ENSC 351
How To Guide:
Transmitting/Displaying Video Over UDP
Using Python & OpenCV

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Introduction

This guide provides information on how to transmit data from a USB webcam plugged into a BeagleBone Green to a host computer. The tutorial includes code for the UDP transmission, and displaying the image on the host machine.

Hardware Required
- Beaglebone Green
- Any USB webcam that is compatible with Linux
- Host Computer

Software Required
- Python
- Numpy library
- CVZone library
- Socket Library

1. Verify Webcam is Compatible with Linux

1.1:
Start your host machine and connect the webcam to a USB port.

1.2:
After plugging in the webcam, check if it is detected by your pc. This can be done by using the command:

(host) ~$ lsusb

Sample output:
```
Bus 002 Device 003: ID 046d:082d Logitech, Inc. HD Pro Webcam C920
Bus 002 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 001 Device 003: ID 0e0f:0002 VMware, Inc. Virtual USB Hub
Bus 001 Device 002: ID 0e0f:0003 VMware, Inc. Virtual Mouse
Bus 001 Device 001: ID 1d6b:0001 Linux Foundation 1.1 root hub
```

or by using:

(host) ~$ ls /dev/ | grep video

Verify that a new video feed shows up after plugging in your webcam

Sample output:
```
video0
video1
```

Troubleshooting:

If the webcam is not detected, make sure the webcam is connected to the pc properly. It is also important to note that not all webcams are supported by Linux. You may also have issues with certain webcam models and certain virtual machines. Make sure your webcam is passed through as a USB device.

Even if you have issues with connecting your webcam to your virtual machine, it may still be compatible with Linux, and could potentially work with the BeagleBone. You may want to skip to part 3 of the guide and test here.

2. Getting Video Feed from Webcam on Host

2.1:
Make sure the camera is functional by installing cheese.
First, if Snap is not currently installed, use the following commands to install it:

(host) ~$ sudo apt update
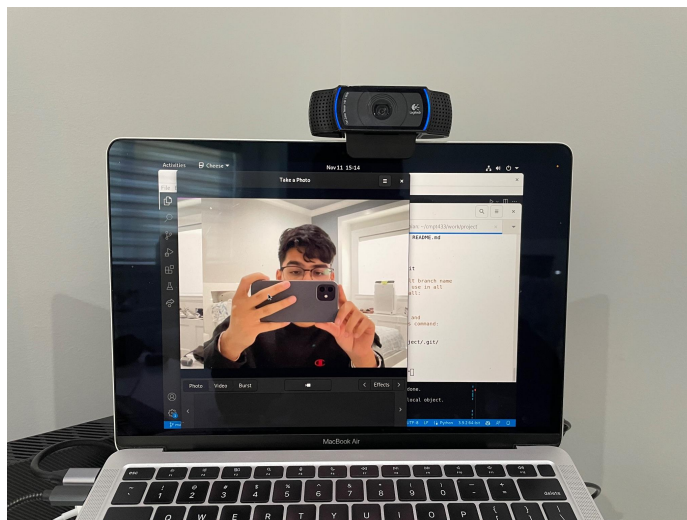**(host) ~$ sudo apt install snapd**

2.2:
Then install Cheese using:

(host) ~$ sudo snap install cheese --candidate

2.3:
Open Cheese to see if the camera is functional (and to ensure it is compatible with Linux).

Troubleshooting:

Make sure the correct device is selected in the "Preference" menu. If Cheese is still not working, try using Kamoso instead. Kamoso can be installed using the following command:

