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Denebola
(See3CAM_CX3RDK)

Linux Application User Manual

Revision 1.1
September 23, 2014

Contents

1 Revision History

Rev No	Date	Major Changes	Edited By
1.0	September 16, 2014	Initial Draft	Camera Dev. Team
1.1	September 23, 2014	Modified Exposure Range	Camera Dev. Team

2 Introduction

Denebola (See3CAM_CX3RDK) is a USB3.0 UVC Reference Design Kit (RDK) developed by e-con Systems using the EZ-USB® CX3 USB3.0 Peripheral controller from Cypress Semiconductors. The Cypress EZ-USB® CX3 is a USB 3.0 peripheral controller that enables developers to add USB 3.0 connectivity to any image sensors compliant with Mobile Industry Processor Interface (MIPI) Camera Serial Interface Type 2 (CSI-2) standard. The Denebola Reference Design Kit developed using EZ-USB® CX3 is a complete Reference Design Kit and has OmniVision OV5640 CMOS image sensor (e-CAM59CX3) interfaced to it through 2-lane MIPI CSI-2 interface. This is a fully functional camera reference design kit that can stream uncompressed 720p60, 1080p30 and full 5MP@15fps. e-con Systems, a Silver level partner of Cypress Partner program, has developed the reference design kit for EZ-USB® CX3 from Cypress Semiconductors and this kit can be purchased directly from our webstore.

Based on the proven EZ-USB FX3 Platform, CX3 comes with an ARM9 CPU and 512KB SRAM that provides 200 MIPS of computational power. The CX3 supports MIPI CSI-2 version 1.01, up to 4 data lanes with data speed up to 1Gbps per lane, for a total bandwidth of 4 Gbps. CX3 is ideally suited for high-definition or high-speed image-capturing applications. CX3 supports multiple peripheral interfaces such as I2C, SPI, and UART, which can be programmed to support Pan, Tilt and Zoom or other camera control functions.

Denebola RDK is a two-board solution containing base board designed around Cypress CX3 USB3.0 Peripheral controller and the Camera daughter board (part number: e-CAM59CX3) designed using OmniVision OV5640 CMOS image sensor based Autofocus camera module. E-con also plans to support multiple camera sensor daughter boards in the future that can be used to evaluate CX3 performance and also other CMOS Image sensors.

See3CAM_CX3RDK with e-CAM59CX3 is a UVC compliant device and does not require any additional drivers to be installed on the PC. The native UVC drivers of Windows, Mac and Linux Operating Systems shall be compatible with this camera. E-con also provides the sample application that demonstrates some of the features of this camera. However, this camera can be utilized any V4L2 application such as Skype, Cheese etc.

3 Scope

e-con provides a sample V4L2 application, called see3camguvcview, along with the See3CAM_CX3RDK with e-CAM59CX3. See3camguvcview is a V4L2 video viewer and capture software for the linux UVC driver, but customized to demonstrate some of the features of See3CAM_CX3RDK with e-CAM59CX3.

This document describes about the usage of the see3camguvcview application on the Ubuntu [>=12.04 (LTS)] 32- and 64-bit Linux operating systems. This document also describes about the special features of see3camguvcview camera application when it is used with See3CAM_CX3RDK with e-CAM59CX3.

4 Description

The See3CAM_CX3RDK with e-CAM59CX3 is a USB 3.0 device capable of streaming camera frames VGA @ 60 fps, 720p @ 60 fps, 1080p @ 30fps and 5MP @ 15 fps when connected to USB3.0 host port by leveraging the full throughput of USB3.0. It also supports all the features with a USB 2.0 fallback. However, in USB 2.0, See3CAM_CX3RDK with e-CAM59CX3 can stream only in VGA resolution and at 30 fps only.

The See3CAM_CX3RDK with e-CAM59CX3 has the following UVC camera controls,

- Brightness
- Contrast
- Saturation
- Hue

- Sharpness
- White Balance (Manual and Automatic)
- Exposure (Manual and Automatic)
- Focus (Manual and Automatic)

The **See3CAM guvcviewer** or **see3camguvcview** is a simple GTK+ interface for capturing and viewing video from the devices supported by the Linux UVC driver. This tool also supports extension unit control of e-con's See3CAM usb 3.0 camera products. The features provided in the application are as follows:

a) Enumerating and listing all USB video and audio devices connected.
b) Properties of audio capture devices (if any audio device is available).
c) Properties of video renderer.
d) Changing resolution and color space/compression for video stream(if different resolution are supported by the device)
e) Currently configured values of preview which is being shown.
f) User can capture still images and set the path where still images will be saved.
g) Configure UVC Extension Control (if supported by device)
h) Displaying the average frame rate.

All the above listed properties can be configured by attractive and easy to use Graphical User Interface. The application will run in Ubuntu [>=12.04 (LTS)] 32-bit and 64-bit Linux Distribution.

5 Identifying the Deliverables

The release package See3CAM_LINUX_REL_Package_xxxx.tar.gz is a compressed (i.e. tar.gz) file which will provide the UVC XU control application binary, source and documents when uncompressed.

Use the command 'tar' for uncompressing this release package

tar –xzvf See3CAM_LINUX_REL_Package_xxxx.tar.gz

After uncompressing this package, a directory is created in the name

See3CAM_LINUX_REL_Package_xxxx

The hierarchy of the See3CAM_LINUX_REL_Package_xxxx directory is as follows

```
.
|-- doc
|   |-- See3CAM_CX3RDK_e-CAM59CX3
|   |    `-- See3CAM_ CX3RDK_e-CAM59CX3_Linux_App_User_Manual_Rev_1_0.pdf
|    `-- See3CAM-GUVCView_Build_&_Install_Guide_Rev_1_6.pdf
|-- README
|-- src
|   `-- See3CAM_guvcview-src-1.7.2
|-- Ubuntu_12.04
|   |-- binary
|   |   |-- bin
|   |   |-- install-sh
|   |    `-- share
|    `-- binary_x64
```

```
|       |-- bin
|       |-- install-sh
|       `-- share
`-- Ubuntu_14.04
    |-- binary
    |   |-- bin
    |   |-- install-sh
    |   `-- share
    `-- binary_x64
        |-- bin
        |-- install-sh
        `-- share
```

6 Launching the Application

- Connect the See3CAM USB 3.0 camera to the Linux Development System.
- Refer ‘see3camguvcview_Build_&_Install_Guide.pdf to install the application in the linux system.
- Launch the see3camguvcview from the terminal as shown in the figure 6-1 below.

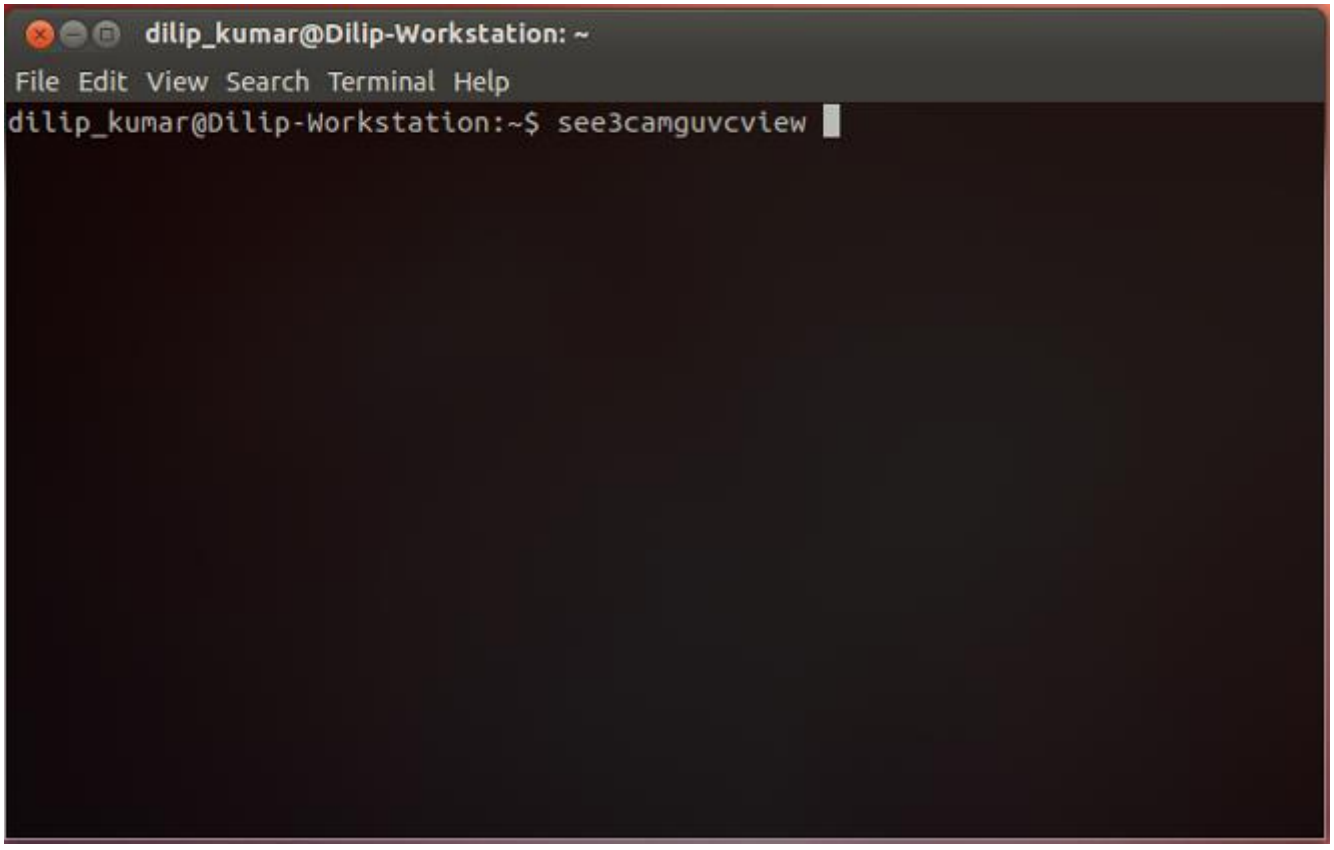

Figure 6-1 Terminal Window where application is launched

- When application is launched, control window and video display window will appear as shown in figure 6-2 below.

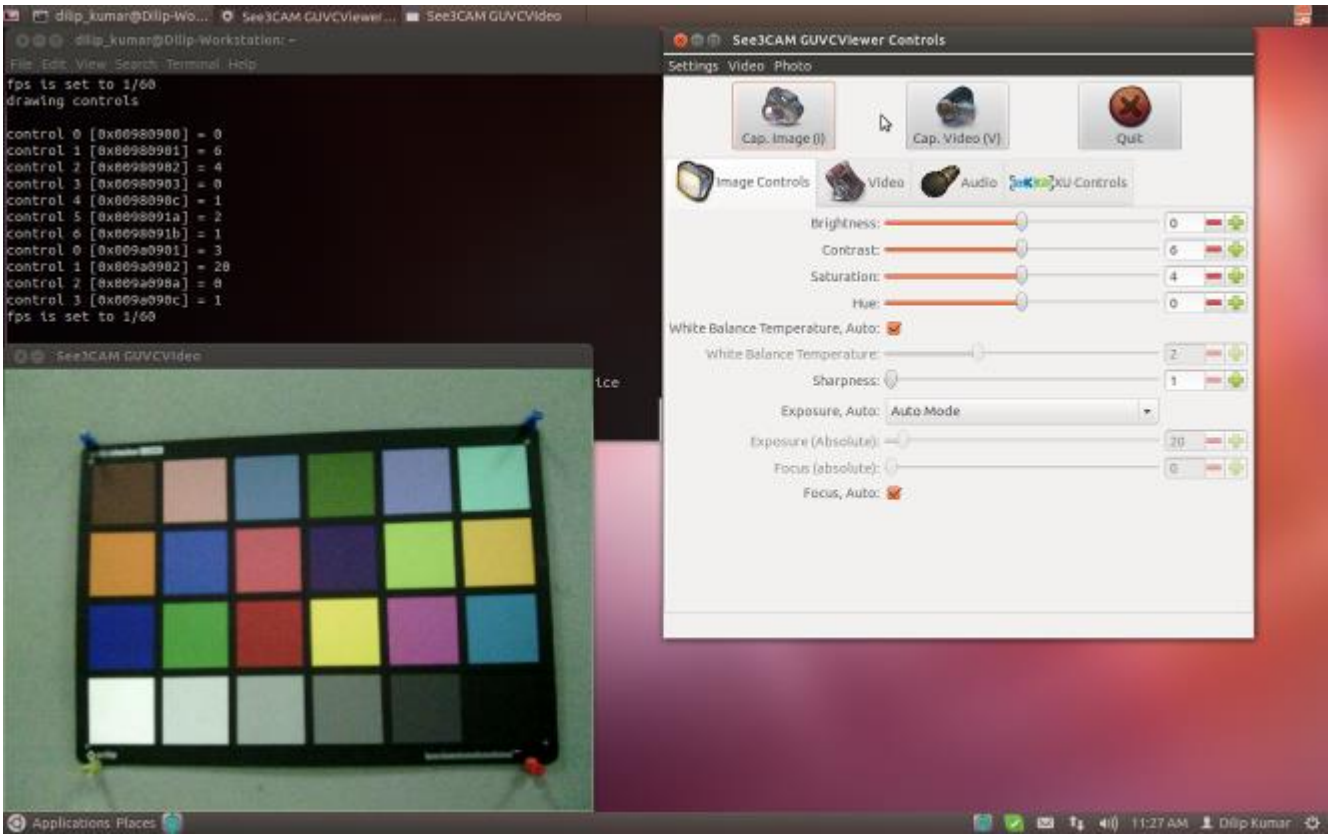

Figure 6-2 Initial Window Appearance when application is launched

7 Application Features

The features that are supported in the current version of see3camguvcview are briefly described here. The features are categorized into 4 tab controls. They are

1. Image Controls tab
2. Video tab
3. Audio tab
4. See3CAM XU controls tab

7.1 Image Control Tab

On selecting Image Controls Tab, control menu will display camera control settings. The user can adjust the video preview settings in the Menu tab. Sliders whose labels are not grayed out can only be configured.

The user can move the slider and configure the preview settings according to their needs. The value being set will be displayed in the text box based on the position of the slider marker. As soon as the slider is moved to configure the values the preview's property will change at that instance.

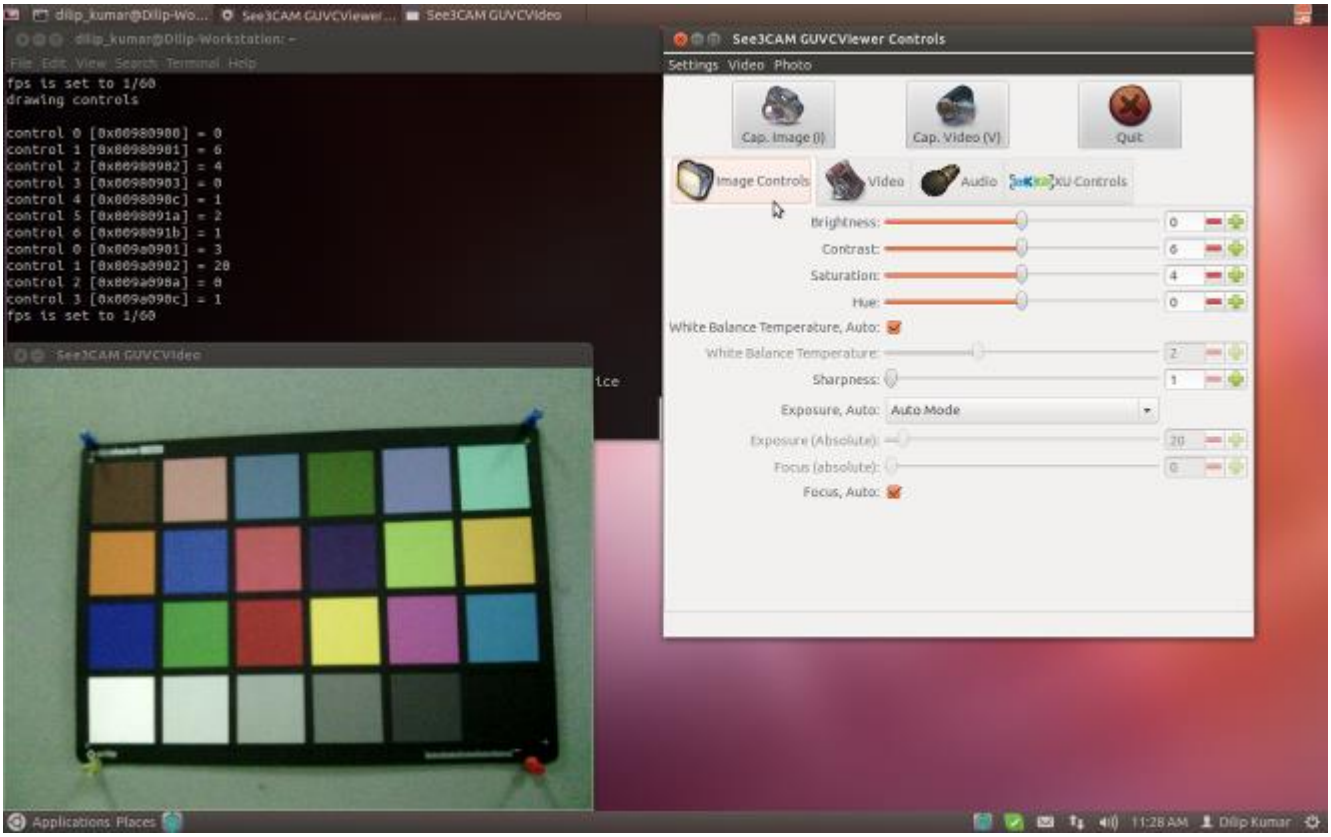

Figure 7-1 Image control Tab Menu

7.1.1 Brightness control

The Brightness values can be changed from a minimum value of -6 to +6 by moving the slider, and the exact changes will be reflected immediately in the preview. This brightness control increases the brightness of See3CAM_CX3RDK with e-CAM59CX3. The Default value is 0.

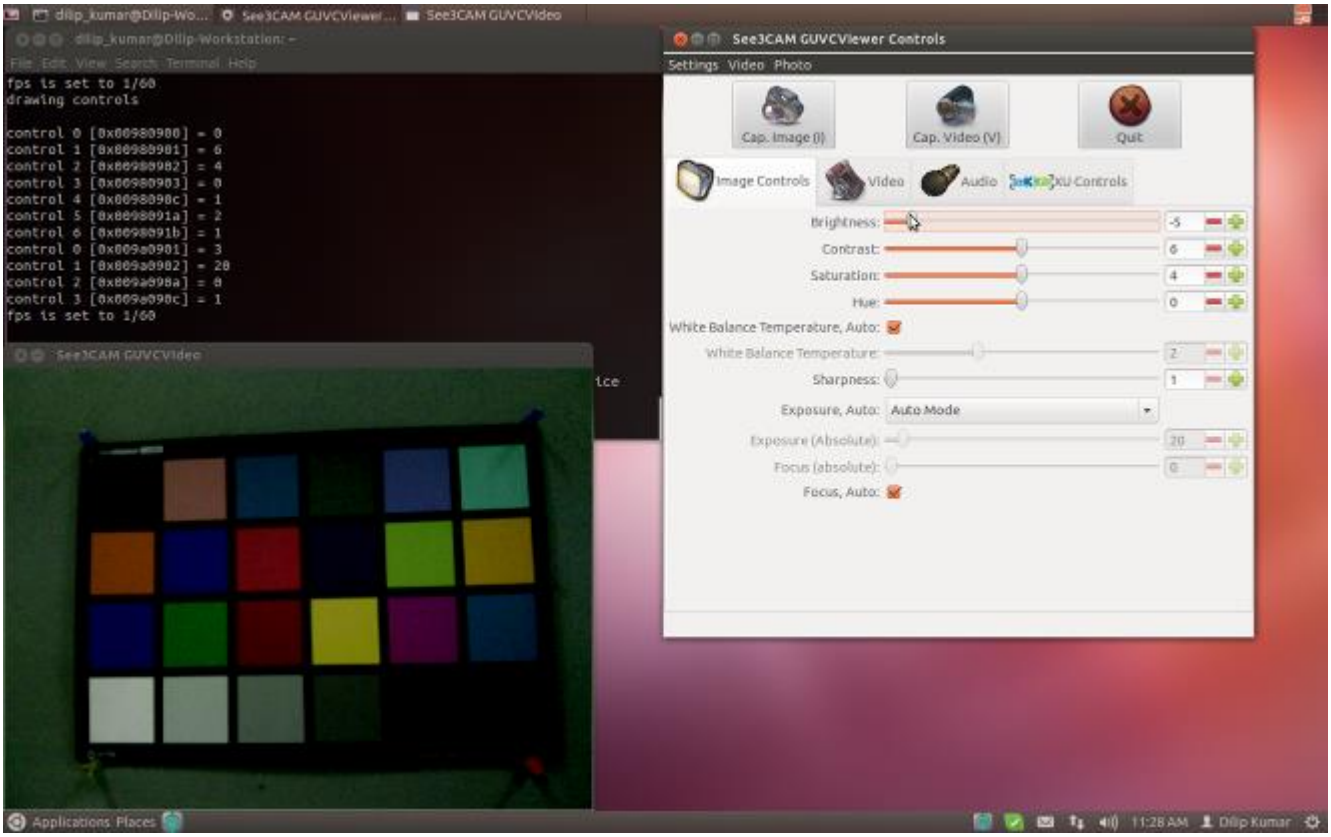

Figure 7-2 Adjusting Camera brightness

7.1.2 Contrast control

The Contrast values can be changed from a minimum value of 0 to 12 by moving the slider, and the exact changes will be reflected immediately in the preview. Increasing the Contrast value increases the contrast of See3CAM_CX3RDK with e-CAM59CX3. The Default value is 6.

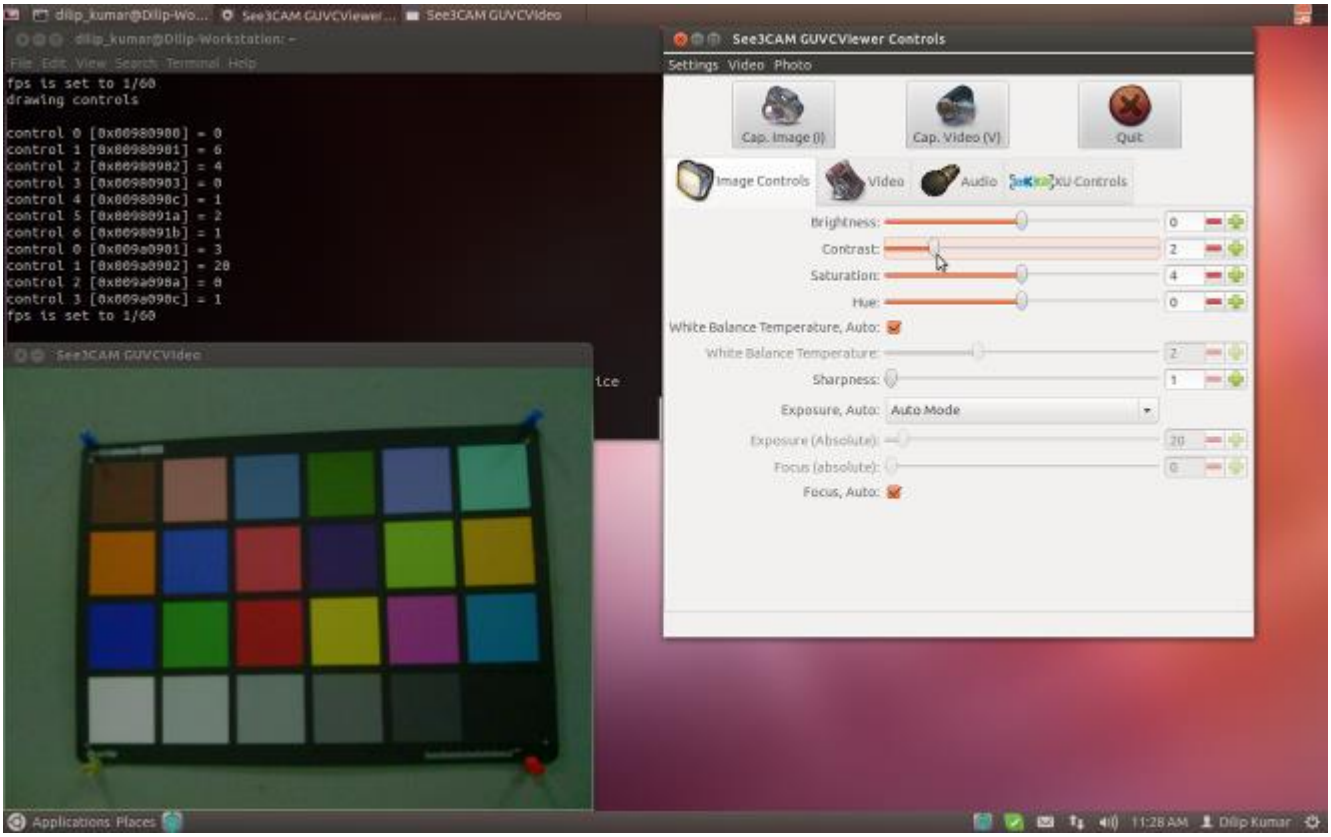

Figure 7-3 Adjusting Camera contrast

7.1.3 Saturation control

The Saturation values can be changed from a minimum value of 0 to 8 by moving the slider, and the exact changes will be reflected immediately in the preview. Increasing the Saturation value increases the saturation of See3CAM_CX3RDK with e-CAM59CX3. The Default value is 4.

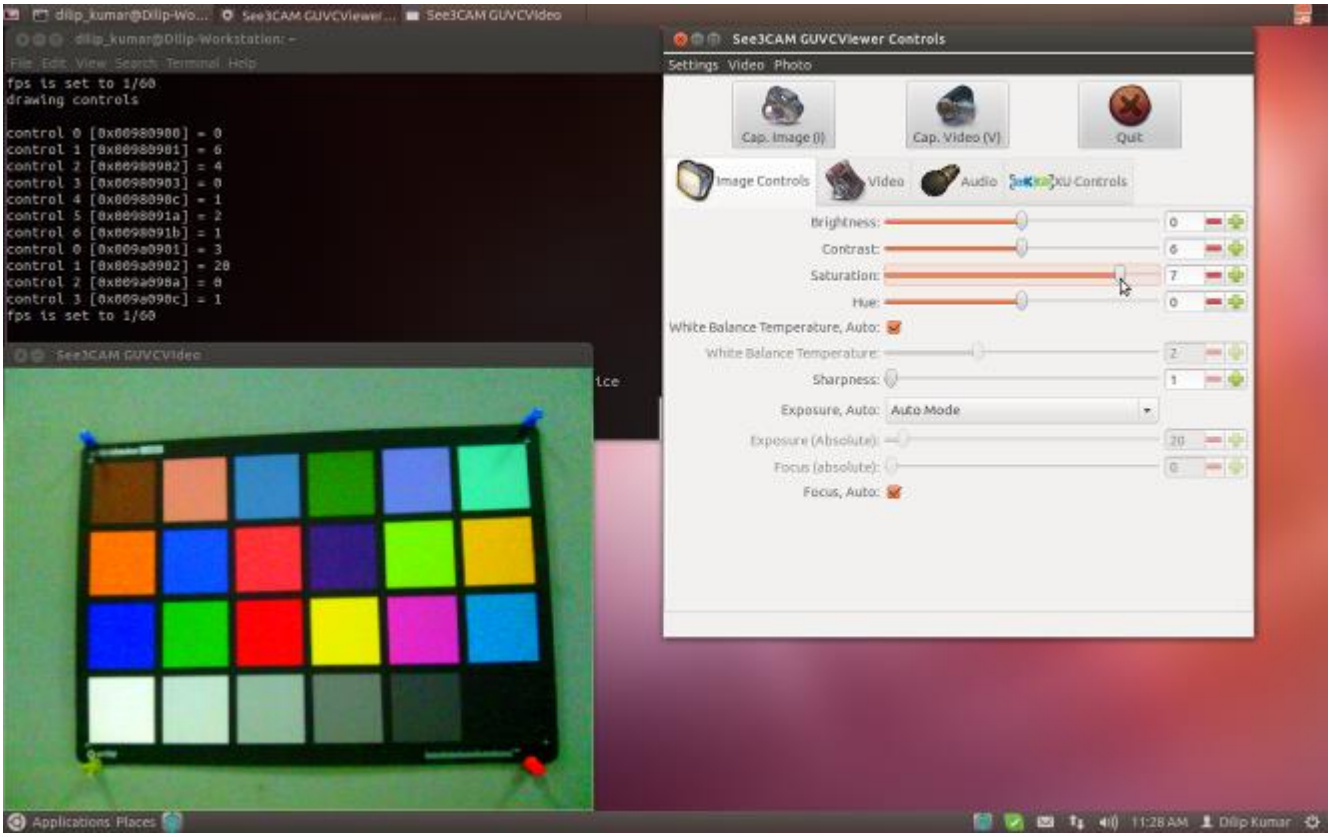

Figure 7-4 Adjusting Camera saturation

7.1.4 Hue control

The Hue values can be changed from a minimum value of -120 to 120 by moving the slider, and the exact changes will be reflected immediately in the preview. This Hue control increases the hue of the See3CAM_CX3RDK with e-CAM59CX3. The Default value is 0.

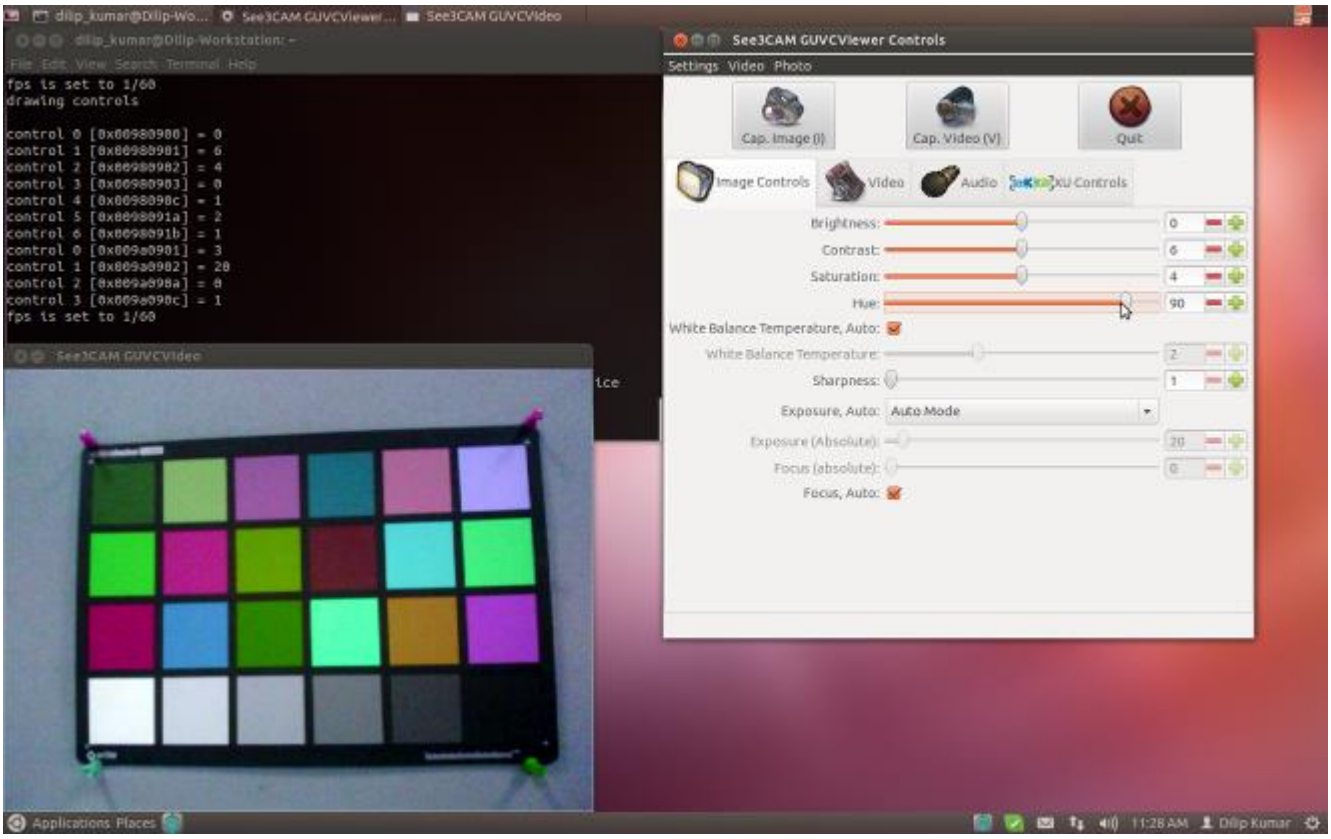

Figure 7-5 Adjusting Camera Hue

7.1.5 Sharpness control

The Sharpness values can be changed from a minimum value of 1 to 5 by moving the slider, and the exact changes will be reflected immediately in the preview. This Sharpness control increases sharpness of See3CAM_CX3RDK with e-CAM59CX3. The Default value is 1.

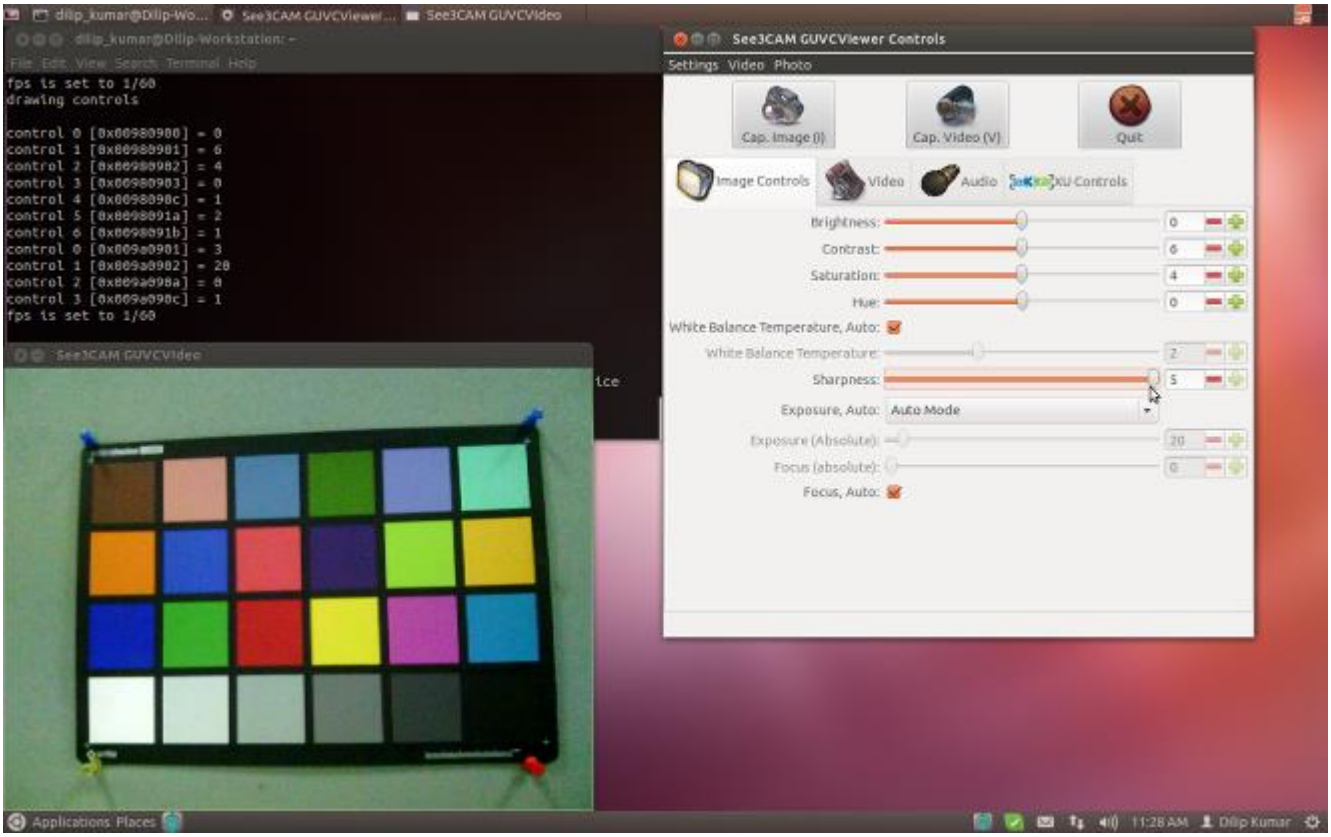

Figure 7-6 Adjusting Camera sharpness

7.1.6 WhiteBalance Control

The Manual White Balance can be selected by unchecking the check box for **White Balance Temperature, Auto**. The Manual White Balance values can be changed from a minimum value of 1 to 4 by moving the slider **White Balance Temperature**, and the exact changes will be reflected immediately in the preview. The Default value is 2.

The Auto WhiteBalance can be selected by selecting the check box for **White Balance Temperature, Auto**.

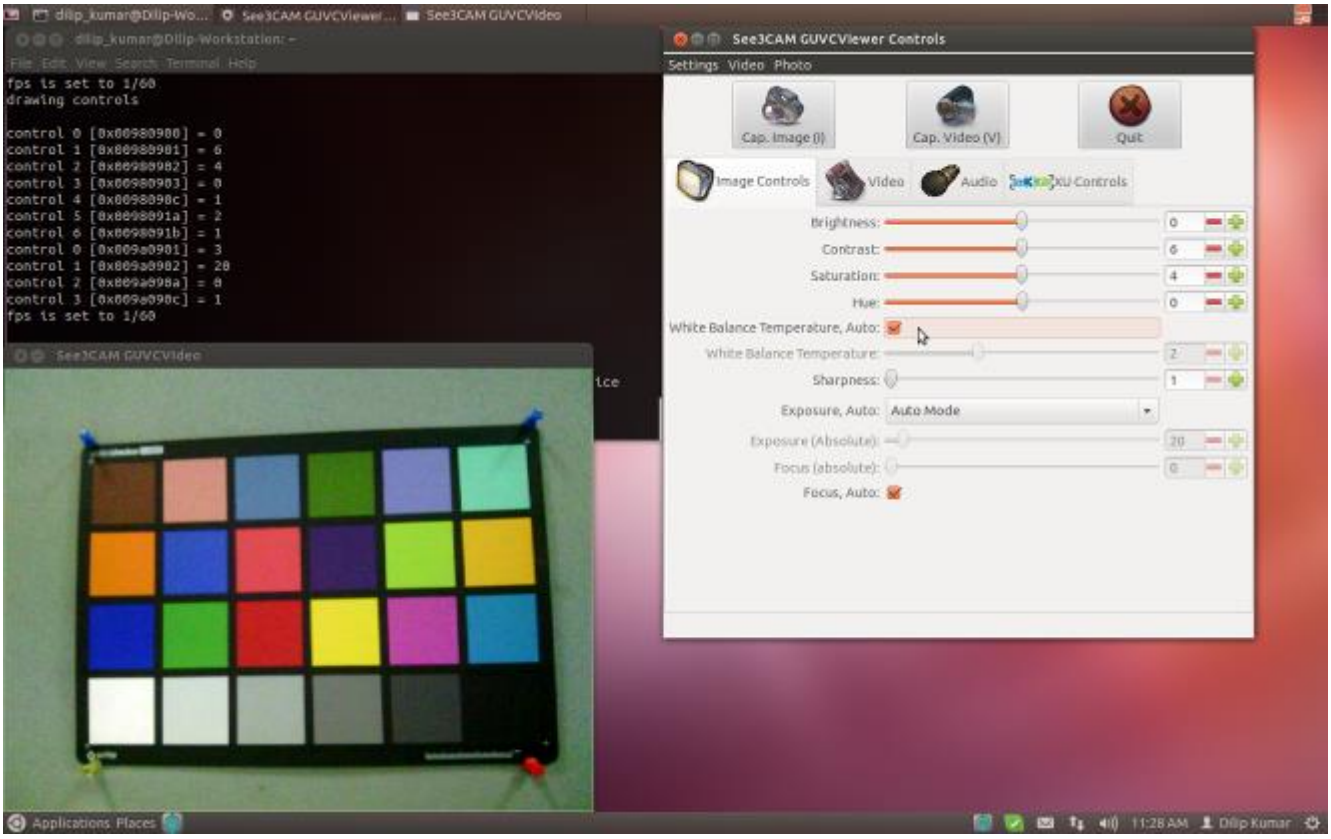

Figure 7-7 Selecting Auto White Balance

The Manual White Balance supported is,

- Daylight
- Incandescent
- Fluorescent
- Cloudy

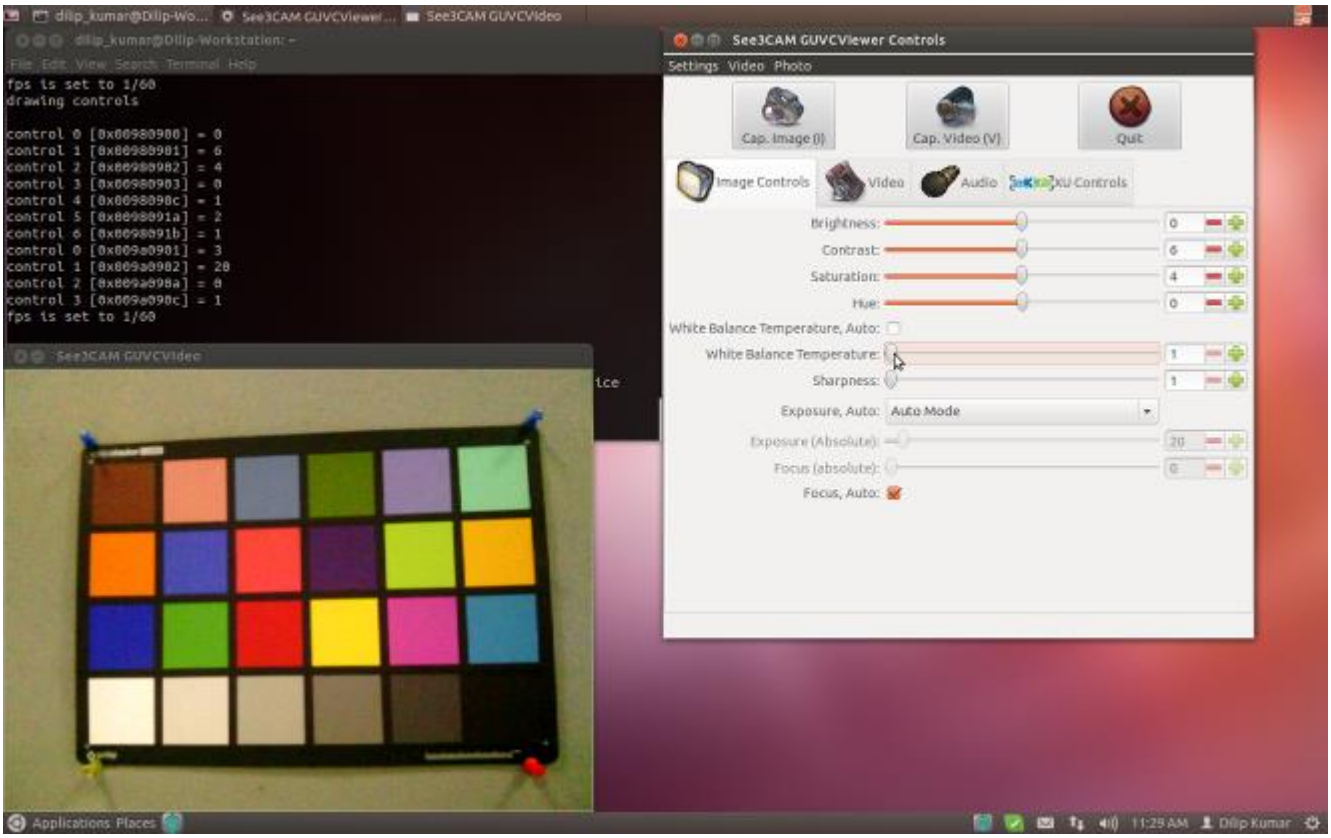

Figure 7-8 Manual White Balance Temperature – Daylight

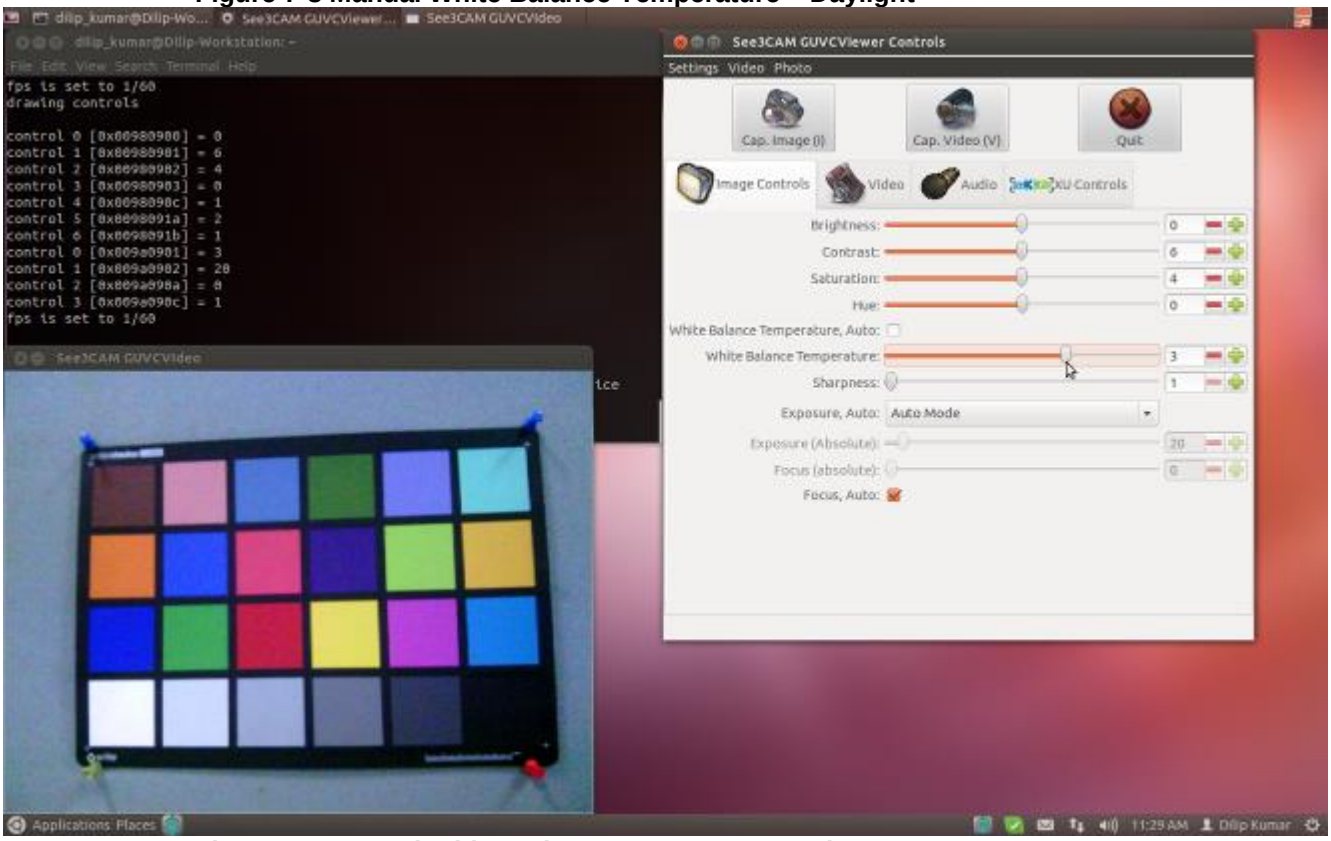

Figure 7-9 Manual White Balance Temperature – Fluorescent

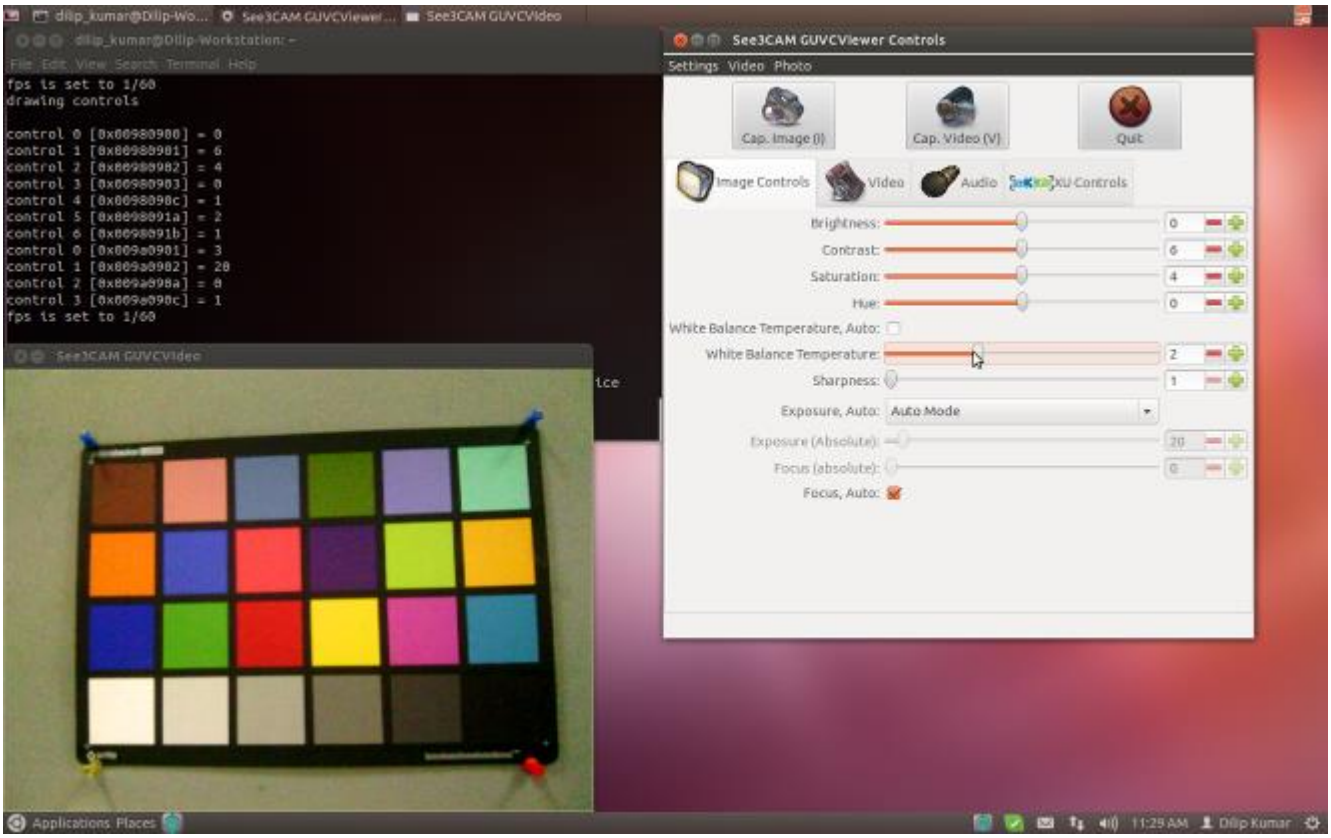

Figure 7-10 Manual White Balance Temperature – Incandescent

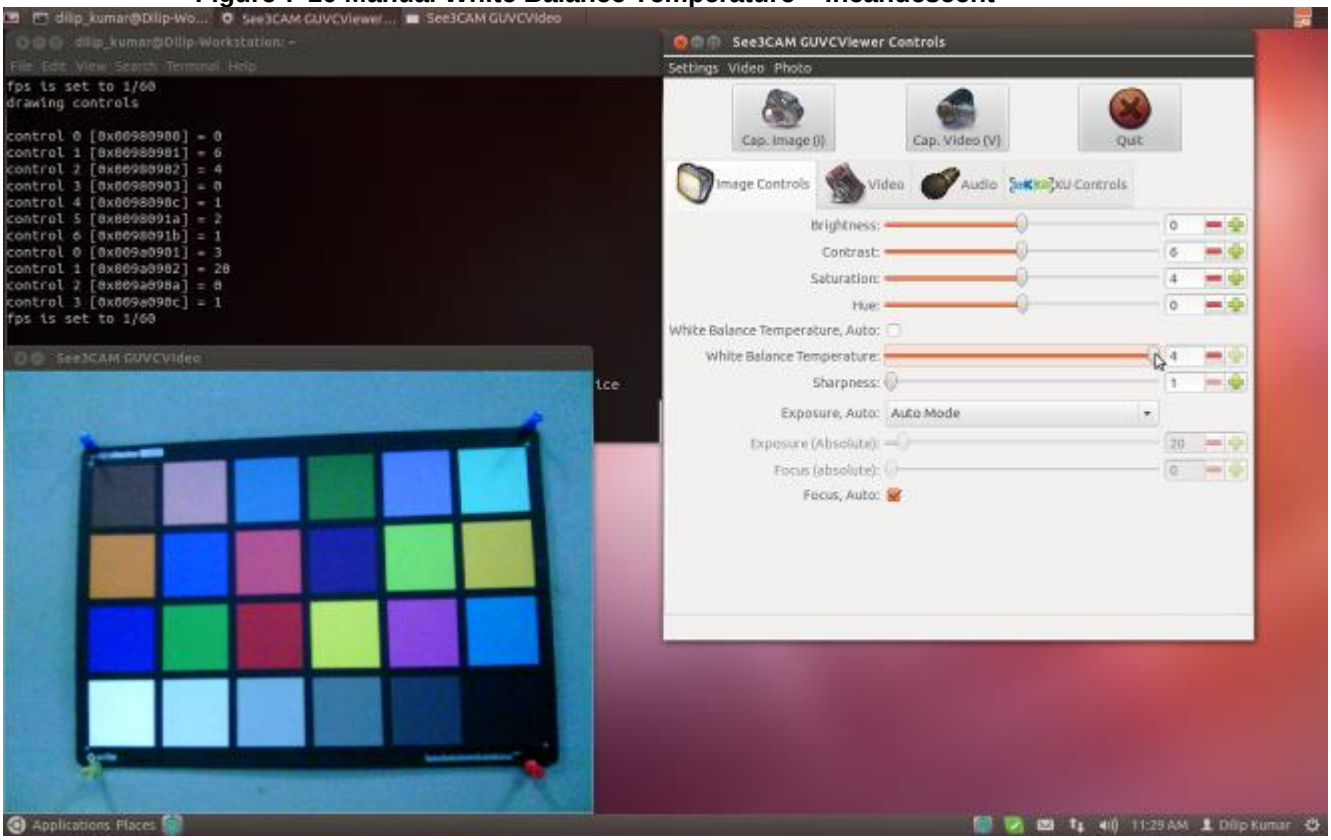

Figure 7-11 Manual White Balance Temperature – Cloudy

7.1.7 Exposure Control

The See3CAM_CX3RDK with e-CAM59CX3 supports both auto and manual exposure control which can be controlled using the **Exposure (Absolute)** slider of the **Image Controls** tab of the see3camguvcview. To use the manual exposure slider the user must first select the **Manual Mode** from the **Exposure,Auto** drop down list box. The exposure value could be manually changed by moving the slider, and the See3CAM_CX3RDK with e-CAM59CX3 supports exposure values ranging from **1 to 400** in the slider. The exposure values are configured inside the CMOS image sensor based on the sensor configuration and clock configuration details. The default value in the slider is 20.

To obtain a good low light performance it is essential to change the exposure according to the change in lighting conditions. To support this feature the See3CAM_CX3RDK with e-CAM59CX3 has an auto exposure feature, by which the exposure of the camera will be changed according to the lighting conditions giving the best low light performance. To select this auto exposure control the user has to select the **Auto Mode** from the **Exposure, Auto** drop down list box.

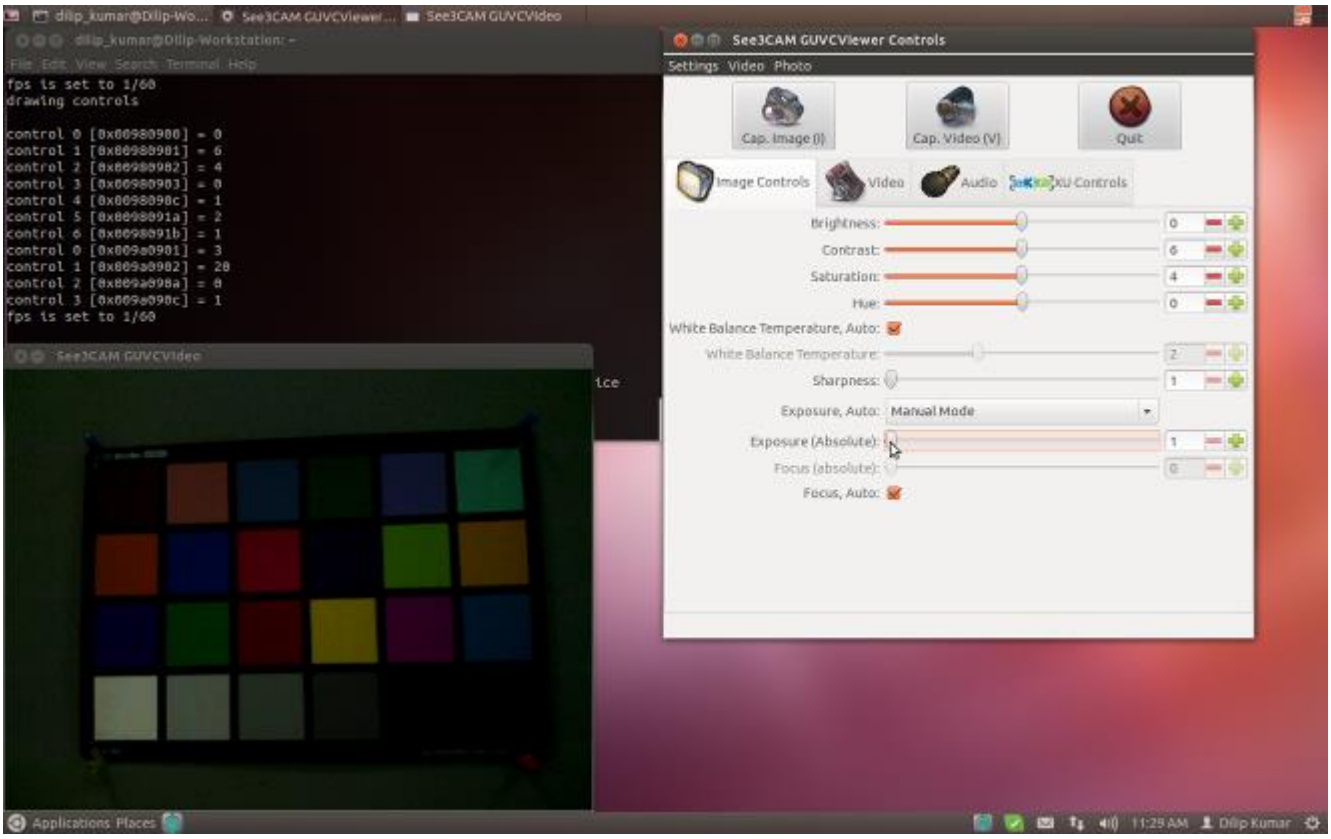

Figure 7-12 Adjusting Camera Manual Exposure

Note: Controls are global across all resolutions, and hence changing the control values will reflect the changes in other resolutions as well.

The slider values are computed according to the USB Video Class standards. So when the user is in a specific range of exposure value, the same value will persist in the exposure setting of the See3CAM_CX3RDK with e-CAM59CX3. To switch to a new value the user must increase the value to the next range by moving the slider. This is done to ensure compliance with the USB Video Class standard.

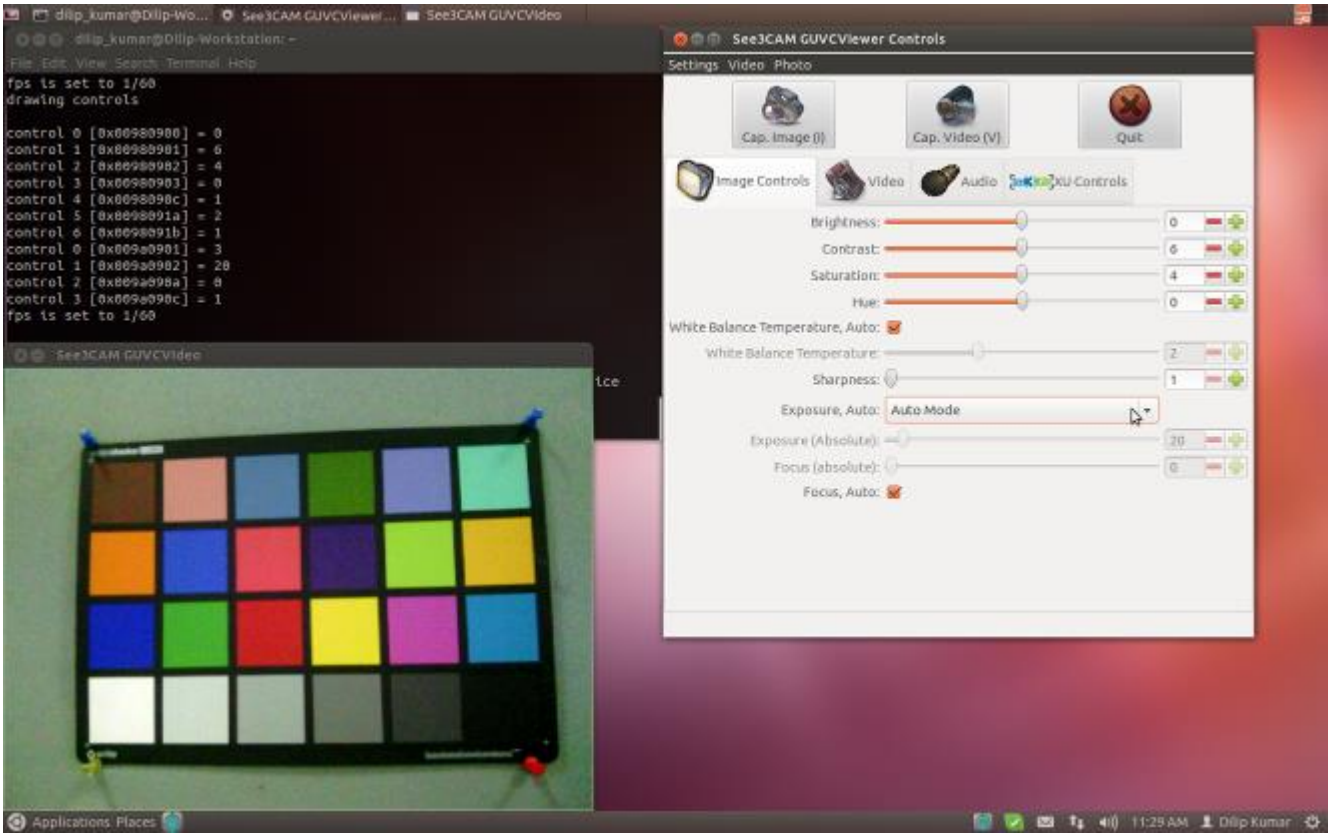

Figure 7-13 Selecting Auto Exposure Control

7.1.8 Focus Control

The See3CAM_CX3RDK with e-CAM59CX3 supports both auto and manual focus control. They can be controlled using the **Focus (absolute)** slider and the **Focus, auto** checkbox of the **Image Controls** tab in see3camguvcview. To use the manual focus slider the user must first uncheck the **Focus, auto** check box. The focus value can be manually changed by moving the slider, and the See3CAM_CX3RDK with e-CAM59CX3 supports focus values ranging from 0 to 1023 in the slider. The default value is 0.

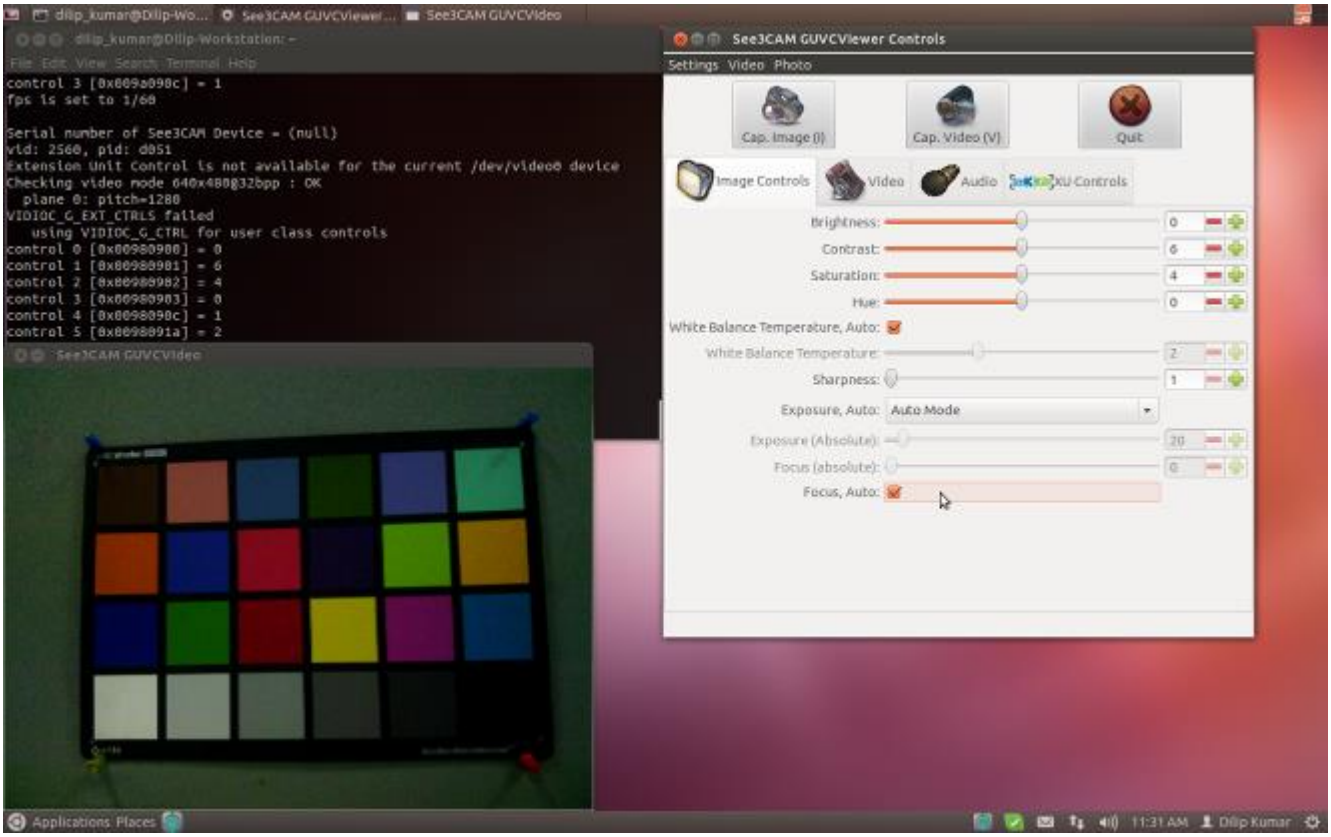

Figure 7-14 Selecting Auto Focus Control

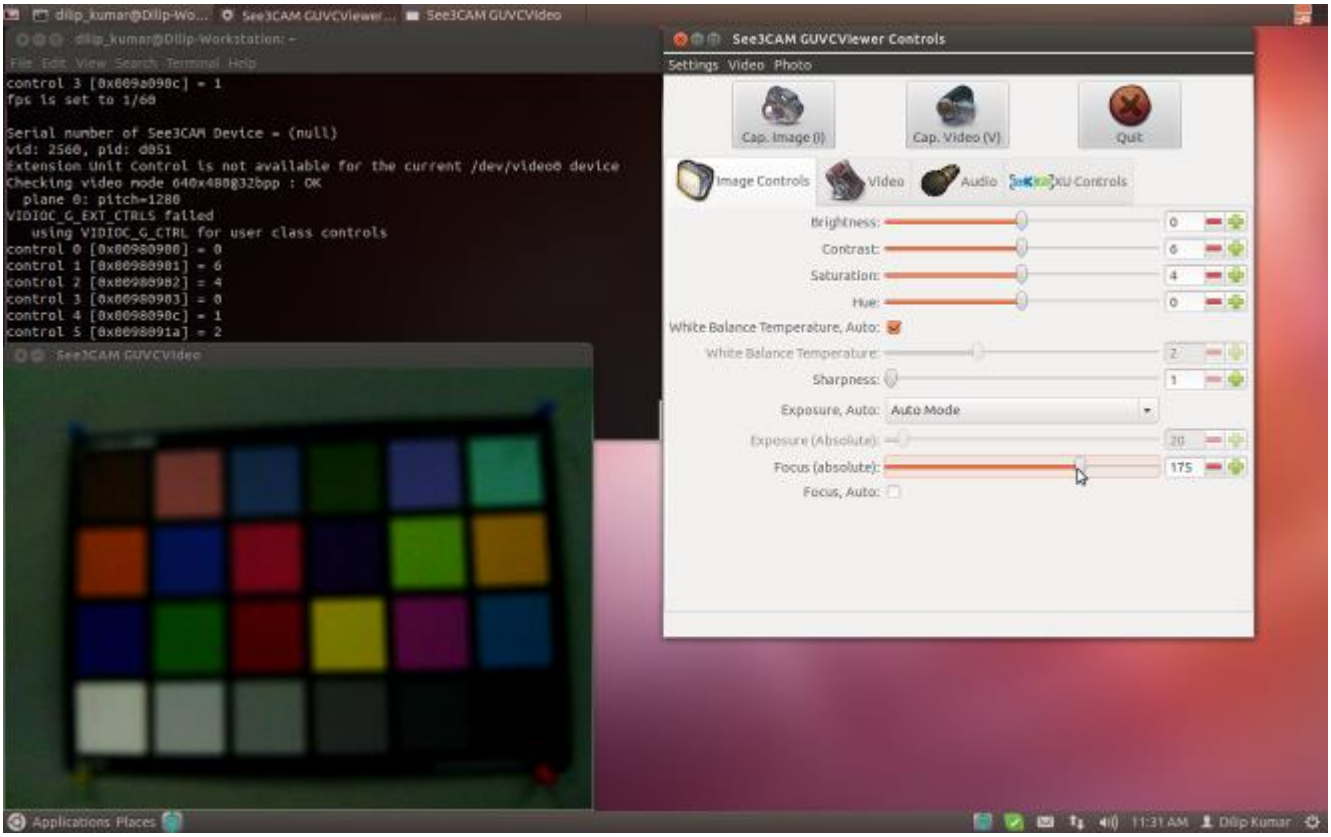

Figure 7-15 Adjusting Camera Manual Focus

7.2 Video Tab

On selecting Video Tab, video renderer properties will be displayed. The user can adjust the video preview settings in the Menu tab. This tab will have device selection list, frame rate control, resolution control color, space control and video filter controls.

When user clicks on Device sub menu in Video Tab all the video devices connected to the PC will be enumerated and listed out.

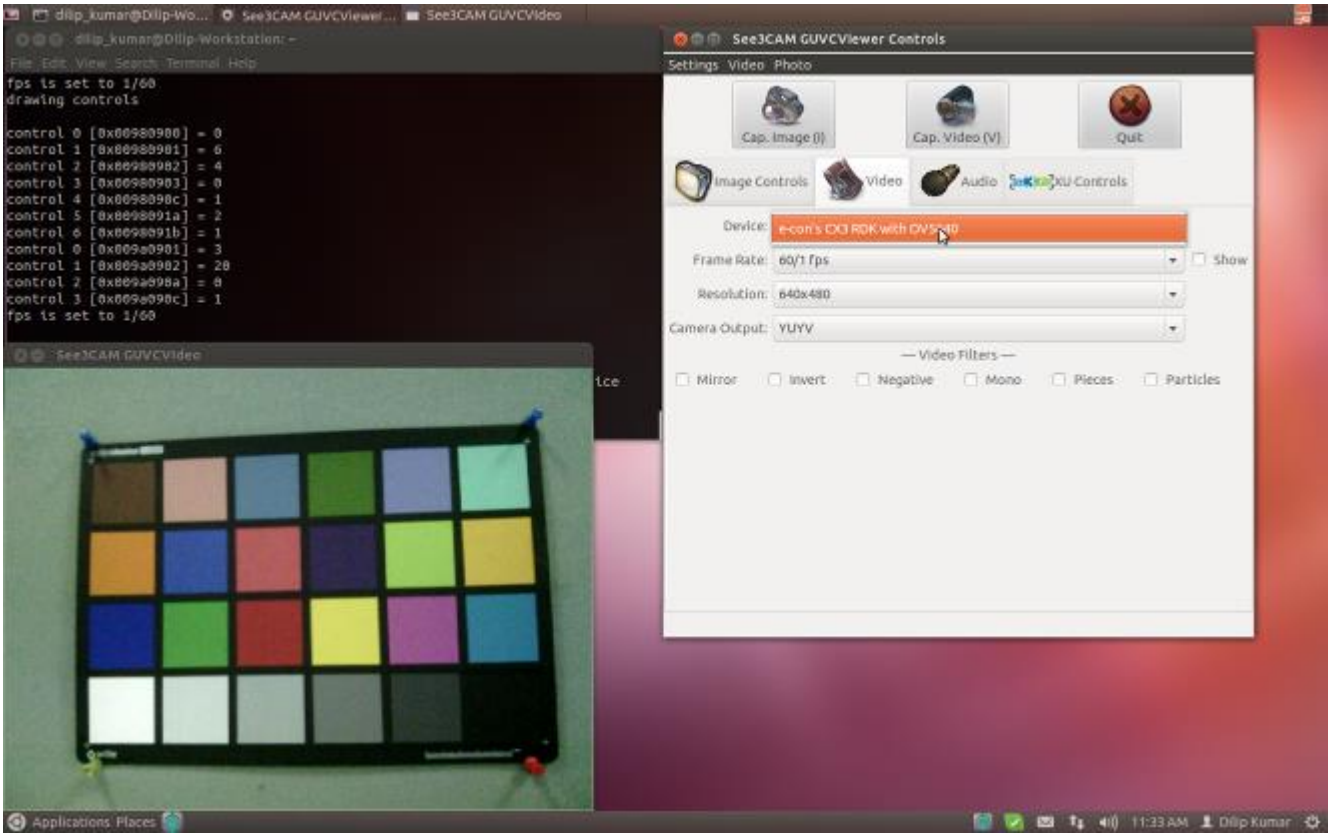

Figure 7-16 Enumerated Device List

7.2.1 Video Capture Properties

The user can configure the output size (Resolution) and compression features (Camera Output) of stream format. The available output size and color spaces will be listed in the combo box.

Currently See3CAM_CX3RDK with e-CAM59CX3 supports only **YUV2** color format and in this format four resolutions are supported in USB3.0 and one resolution is supported in USB2.0;

- 640 x 480 at 60 fps in USB 3.0 and 30 fps in USB 2.0.
- 1280 x 720 at 60 fps in USB 3.0.
- 1920 x 1080 at 30fps in USB 3.0.
- 2592 x 1944 at 15 fps in USB 3.0.

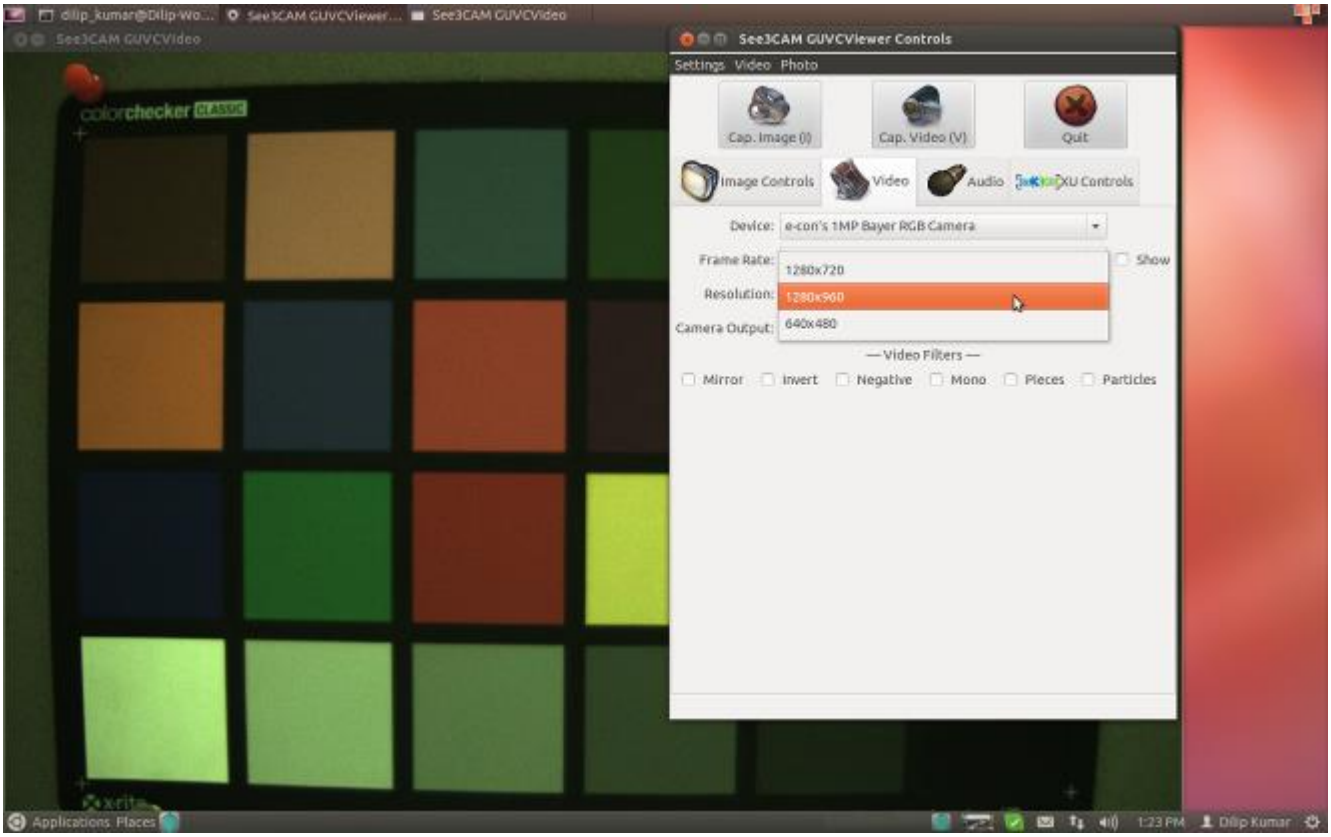

Figure 7-17 Supported video resolutions in Video tab page

7.2.2 Frame Rate

Frame rate of the preview can be viewed by selecting the ‘show’ check button in the Video Tab. After selecting Show button, frame rate will be displayed in the top of the preview window. Frame rate will be affected by various environmental parameters.

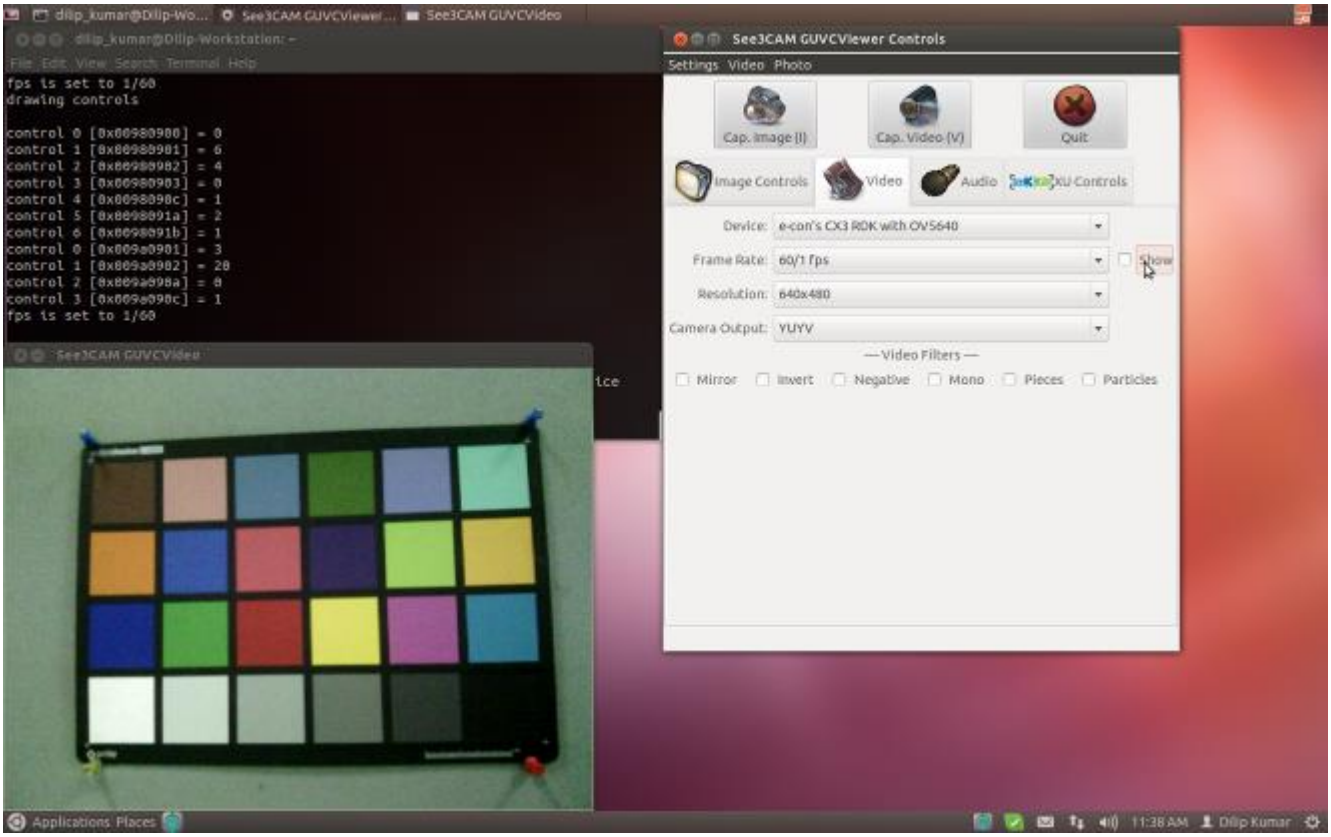

Figure 7-18 Select Show to display frame rate

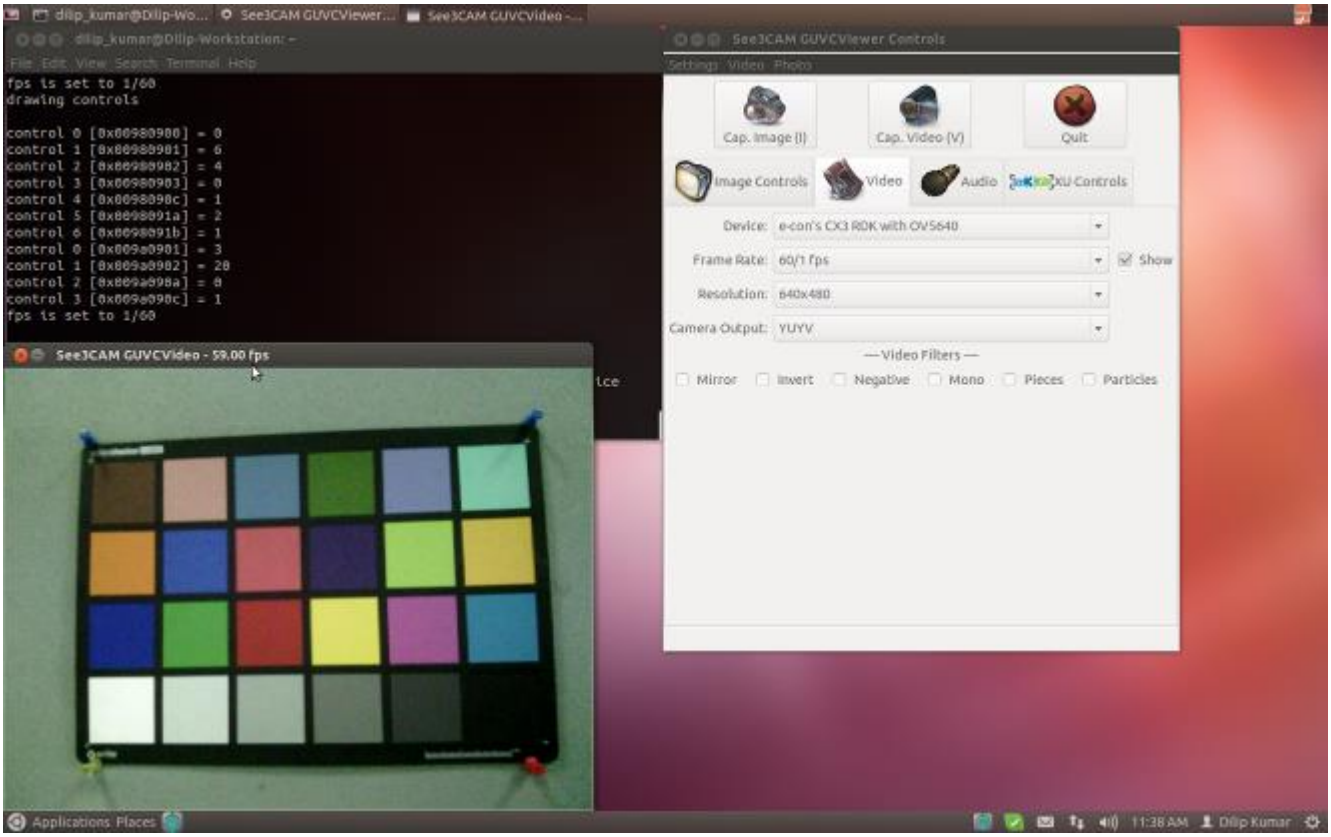

Figure 7-19 Display of frame rate in the preview window

7.2.3 Capture Menu

The user can capture still image or record a video from the selected device in the Device Menu.

7.2.3.1 Still Image Capture

The user can capture the still image by selecting Cap.Image button in the top of the control panel. The image will be saved in the home directory of the current user by default. The user can configure the folder where in to save the images. The default name for captured image file is guvcview_image.jpg

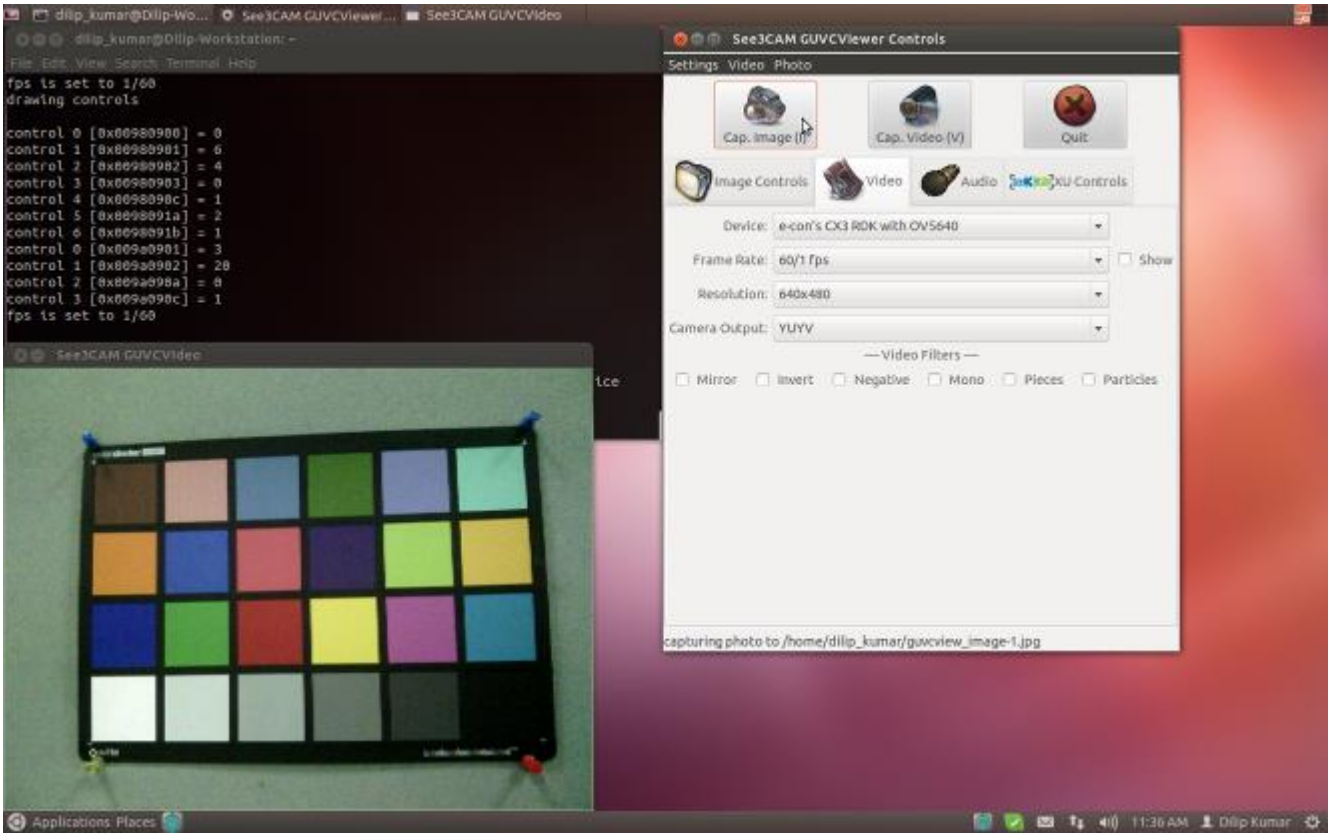

Figure 7-20 Capture still image

Note:

To take an image of another resolution the user must first switch the preview to that resolution. Unlike Windows the Linux kernel does not support cross resolution images.

7.2.3.2 Still File Path and Name

The user can set up the folder where the captured images will be saved using Photo -> File. This will open a save file dialog box. Here the user can select the file format for saving the image capture. The user can also browse to the required directory and set the file name so that in future, images captured will be saved in that folder.

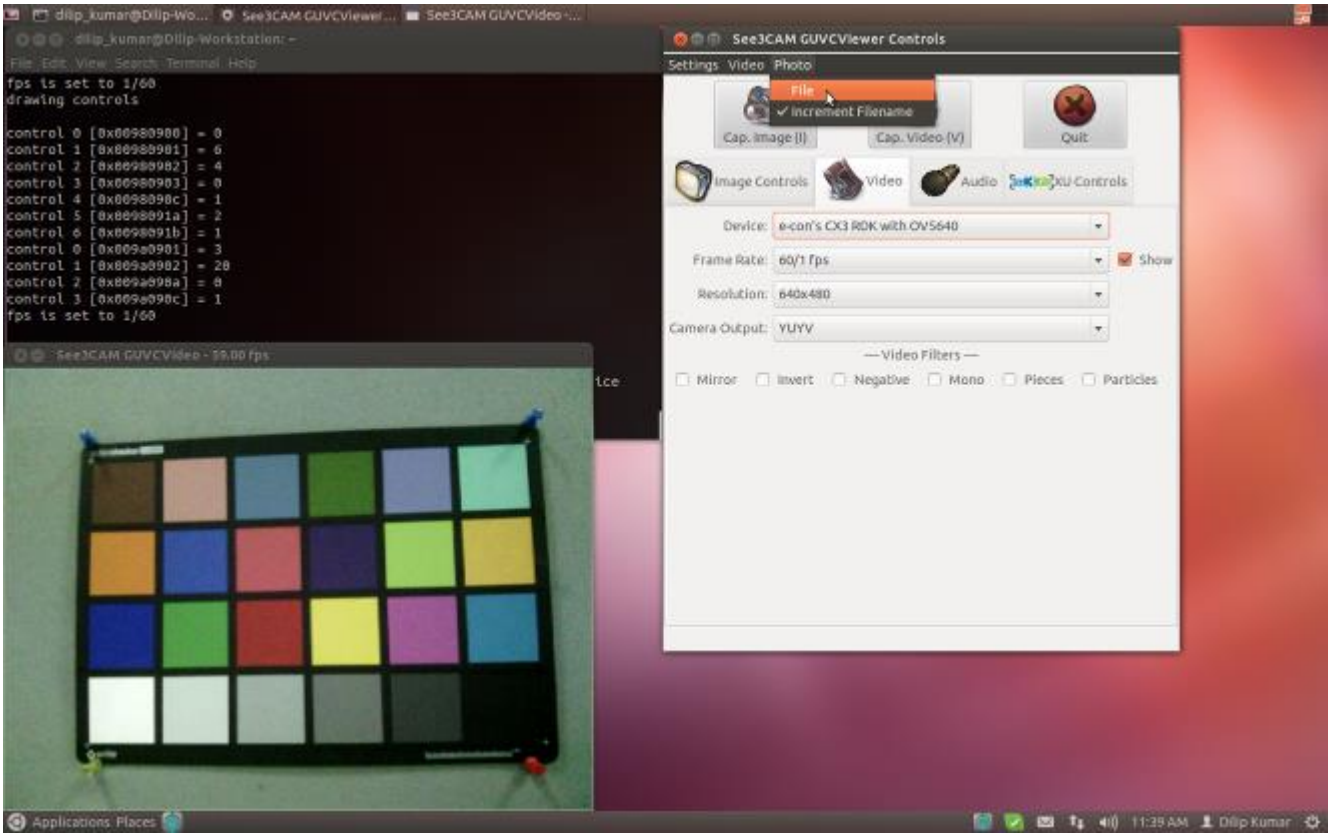

Figure 7-21 Save file dialog to set the Still Image Folder and file name

7.2.3.3 Video Recording

The user can record a video by selecting Cap.Video button in the top of the control panel. The video will be saved along with the audio (from the selected audio device in the audio tab) in the home directory of the current user by default. The default name for recorded video file is guvcview_video.mkv

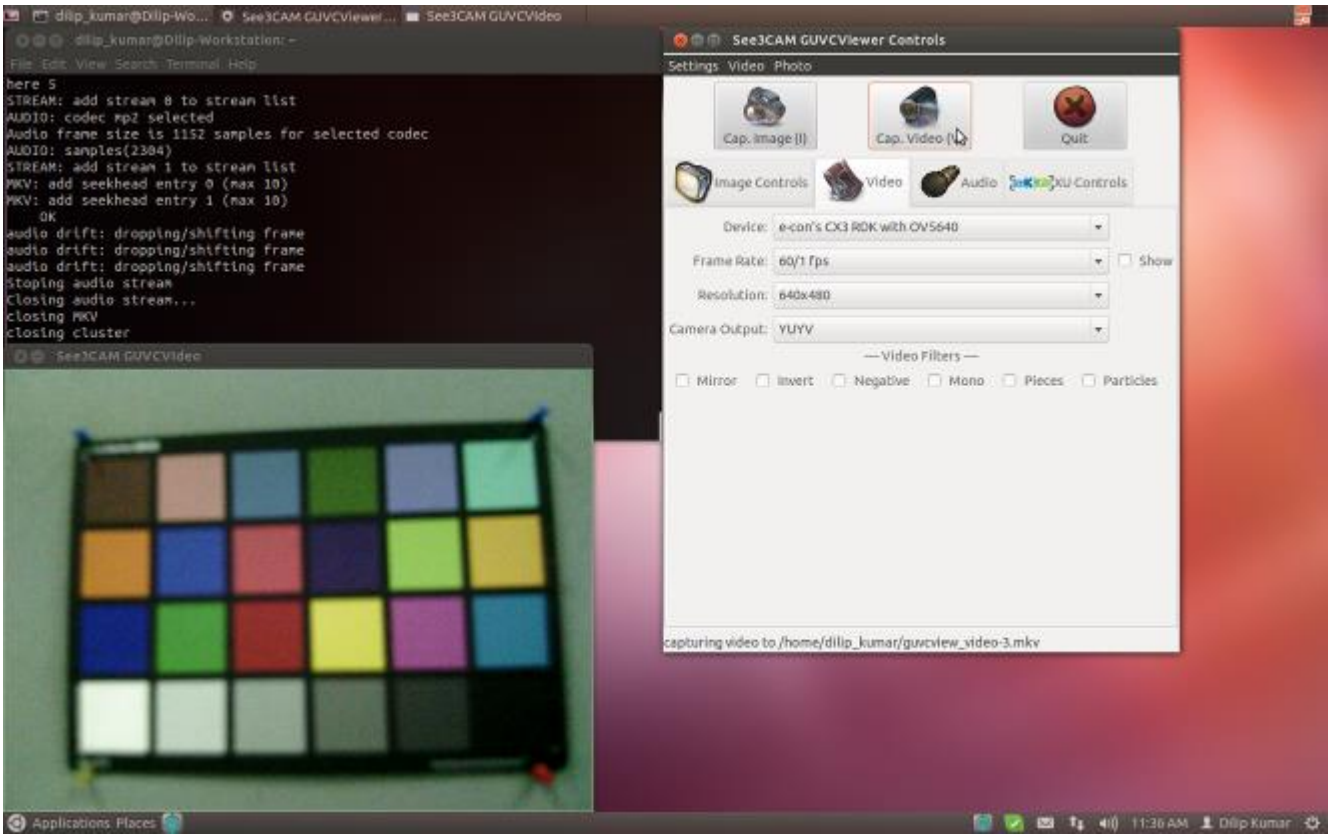

Figure 7-22 Record video from the device

7.2.3.4 Video File Path and Name

The user can set up the folder where the recorded video will be saved using Video -> File. This will open a save file dialog box. Here the user can select the file format for saving the video. The user can also browse to the required directory and set the file name so that in future, videos recorded will be saved in that folder.

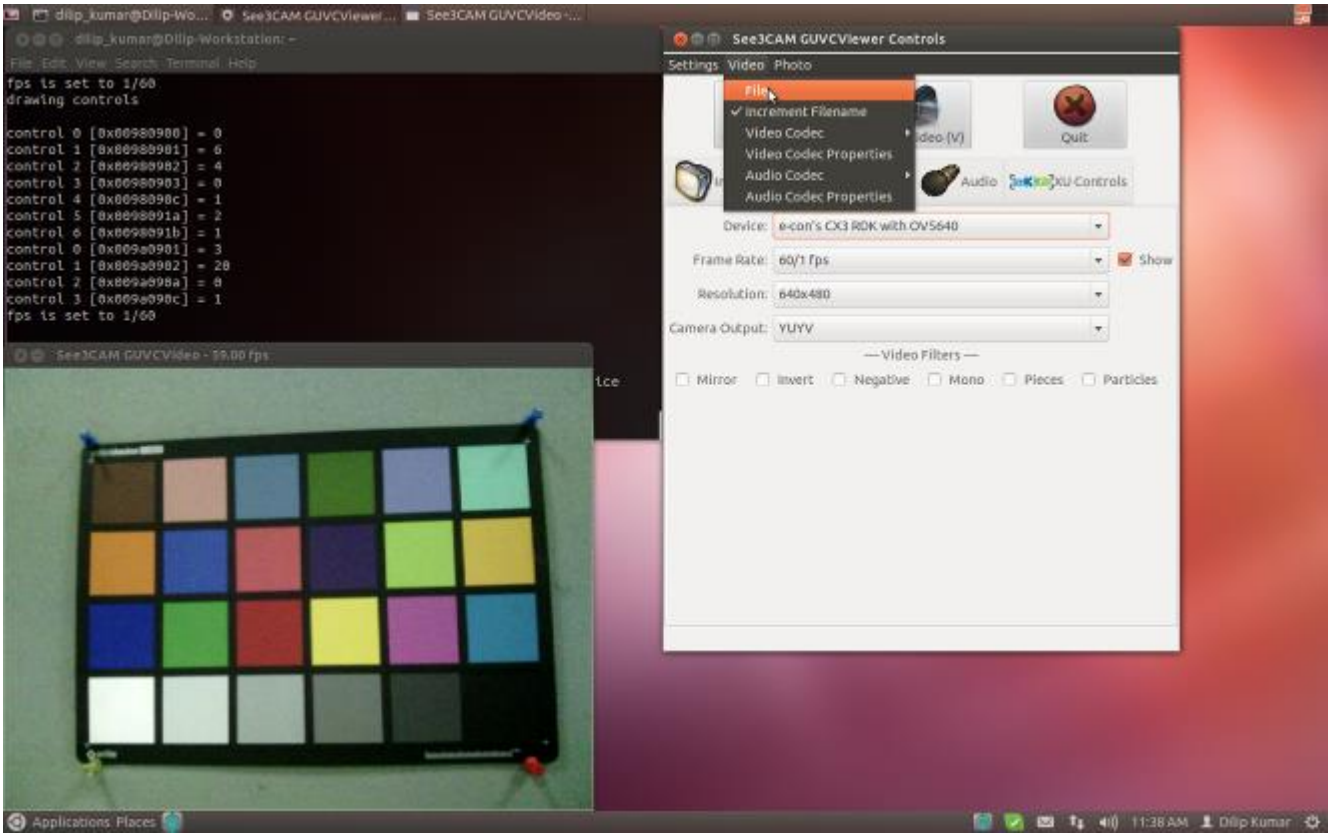

Figure 7-23 Save file dialog to set the Recorded Video Folder and file name

7.3 See3CAM XU Controls Tab

On selecting the See3CAM controls tab, the XU control will appear, if the device supports extension unit. Currently Extension Unit is not supported for the See3CAM_CX3RDK with e-CAM59CX3.

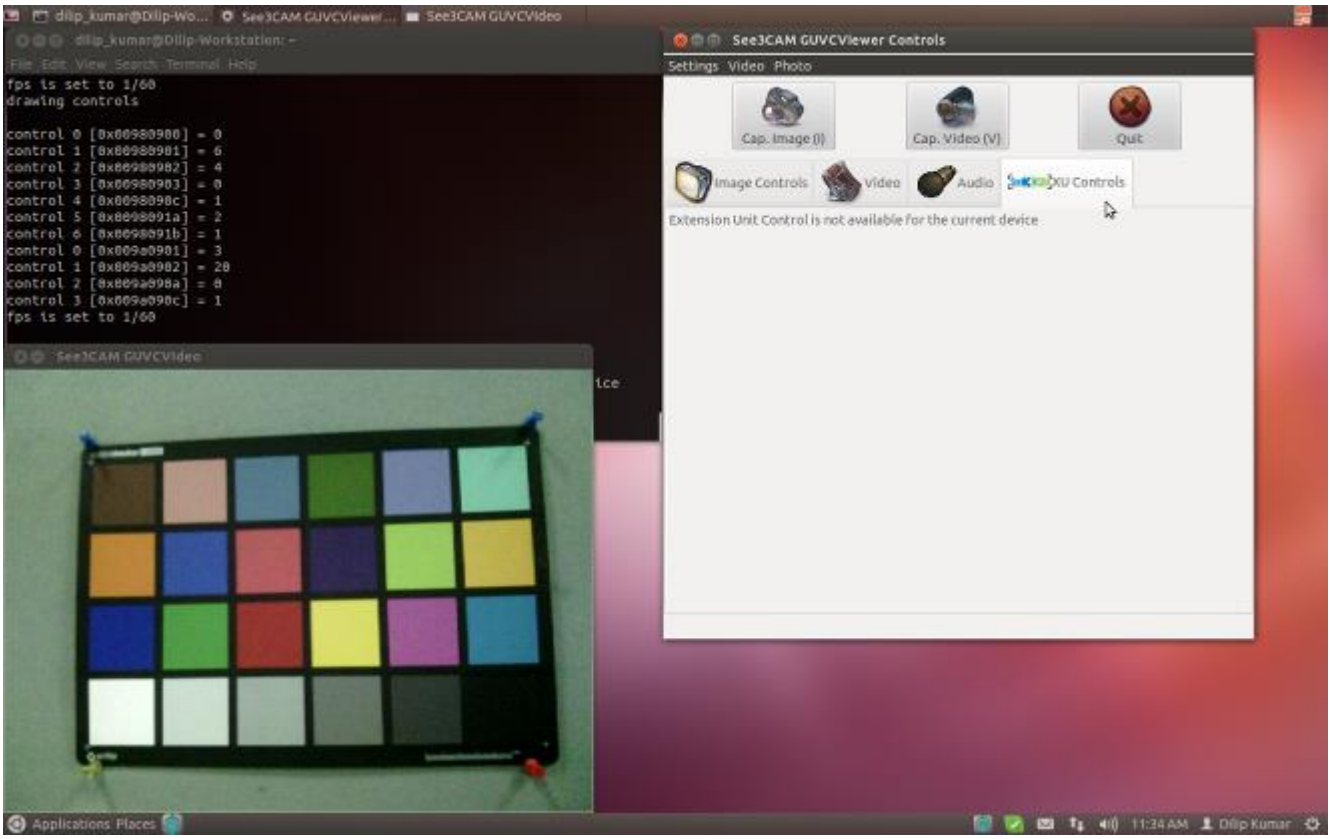

Figure 7-24 See3CAM XU Controls

If non-econ device or e-con usb camera not belonging to See3CAM family is selected for preview in the Video Tab (as shown in the figure 7-25), See3CAM XU controls tab items will be disabled (as shown in the figure 7-26).

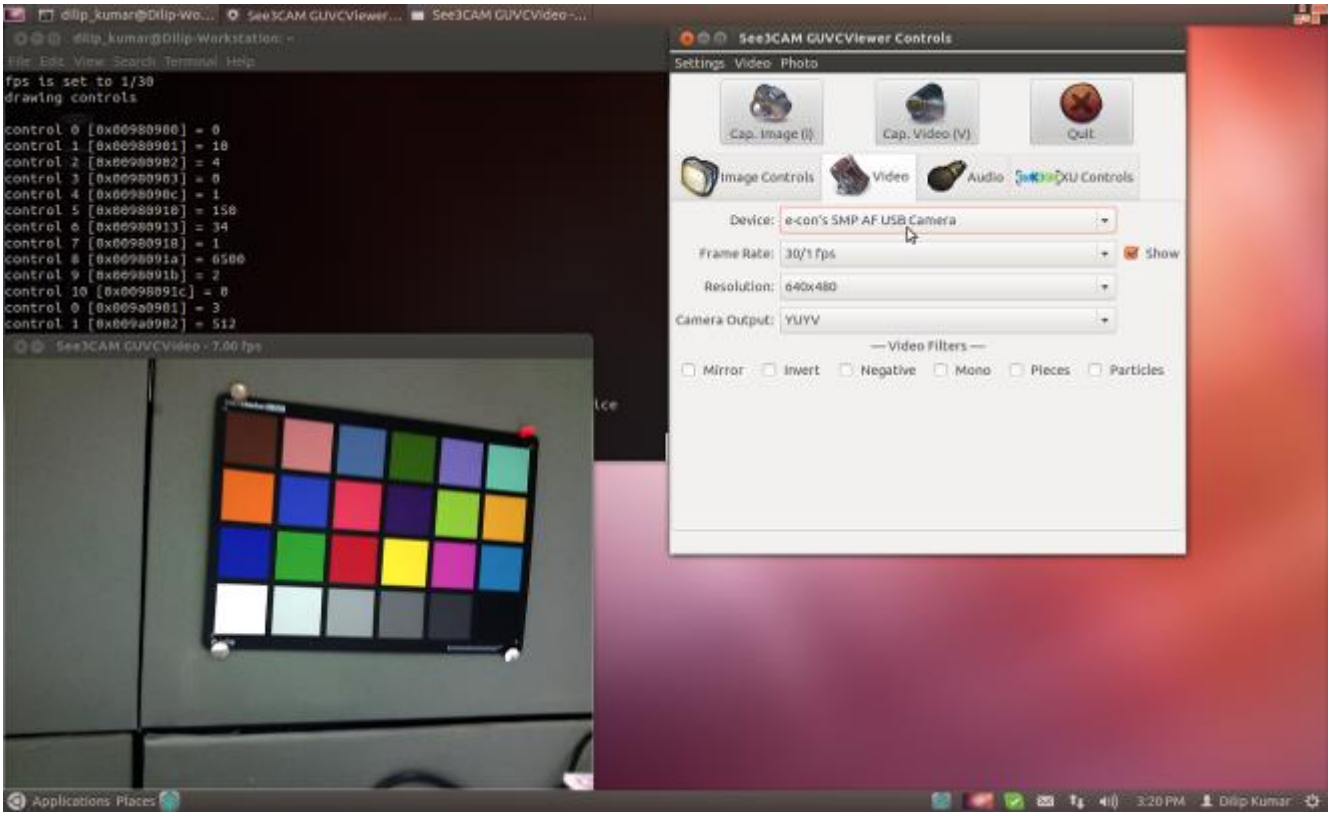

Figure 7-25 Selection of non See3CAM device

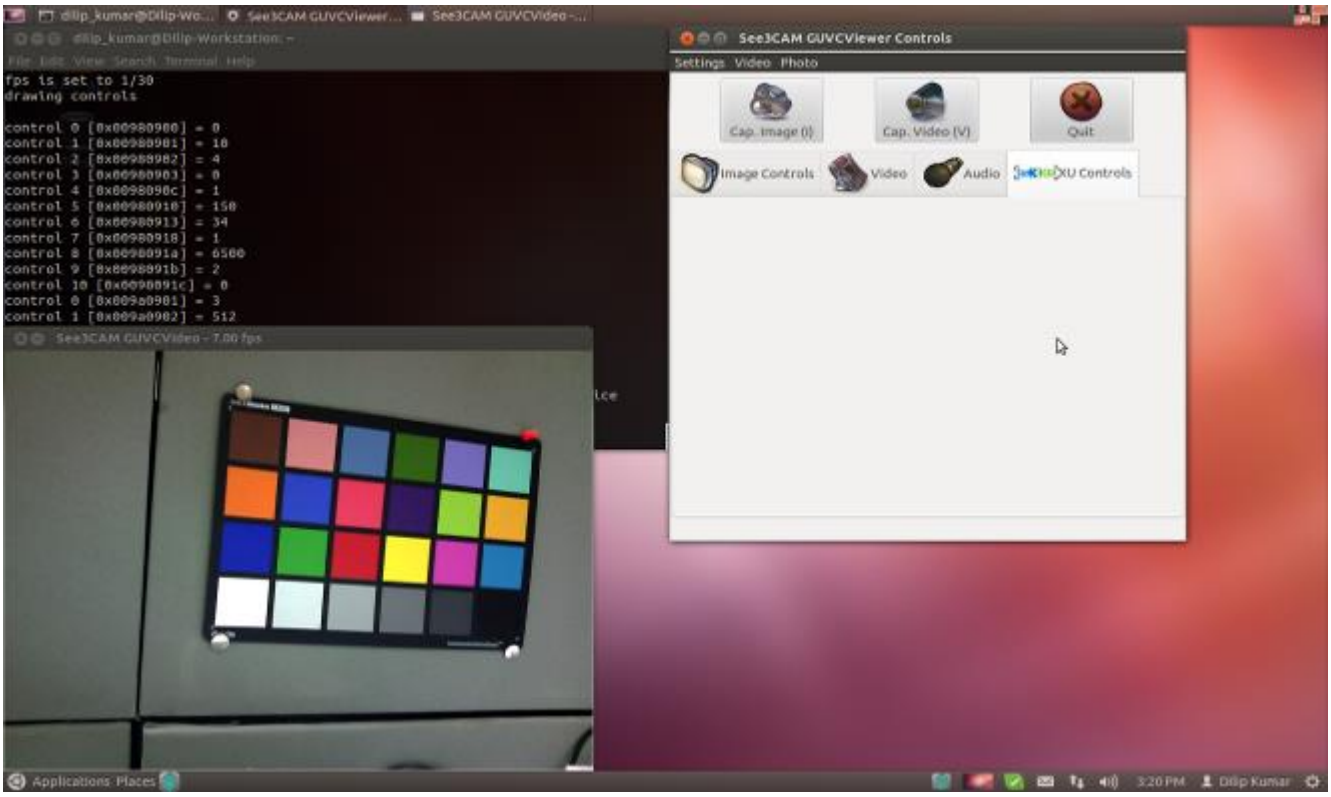

Figure 7-26 See3CAM XU Controls disabled for non See3CAM device

8 Known Issues and Limitation

1. This see3camguvcview XU Control Application is tested in Ubuntu 12.04(32-bit and 64-bit) and Ubuntu 14.04(32-bit and 64-bit) Linux Distribution only.
2. If we unplug and plug the See3CAM_CX3RDK with e-CAM59CX3 while the application is running, the application will be crashed and this situation is not handled.
3. In Ubuntu 12.04(32-bit and 64-bit) the kernel version tested is up to 3.2.0-63-generic-pae. In kernel versions higher than this, switching resolutions of the camera does not work.

9 Conclusion

This document provides detail explanation on various features and options available in see3camguvcview application.