.0-2):
        /dev/video0
        /dev/video1
        /dev/media0
```

3.3.3 List the supported formats

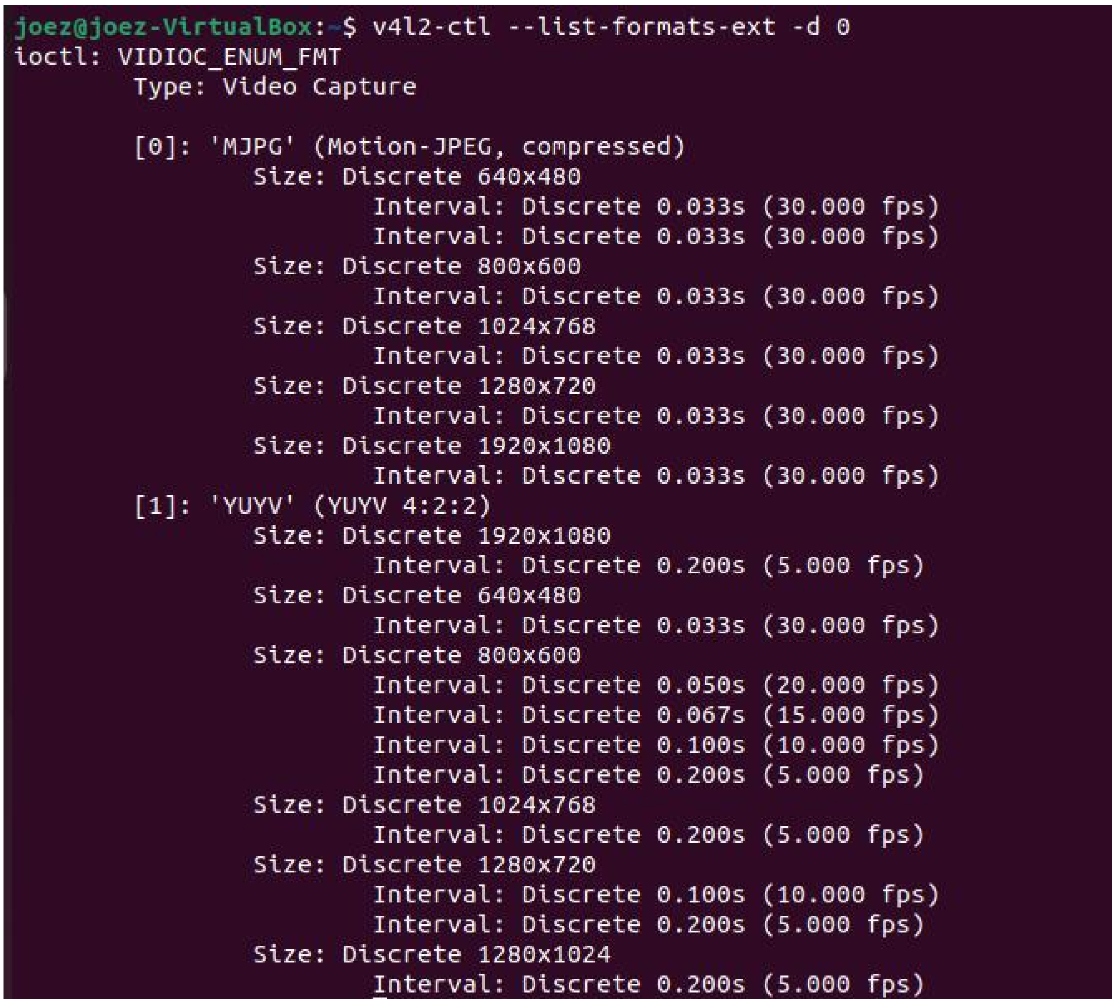
```
v4l2-ctl --list-formats -d
```



```
joez@joez-VirtualBox:~$ v4l2-ctl --list-formats -d 0
ioctl: VIDIOC_ENUM_FMT
        Type: Video Capture

        [0]: 'MJPG' (Motion-JPEG, compressed)
        [1]: 'YUYV' (YUYV 4:2:2)
```

3.3.4 List resolutions and frame

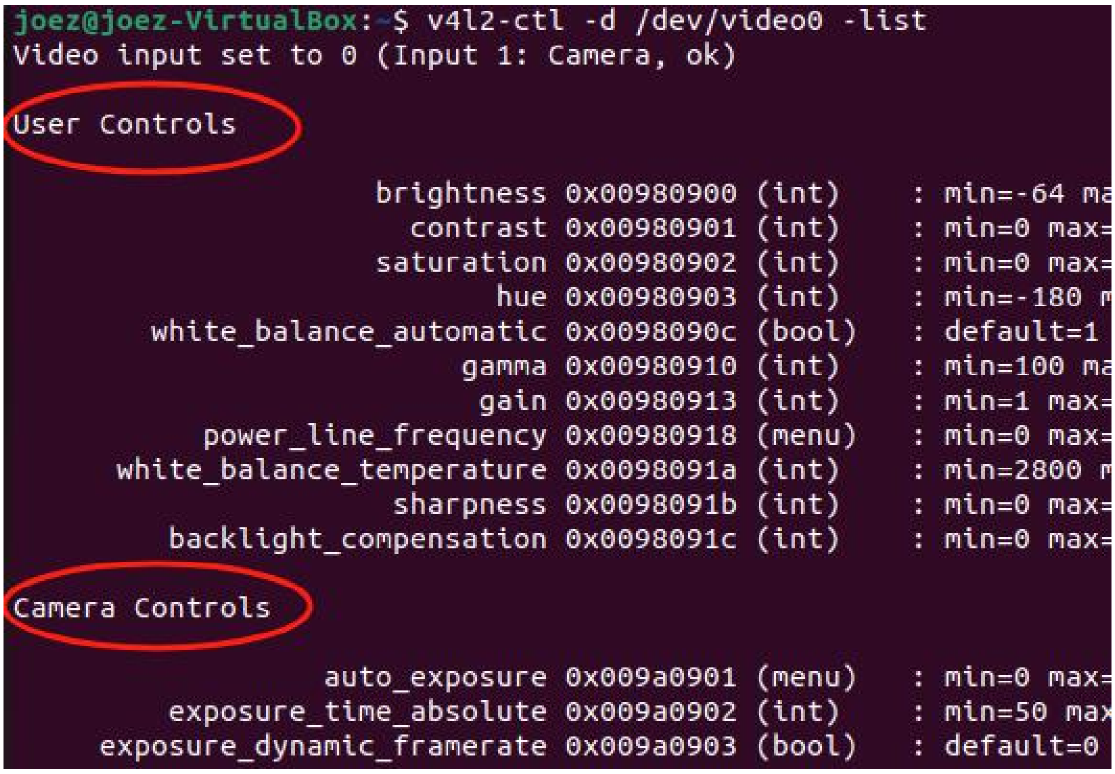
```
v4l2-ctl --list-formats-ext -d 0
```



```
joez@joez-VirtualBox:~$ v4l2-ctl --list-formats-ext -d 0
ioctl: VIDIOC_ENUM_FMT
        Type: Video Capture

        [0]: 'MJPG' (Motion-JPEG, compressed)
                Size: Discrete 640x480
                        Interval: Discrete 0.033s (30.000 fps)
                        Interval: Discrete 0.033s (30.000 fps)
                Size: Discrete 800x600
                        Interval: Discrete 0.033s (30.000 fps)
                Size: Discrete 1024x768
                        Interval: Discrete 0.033s (30.000 fps)
                Size: Discrete 1280x720
                        Interval: Discrete 0.033s (30.000 fps)
                Size: Discrete 1920x1080
                        Interval: Discrete 0.033s (30.000 fps)
        [1]: 'YUYV' (YUYV 4:2:2)
                Size: Discrete 1920x1080
                        Interval: Discrete 0.200s (5.000 fps)
                Size: Discrete 640x480
                        Interval: Discrete 0.033s (30.000 fps)
                Size: Discrete 800x600
                        Interval: Discrete 0.050s (20.000 fps)
                        Interval: Discrete 0.067s (15.000 fps)
                        Interval: Discrete 0.100s (10.000 fps)
                        Interval: Discrete 0.200s (5.000 fps)
                Size: Discrete 1024x768
                        Interval: Discrete 0.200s (5.000 fps)
                Size: Discrete 1280x720
                        Interval: Discrete 0.100s (10.000 fps)
                        Interval: Discrete 0.200s (5.000 fps)
                Size: Discrete 1280x1024
                        Interval: Discrete 0.200s (5.000 fps)
```

3.3.5 List Control parameters

v4l2-ctl -d /dev/video0 -list

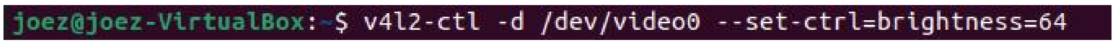


```
joez@joez-VirtualBox:~$ v4l2-ctl -d /dev/video0 -list
Video input set to 0 (Input 1: Camera, ok)

User Controls

                     brightness 0x00980900 (int)    : min=-64 ma
                       contrast 0x00980901 (int)    : min=0 max=
                     saturation 0x00980902 (int)    : min=0 max=
                            hue 0x00980903 (int)    : min=-180 m
        white_balance_automatic 0x0098090c (bool)   : default=1
                          gamma 0x00980910 (int)    : min=100 ma
                           gain 0x00980913 (int)    : min=1 max=
           power_line_frequency 0x00980918 (menu)   : min=0 max=
      white_balance_temperature 0x0098091a (int)    : min=2800 m
                      sharpness 0x0098091b (int)    : min=0 max=
         backlight_compensation 0x0098091c (int)    : min=0 max=

Camera Controls

                  auto_exposure 0x009a0901 (menu)   : min=0 max=
         exposure_time_absolute 0x009a0902 (int)    : min=50 max
     exposure_dynamic_framerate 0x009a0903 (bool)   : default=0
```

3.3.6 Set User/Camera controls

For example, set camera brightness to 64

v4l2-ctl -d /dev/video0 --set-ctrl=brightness=64



```
joez@joez-VirtualBox:~$ v4l2-ctl -d /dev/video0 --set-ctrl=brightness=64
```

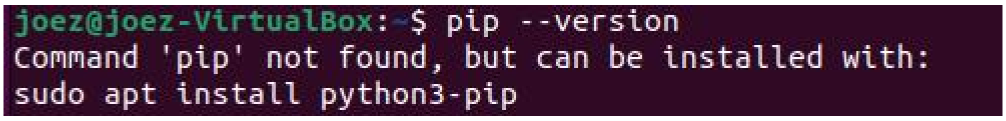
3.4 OpenCV Python

3.4.1 Install Opencv-Python

Check python pip version

```
python3 --version
pip --version
```

Run below command if not find the pip.



```
joez@joez-VirtualBox:~$ pip --version
Command 'pip' not found, but can be installed with:
sudo apt install python3-pip
```

```
sudo apt install python3-pip
```

Install opencv-python

```
sudo pip install OpenCV-python
```

*** If you en count download errors**

```
sudo pip install opencv-python -i https://pypi.tuna.tsinghua.edu.cn/simple
```

3.4.2 Set user controls parameters.

Below code sample set brightness as 64, contrast as 0

```
import cv2

# open video0
cap = cv2.VideoCapture(0)

# The control range can be viewed through v4l2-ctl -L
cap.set(cv2.CAP_PROP_BRIGHTNESS, 64)
cap.set(cv2.CAP_PROP_CONTRAST, 0)

while(True):
    # Capture frame-by-frame
    ret, frame = cap.read()
    # Display the resulting frame
    cv2.imshow('frame', frame)
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

# When everything done, release the capture
cap.release()
cv2.destroyAllWindows()
```

SAVE File name as 1.py, then run

```
sudo python3 1.py
```

3.4.3 Controlling values through code

```
import cv2
import time
# open video0
cap = cv2.VideoCapture(0)
cap.grab()

cap.set(cv2.CAP_PROP_AUTOFOCUS, 1)
time.sleep(2)
cap.set(cv2.CAP_PROP_AUTOFOCUS, 0)
time.sleep(2)
cap.set(cv2.CAP_PROP_FOCUS, 123)



cap.set(cv2.CAP_PROP_FRAME_WIDTH, 640)
cap.set(cv2.CAP_PROP_FRAME_HEIGHT, 480)

while(True):
    # Capture frame-by-frame
    ret, frame = cap.read()
    # Display the resulting frame
    cv2.imshow('frame', frame)
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

# When everything done, release the capture
cap.release()
cv2.destroyAllWindows()
```

SAVE File name as 2.py, then run

```
sudo python3 2.py
```

3.4.4 Controlling values through UI interface

```
import cv2
import argparse
import configparser
from pathlib import Path
import time



parser = argparse.ArgumentParser()
parser.add_argument("-v", "--vid", default="0", help="Video sourse, default 0")
parser.add_argument(
        "-f", "--auto_focus", action="store_true", default=False, help="Turn on auto focus"
)
parser.add_argument(
        "-c",
        "--config",
        default="focus.ini",
        help="Focus config file, default focus.ini",
)
args = parser.parse_args()

try:
        vid = int(args.vid)
except ValueError:
        vid = args.vid

config_path = (Path(__file__).parent / Path(args.config)).resolve().absolute()
print("config file :", config_path)

config = configparser.ConfigParser()

config.read(config_path, encoding="utf-8")

cap = cv2.VideoCapture(vid)
cap.grab()
cap.set(cv2.CAP_PROP_AUTOFOCUS, 1)
```

```
if not args.auto_focus and config.has_section("Focus"):
    auto_focus = (
        config.getint("Focus", "auto_focus")
        if config.has_option("Focus", "auto_focus")
        else 1
    )
    focus = (
        config.getint("Focus", "focus")
        if config.has_option("Focus", "focus")
        else int(cap.get(cv2.CAP_PROP_FOCUS))
    )
else:
    auto_focus = 1
    focus = None
print("config auto_focus = %s" % auto_focus)
print("config focus = %s" % focus)
print("*" * 10)


if not auto_focus:
    cap.set(cv2.CAP_PROP_AUTOFOCUS, 0)

time.sleep(2)
if focus:
    cap.set(cv2.CAP_PROP_FOCUS, focus)

cv2.namedWindow("frame")


def set_auto_focus(x):
    cap.set(cv2.CAP_PROP_AUTOFOCUS, x)


cv2.createTrackbar(
    "0: OFF\r\n 1: ON\r\nauto_focus",
    "frame",
    int(cap.get(cv2.CAP_PROP_AUTOFOCUS)),
    1,
    set_auto_focus,
)
```

```
def set_focus(x):
    cap.set(cv2.CAP_PROP_FOCUS, x)


cv2.createTrackbar("focus", "frame", int(cap.get(cv2.CAP_PROP_FOCUS)), 1023, set_focus)

while cap.isOpened():
    # cap frame-by-frame
    ret, frame = cap.read()
    if not ret:
        break
    focus = int(cap.get(cv2.CAP_PROP_FOCUS))
    cv2.setTrackbarPos("focus", "frame", focus)

    af = int(cap.get(cv2.CAP_PROP_AUTOFOCUS))
    cv2.setTrackbarPos("0: OFF\r\n 1: ON\r\nauto_focus", "frame", af)

    cv2.imshow("frame", frame)

    if cv2.waitKey(1) & 0xFF == ord("q"):
        break

# When everything done, release the cap
cap.release()
cv2.destroyAllWindows()

if not config.has_section("Focus"):
    config.add_section("Focus")

print("set auto_focus = 0")
config.set("Focus", "auto_focus", "0")

print("set focus = %s" % focus)
config.set("Focus", "focus", str(focus))