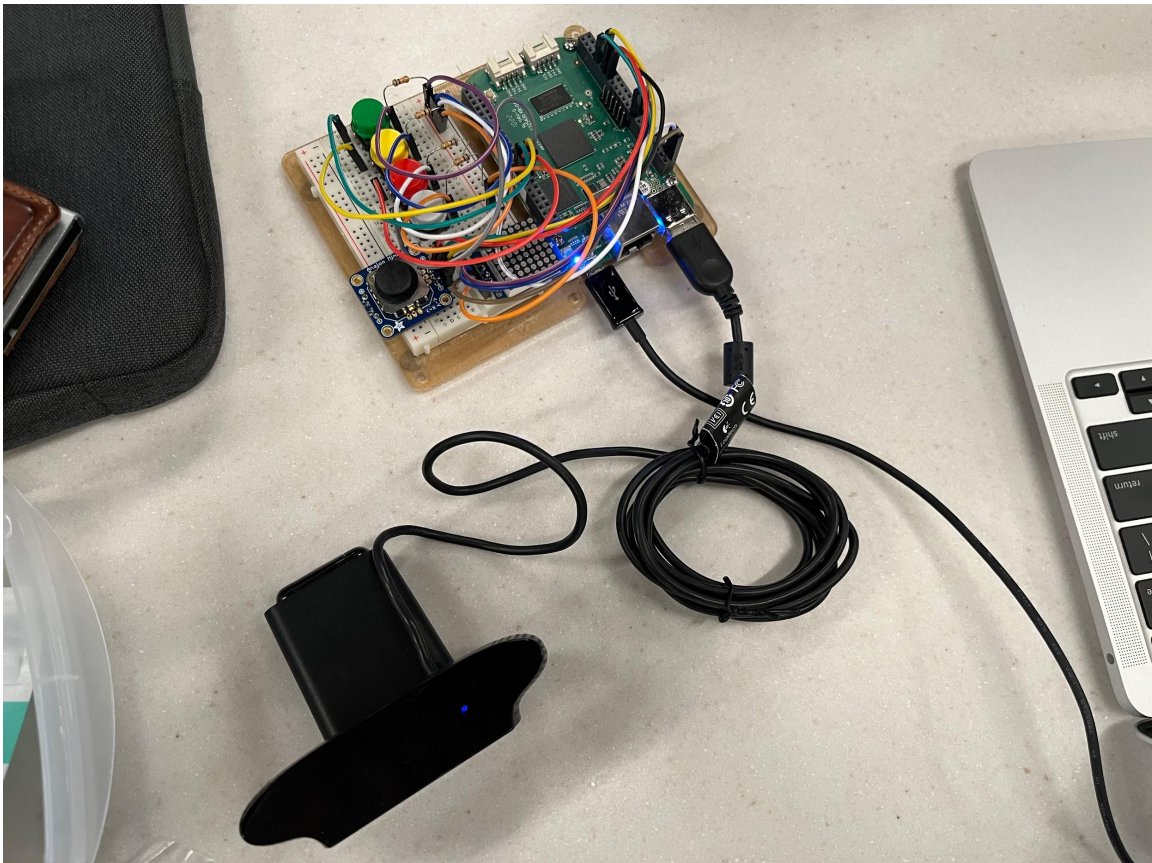**(host) ~$ sudo apt install kamoso**

3. Connecting Webcam to Beaglebone Green

3.1:

Connect the Beaglebone Green to the host via the micro USB cable. Make sure network configuration is correct. Throughout this guide, the BeagleBone will be connected as 192.168.7.2

3.2:

Plug the webcam into the USB port on the Beaglebone.

3.3:

After plugging in the webcam, check if it is detected by your pc. This can be done by using the command:

(bbg) ~$ lsusb

Sample output:

```
Bus 002 Device 003: ID 046d:082d Logitech, Inc. HD Pro Webcam C920
Bus 002 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 001 Device 003: ID 0e0f:0002 VMware, Inc. Virtual USB Hub
Bus 001 Device 002: ID 0e0f:0003 VMware, Inc. Virtual Mouse
Bus 001 Device 001: ID 1d6b:0001 Linux Foundation 1.1 root hub
```

or by using:

(bbg) ~$ ls /dev/ | grep video

<u>Verify that a new video feed shows up after plugging in your webcam</u>

Sample output:
```
video0
video1
```

Troubleshooting:

If the webcam is not detected, make sure the webcam and Beaglebone are connected to the pc properly. It is also important to note that not all webcams are supported by Linux.

4. Install dependencies for Host/BBG Programs

4.1:

Verify that Python is installed on both the Host and BeagleBone by running the following commands

(host) ~$ python3 --version

(bbg) ~$ python3 --version

If Python is not installed, you can do so using the following guide:
https://opensource.com/article/20/4/install-python-linux

You will also need to verify that pip is installed:

(host) ~$ pip3 --version

(bbg) ~$ pip3 --version

You can install pip using the following commands on both the host and BeagleBone:

(host) ~$ sudo apt install python3-pip

(bbg) ~$ sudo apt install python3-pip

4.2:
Next we will install OpenCV. We will be using OpenCV to encode, decode, and show the image on our host. OpenCV will need to be installed on both the host and BeagleBone.

(host) ~$ pip3 install opencv-python

(bbg) ~$ pip3 install opencv-python

Troubleshooting:
You may need to use the commands **python** instead of **python3**, and **pip** instead of **pip3.** If this is the case, please use these commands throughout the rest of the tutorial. If you have difficulties, make sure python3 is configured correctly.

You may need to install the following dependencies on the BeagleBone

(bbg) ~$ sudo apt-get install libcblas-dev sudo apt-get install libhdf5-dev sudo apt-get install libhdf5-serial-dev sudo apt-get install libatlas-base-dev sudo apt-get install libjasper-dev sudo apt-get install libqtgui4 sudo apt-get install libqt4-test

5. Run Python Program on Host and Receiver

5.1:
Download the programs guideUDPSender.py and guideUDPReceiver.py.

5.2:
Copy the guideUDPSender.py file to the public directory of your cmpt433 folder. You will need to access it on the NFS mount on your BeagleBone.

5.3:
Open a terminal on your host machine in the directory containing guideUDPReceiver.py. Then start running the program using the following command:

(host) ~$ python3 guideUDPReceiver.py

Navigate to the folder containing guideUDPSender.py on the BeagleBone. Then start running the program using the following command

(bbg) ~$ python3 guideUDPSender.py

If your webcam has an indicator light it should turn on. You will see a window pop-up on the host machine with the webcam image displayed as below: