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ACTIVITY NO. 3	Basic I/O Scripting, Part 2
Name	De los Reyes,Jann Moises Nyll
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Instructor:	Engr. Roman M. Richard

1. Objectives

This activity aims to introduce students to OpenCV's I/O Functionality for video processing.

2. Intended Learning Outcomes (ILOs)

After this activity, the students should be able to:

- Read and write video files using openCV.
- Utilize openCV to capture and display images and videos.

3. Procedures and Outputs

NOTE: For this laboratory activity, it is recommended that you download and run the Python notebook on *Spyder IDE*. You must install dependencies by running `!pip install numpy` and `!pip install opencv-python==4.6.0.66`.

Reading/Writing a Video File

OpenCV provides the `VideoCapture` and `VideoWriter` classes that support various video file formats. The supported formats vary by system but should always include an AVI. Via its `read()` method, a `VideoCapture` class may be polled for new frames until it reaches the end of its video file. Each frame is an image in a BGR format.

Conversely, an image may be passed to the `write()` method of the `VideoWriter` class, which appends the image to a file in `VideoWriter`. Let's look at an example that reads frames from one AVI file and writes them to another with a YUV encoding:

```
In [ ]: import cv2

videoCapture = cv2.VideoCapture('MyInputVid.avi')

fps = videoCapture.get(cv2.CAP_PROP_FPS)
size = (int(videoCapture.get(cv2.CAP_PROP_FRAME_WIDTH)),
        int(videoCapture.get(cv2.CAP_PROP_FRAME_HEIGHT)))

videoWriter = cv2.VideoWriter(
    'MyOutputVid.avi', cv2.VideoWriter_fourcc('I', '4', '2', '0'),
    fps, size)

success, frame = videoCapture.read()
while success: # Loop until there are no more frames
```

```
videoWriter.write(frame)
success, frame = videoCapture.read()
```

The arguments to the VideoWriter class constructor deserve special attention. A video's filename must be specified. Any preexisting file with this name is overwritten. A video codec must also be specified. The available codecs may vary from system to system. These are the options that are included:

- `cv2.VideoWriter_fourcc('I', '4', '2', '0')` : This option is an uncompressed YUV encoding, 4:2:0 chroma subsampled. This encoding is widely compatible but produces large files. The file extension should be .avi.
- `cv2.VideoWriter_fourcc('P', 'I', 'M', '1')` : This option is MPEG-1. The file extension should be .avi.
- `cv2.VideoWriter_fourcc('X', 'V', 'I', 'D')` : This option is MPEG-4 and a preferred option if you want the resulting video size to be average. The file

extension should be .avi.

- `cv2.VideoWriter_fourcc('T', 'H', 'E', '0')` : This option is Ogg Vorbis. The file extension should be .ogv.
- `cv2.VideoWriter_fourcc('F', 'L', 'V', '1')` : This option is a Flash video. The file extension should be .flv.

A frame rate and frame size must be specified too. Since we are copying video frames from another video, these properties can be read from the `get()` method of the VideoCapture class.

Capturing camera frames

A stream of camera frames is represented by the VideoCapture class too. However, for a camera, we construct a VideoCapture class by passing the camera's device index instead of a video's filename. Let's consider an example that captures 10 seconds of video from a camera and writes it to an AVI file:

```
In [2]: import cv2

cameraCapture = cv2.VideoCapture(0)
fps = 30 # an assumption

size = (int(cameraCapture.get(cv2.CAP_PROP_FRAME_WIDTH)),
        int(cameraCapture.get(cv2.CAP_PROP_FRAME_HEIGHT)))

videoWriter = cv2.VideoWriter(
    'MyOutputVid.avi', cv2.VideoWriter_fourcc('I', '4', '2', '0'),
    fps, size)

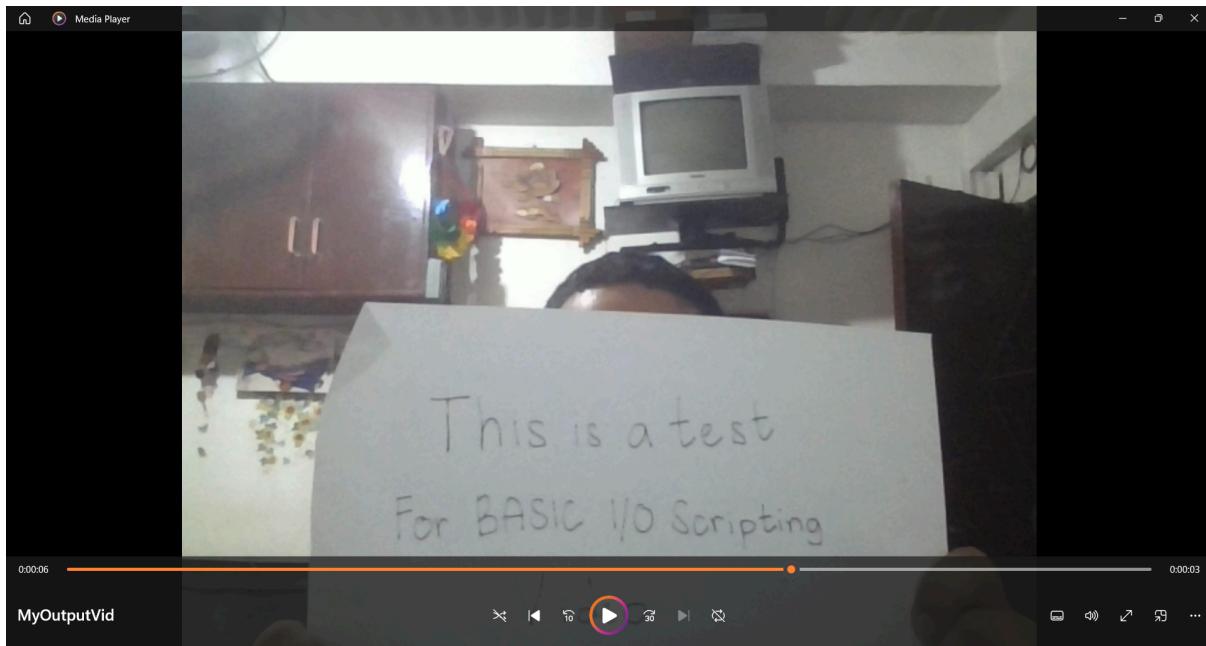
success, frame = cameraCapture.read()
numFramesRemaining = 10 * fps - 1

while success and numFramesRemaining > 0:
    videoWriter.write(frame)
    success, frame = cameraCapture.read()
    numFramesRemaining -= 1

cameraCapture.release()
```

Sample Output

[Click this link to see the output](#)



Unfortunately, the `get()` method of a `VideoCapture` class does not return an accurate value for the camera's frame rate; it always returns 0. The official documentation at http://docs.opencv.org/modules/highgui/doc/reading_and_writing_images_and_video.html reads:

"When querying a property that is not supported by the backend used by the `VideoCapture` class, value 0 is returned."

This occurs most commonly on systems where the driver only supports basic functionalities. For the purpose of creating an appropriate `VideoWriter` class for the camera, we have to either make an assumption about the frame rate (as we did in the code previously) or measure it using a timer.

The `read()` method is inappropriate when we need to synchronize a set of cameras or a multihead camera (such as a stereo camera or Kinect). Then, we use the `grab()` and `retrieve()` methods instead. For a set of cameras, we use this code:

```
In [ ]: """
success0 = cameraCapture0.grab()
success1 = cameraCapture1.grab()
if success0 and success1:
    frame0 = cameraCapture0.retrieve()
    frame1 = cameraCapture1.retrieve()
"""
```

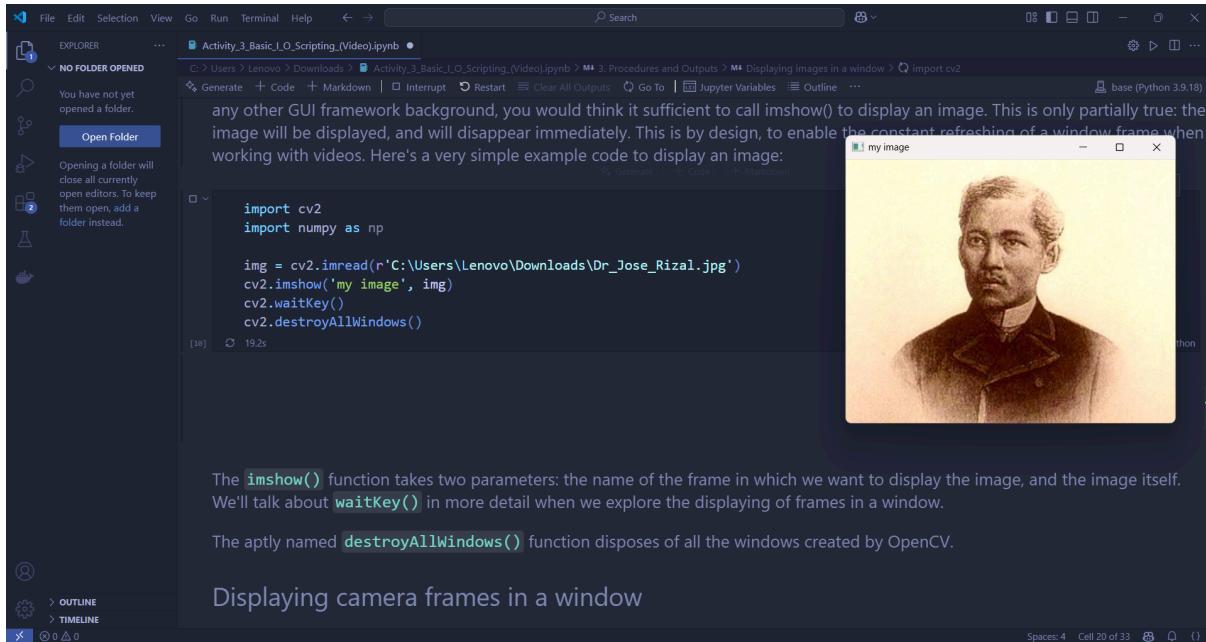
Displaying images in a window

One of the most basic operations in OpenCV is displaying an image. This can be done with the `imshow()` function. If you come from any other GUI framework background, you would think it sufficient to call `imshow()` to display an image. This is only partially true: the image will be displayed, and will disappear immediately. This is by design, to enable the constant refreshing of a window frame when working with videos. Here's a very simple example code to display an image:

```
In [3]: import cv2
import numpy as np

img = cv2.imread(r'C:\Users\Lenovo\Downloads\Dr_Jose_Rizal.jpg')
cv2.imshow('my image', img)
cv2.waitKey()
cv2.destroyAllWindows()
```

Sample Output of the Code:



The `imshow()` function takes two parameters: the name of the frame in which we want to display the image, and the image itself. We'll talk about `waitKey()` in more detail when we explore the displaying of frames in a window.

The aptly named `destroyAllWindows()` function disposes of all the windows created by OpenCV.

Displaying camera frames in a window

OpenCV allows named windows to be created, redrawn, and destroyed using the `namedWindow()`, `imshow()`, and `destroyWindow()` functions. Also, any window may capture keyboard input via the `waitKey()` function and mouse input via the `setMouseCallback()` function. Let's look at an example where we show the frames of a live camera input:

```
In [13]: import cv2

clicked = False

def onMouse(event, x, y, flags, param):
    global clicked
    if event == cv2.EVENT_LBUTTONDOWN:
        clicked = True

cameraCapture = cv2.VideoCapture(0)
cv2.namedWindow('MyWindow')
cv2.setMouseCallback('MyWindow', onMouse)

print('Showing camera feed. Click window or press any key to stop.')

success, frame = cameraCapture.read()

while success and cv2.waitKey(1) == -1 and not clicked:
    cv2.imshow('MyWindow', frame)
```

```

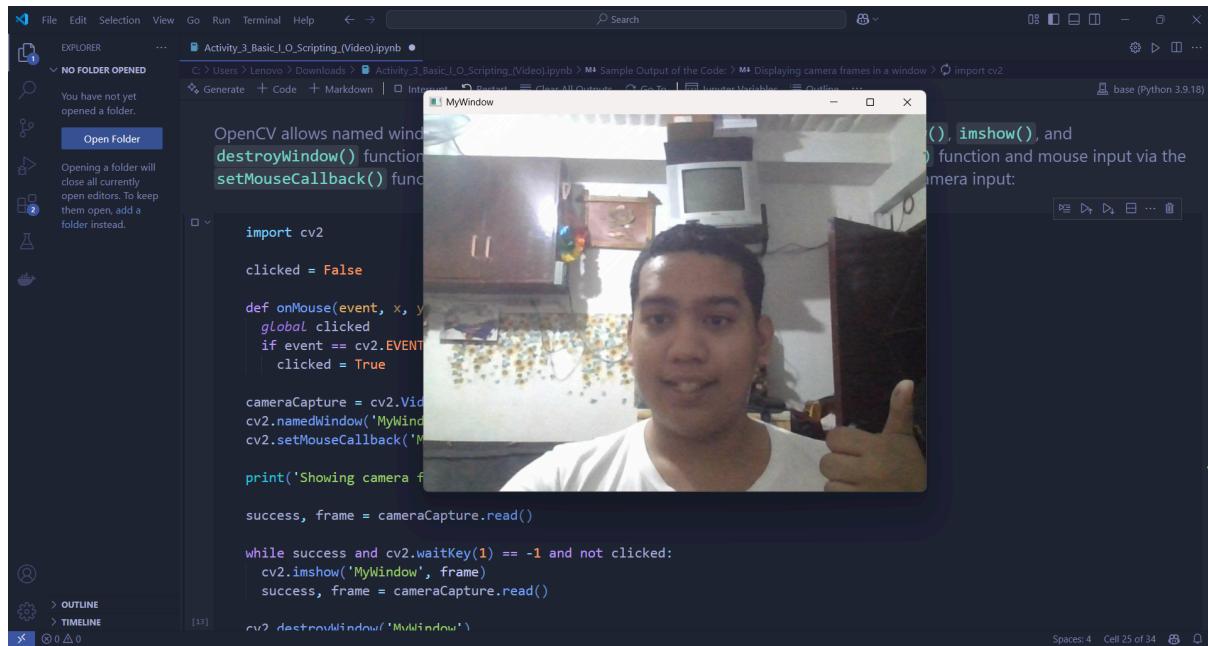
success, frame = cameraCapture.read()

cv2.destroyAllWindows('MyWindow')
cameraCapture.release()

```

Showing camera feed. Click window or press any key to stop.

Sample output of the program:



The argument for `waitKey()` is a number of milliseconds to wait for keyboard input. The return value is either `-1` (meaning that no key has been pressed) or an ASCII keycode, such as `27` for Esc. For a list of ASCII keycodes, see <http://www.asciitable.com/>. Also, note that Python provides a standard function, `ord()`, which can convert a character to its ASCII keycode. For example, `ord('a')` returns `97`.

OpenCV's window functions and `waitKey()` are interdependent. OpenCV windows are only updated when `waitKey()` is called, and `waitKey()` only captures input when an OpenCV window has focus.

The mouse callback passed to `setMouseCallback()` should take five arguments, as seen in our code sample. The callback's param argument is set as an optional third argument to `setMouseCallback()`. By default, it is 0. The callback's event argument is one of the following actions:

- `cv2.EVENT_MOUSEMOVE` : This event refers to mouse movement
- `cv2.EVENT_LBUTTONDOWN` : This event refers to the left button down
- `cv2.EVENT_RBUTTONDOWN` : This refers to the right button down
- `cv2.EVENT_MBUTTONDOWN` : This refers to the middle button down
- `cv2.EVENT_LBUTTONUP` : This refers to the left button up
- `cv2.EVENT_RBUTTONUP` : This event refers to the right button up
- `cv2.EVENT_MBUTTONUP` : This event refers to the middle button up
- `cv2.EVENT_LBUTTONDOWNDBLCLK` : This event refers to the left button being double-clicked
- `cv2.EVENT_RBUTTONDOWNDBLCLK` : This refers to the right button being double-clicked
- `cv2.EVENT_MBUTTONDOWNDBLCLK` : This refers to the middle button being double-clicked

The mouse callback's flags argument may be some bitwise combination of the following events:

- `cv2.EVENT_FLAG_LBUTTON` : This event refers to the left button being pressed
- `cv2.EVENT_FLAG_RBUTTON` : This event refers to the right button being pressed
- `cv2.EVENT_FLAG_MBUTTON` : This event refers to the middle button being pressed

- `cv2.EVENT_FLAG_CTRLKEY` : This event refers to the Ctrl key being pressed
- `cv2.EVENT_FLAG_SHIFTKEY` : This event refers to the Shift key being pressed
- `cv2.EVENT_FLAG_ALTKEY` : This event refers to the Alt key being pressed

Unfortunately, OpenCV does not provide any means of handling window events. For example, we cannot stop our application when a window's close button is clicked. Due to OpenCV's limited event handling and GUI capabilities, many developers prefer to integrate it with other application frameworks.

4. Supplementary Activity

Perform each of the following tasks.

1. Try reading and writing a video file in various formats.
2. Similar to activity #1, show an image of your favorite character on a window. Afterwards, slice so that only the character's face is displayed.
3. Capture video from your webcam and display on a window. Afterwards, the video should be written as a new file.

Reading and Writing a video file in a various format (MP4)

READING

[Link to the video in this activity:](#)

```
In [ ]: import cv2

# Reading a mp4 video file
videoCapture = cv2.VideoCapture(r'C:\Users\Lenovo\Downloads\Truman.mp4') # Path to the video file.
fps = videoCapture.get(cv2.CAP_PROP_FPS)
size = (int(videoCapture.get(cv2.CAP_PROP_FRAME_WIDTH)),
        int(videoCapture.get(cv2.CAP_PROP_FRAME_HEIGHT)))
print('fps', fps)
print('size', size)

fps 25.0
size (480, 272)
```

```
In [8]: #Playing a video file
success, frame = videoCapture.read()
while success:
    cv2.imshow('The Truman Show', frame)
    success, frame = videoCapture.read()
    key = cv2.waitKey(33)
    if key != -1: # If any key is pressed
        break

cv2.destroyAllWindows()
```

Sample Output

```

Activity_3_Basic_I_O_Scripting_(Video).ipynb ● import cv2 Untitled-11 ●
C: > Users > Lenovo > Downloads > Activity_3_Basic_I_O_Scripting_(Video).ipynb > M4 4. Supplementary Activity > M4 Reading and Writing a video file in a various format (MP4) > #Playing a video file
Generate + Code + Markdown | ⌂ Interrupt ⌂ Restart ⌂ Clear All Outputs ⌂ Go To | ⌂ Jupyter Variables ⌂ Outline ⌂ ...
print('fps', fps)
print('size', size)

[1]: ✓ 0.4s
...   fps 25.0
      size (480, 272)

[2]: #Playing a video file
      success, frame = videoCapture.read()
      while success:
          cv2.imshow('The Truman Show', frame)
          success, frame = videoCapture.read()
          key = cv2.waitKey(33)
          if key != -1: # If any key is pressed
              break
      cv2.destroyAllWindows()

[3]: 7.6s

```

5. Summary, Conclusions and Lessons Learned

Writing an mp4 format video

```

In [ ]: # Capturing a video from the camera
cameraCapture = cv2.VideoCapture(0)
fps = 30
size = (int(cameraCapture.get(cv2.CAP_PROP_FRAME_WIDTH)),
        int(cameraCapture.get(cv2.CAP_PROP_FRAME_HEIGHT)))
# Writing a video file
videoWriter = cv2.VideoWriter(
    'CountLove.mp4', cv2.VideoWriter_fourcc(*'XVID'),
    fps, size)

success, frame = cameraCapture.read()
numFramesRemaining = 15 * fps - 1

while success and numFramesRemaining > 0:
    videoWriter.write(frame)
    success, frame = cameraCapture.read()
    numFramesRemaining -= 1

cameraCapture.release()

# Note: The video file will be saved in the same directory as the script.
# The video may took a while to be saved, depending on the number of frames and the resolution of the video.

```

Output: CountLove Demo

Capture Image and display in Window

```

In [4]: img = cv2.imread(r'C:\Users\Lenovo\Downloads\drdoom.png') # Path to the image file.
cv2.imshow('DrDoom', img)
cv2.waitKey()
cv2.destroyAllWindows()

```

Output:

Capture Image and display in Window

```


5. Summary. Conclusions and Lessons Learned


```

```
In [7]: # Capture character face from window display
doom_head = img[0:100, 170:300]
cv2.imshow('DrDoom Head', doom_head)
cv2.waitKey()
cv2.destroyAllWindows()
```

Output:



Display Captured Video on Windows and Save as a new file

```
In [11]: import cv2

def capture_video():
    cameraCapture = cv2.VideoCapture(0)
    cv2.namedWindow('MyWebcam')

    size = (int(cameraCapture.get(cv2.CAP_PROP_FRAME_WIDTH)),
            int(cameraCapture.get(cv2.CAP_PROP_FRAME_HEIGHT)))

    print('Showing camera feed. Press the spacebar to stop.')

    VideoWriter = cv2.VideoWriter(
        'MyWebcam.avi', cv2.VideoWriter_fourcc(*'XVID'),
        30, size)

    success, frame = cameraCapture.read()

    while success:
        cv2.imshow('MyWebcam', frame)
        VideoWriter.write(frame)
        success, frame = cameraCapture.read()
```

```

# Check for key press
key = cv2.waitKey(1) & 0xFF
if key == 32: # ASCII code for spacebar
    break

cv2.destroyAllWindows('MyWebcam')
cameraCapture.release()
VideoWriter.release()
cv2.destroyAllWindows()

# Call the function
capture_video()

# Note: The video file will be saved in the same directory as the script.
# The video may took a while to be saved, depending on the number of frames and the resolution of the video.
# Press the spacebar to stop the video recording.
# Rerunning the script will overwrite the previous video file.

```

Showing camera feed. Press the spacebar to stop.

Sample Demo: [MyWebcam](#)

5. Summary, Conclusions and Lessons Learned

In this activity, we perform various tasks for Basic I/O Scripting of videos using OpenCV. This notebook discusses the procedures for reading and writing a video file. We also manipulated various video codecs and captured real-time video via webcam. Some problems I encounter, while recording videos are the quality and the loading of captured video, which takes too long to respond. Transforming different video files is also challenging for me. Exploring the callbacks in the mouse, keyboard, and event flag gave me the idea to explore more complex things I could do whenever I mastered this scripting. I also noticed that knowing the fps of our video can determine how smooth our video and its quality.

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