config.write(open(config_path, "w"))
```

SAVE File name as cvtui.py, then run

```
sudo python3 cvtui.py
```

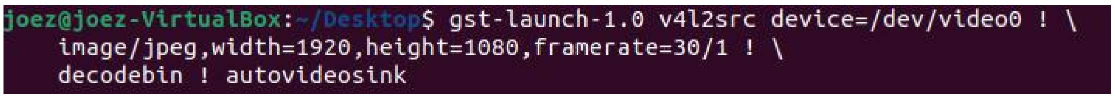
3.5 Gstreamer

GStreamer becomes a popular and powerful open-source multimedia framework to help users to build their own video streaming, playback, editing applications with various codec and functionalities on top of its high-level APIs.

3.5.1 Set Video Output Format

MJPEG

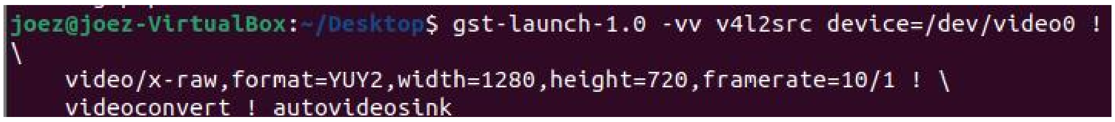
```
gst-launch-1.0 v4l2src device=/dev/video0 ! \
        image/jpeg,width=1920,height=1080,framerate=30/1 ! \
        decodebin ! autovideosink
```



```
joez@joez-VirtualBox:~/Desktop$ gst-launch-1.0 v4l2src device=/dev/video0 ! \
    image/jpeg,width=1920,height=1080,framerate=30/1 ! \
    decodebin ! autovideosink
```

YUV

```
gst-launch-1.0 -vv v4l2src device=/dev/video0 ! \
        video/x-raw,format=YUY2,width=1280,height=720,framerate=10/1 ! \
        videoconvert ! autovideosink
```



```
joez@joez-VirtualBox:~/Desktop$ gst-launch-1.0 -vv v4l2src device=/dev/video0 !
\
    video/x-raw,format=YUY2,width=1280,height=720,framerate=10/1 ! \
    videoconvert ! autovideosink
```

3.5.2 Streaming

MJPEG

```
# server
gst-launch-1.0 v4l2src device=/dev/video0 ! \
        image/jpeg,width=1280,height=720,framerate=30/1 ! \
        tcpserversink host=0.0.0.0 port=5001

# client
# change xxx.xxx.xxx.xxx to the actual ip address
```

```
gst-launch-1.0 -v tcpclientsrc host=xxx.xxx.xxx.xxx port=5001 ! \
        decodebin ! autovideosink
```

Save Video

```
gst-launch-1.0 v4l2src device=/dev/video0 !
image/jpeg,width=1280,height=720,framerate=30/1 ! jpegdec ! qtmux ! filesink
location=test.mp4 -e
```

Save Image

```
gst-launch-1.0 v4l2src device=/dev/video0 num-buffers=1 ! jpegenc ! filesink sync=false
location=file.jpg
```

Preview

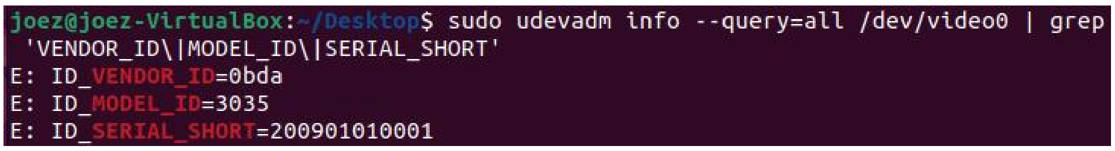
```
gst-launch-1.0 v4l2src device=/dev/video0 !
image/jpeg,width=1280,height=720,framerate=30/1 ! jpegdec ! autovideosink
```

3.6 Read Serial Number

When you need to use multiple cameras,we need to use unique serial ID.

3.6.1 Linux udev

```
sudo udevadm info --query=all /dev/video0 | grep 'VENDOR_ID\|MODEL_ID\|SERIAL_SHORT'
```



```
joez@joez-VirtualBox:~/Desktop$ sudo udevadm info --query=all /dev/video0 | grep
 'VENDOR_ID\|MODEL_ID\|SERIAL_SHORT'
E: ID_VENDOR_ID=0bda
E: ID_MODEL_ID=3035
E: ID_SERIAL_SHORT=200901010001
```