CS7.505 - Assignment 0
OpenCV and Chroma Keying

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Contents

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1 Installing and Testing OpenCV

Main docs: `https://docs.opencv.org/4.x/`
Python docs: `https://docs.opencv.org/4.x/d6/d00/tutorial_py_root.html`

1.1 OpenCV Setup

The procedure to setup OpenCV using Anaconda on windows is listed below

1. Download and install Anaconda from here.
2. Setup the anaconda environment for the shell using `conda init`
3. Setup the environment

   Create the environment

   ```
   conda create -yn "cv-cs7-505"
   conda activate cv-cs7-505
   ```

   Install Python 3.9 into it

   ```
   conda install python=3.9
   ```

   Install the essential packages (before OpenCV)

   ```
   conda install numpy jupyterlab
   ```

4. Install OpenCV using `pip`

   Install using pip

   ```
   pip install opencv-python opencv-contrib-python
   ```

1.2 Testing Installation of OpenCV

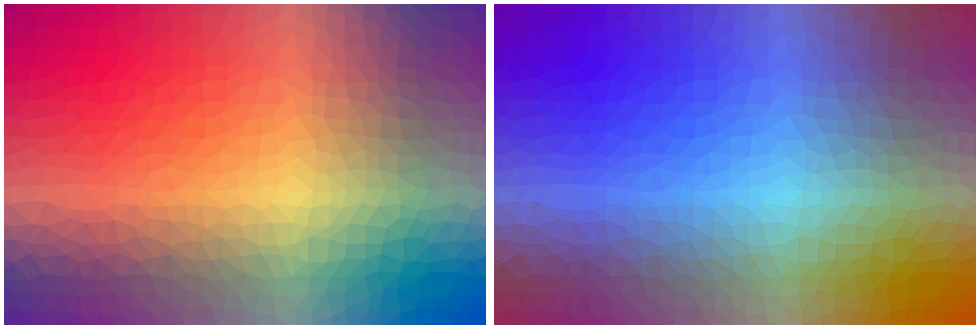
Checking Version

Check version using the script below

```python
# Check OpenCV version
# %% Import everything
import cv2 as cv
import numpy as np

# %% Main entrypoint
if __name__ == "__main__":
    print(f"OpenCV version: {cv.__version__}")
    print(f"Numpy version: {np.__version__}")

# %%
```

The output of the above script is

```
OpenCV version: 4.5.5
Numpy version: 1.21.2
```



(a) Input (b) Output

Figure 1: Test images
The red and blue channels are flipped (their layer intensities are swapped). Check code listing 1

Reading and changing color channels

Consider the images in figure 1. The code to get this output is given below

```
# Change the color channels of an image
"""
    Flips the Reg and Blue channel of an image
"""

# %% Import everything
import cv2 as cv
import numpy as np

# %% Functions
# Show image in a window
def show_img(img, win_name = "Image"):
    cv.namedWindow(win_name, cv.WINDOW_GUI_EXPANDED)
    while True:
        cv.imshow(win_name, img)
        if cv.waitKey(1) == ord('q'):
            break
    cv.destroyWindow(win_name)

# %% Main module
if __name__ == "__main__":
    # Read image
    img_in = cv.imread("./images/test.jpg")
    # Show image
    show_img(img_in, "Input")
    img_out = img_in[:,:,::-1]
    show_img(img_out, "Output")
    # Save output
    cv.imwrite("./images/output.jpg", img_out)

# %%
```

Listing 1: Transform images

2 Chroma Keying with OpenCV

2.1 Video and Images

2.1.1 Video to images

Problem Given a video, convert it into constituent images

Experiments & Learning Experiments performed are listed below

1. Giving user input to the program: Tried using the `input` built-in to read from console. Finally settled at using argparse. Learned how to parse parameters professionally using argparse.
2. Using VideoCapture and read functions to fetch images from a video file, and writing images to disk using imwrite. Some experiments were run where the output prefix directory did not exist, so added the code to create the directory first.

Solution Download video from here and store as `./videos/vtest.avi`. Then run the following

```
python .\vid_to_imgs.py -n 10
```

The code is shown in listing 2. Output is in figure 2.

```python
# Convert a video to images
"""
    Given a video, generate the images. Run as main.
"""

# %% Import everything
import cv2 as cv
import numpy as np
import argparse
import sys
import os

# %% Argument parser
parser = argparse.ArgumentParser(
    formatter_class=argparse.ArgumentDefaultsHelpFormatter)
parser.add_argument('-i', '--vid-file', default="./videos/vtest.avi",
    help="Video file to read")
parser.add_argument('-n', '--num-imgs', default=0, type=int,
    help="The maximum number of images to output from video (0=all)")
parser.add_argument('-o', '--out-prefix', default="./out/img",
    type=str, help="Output prefix for images")

# %% Main entrypoint
if __name__ == "__main__":
    # Parse all (known) arguments
    args, unknown_args = parser.parse_known_args(sys.argv)
    # Check if output directory (if passed) exists
    out_dir = os.path.split(args.out_prefix)[0]
    if not os.path.isdir(out_dir):
        print(f"Folder {out_dir} is being created")
        os.makedirs(out_dir)
    # Read video from file
    cap = cv.VideoCapture(args.vid_file)
    try:
        # Read frames
        fnum = 0
        while cap.isOpened():
            ret, frame = cap.read()
            if not ret:
                print("Probably EOF reached!")
                break
            cv.imshow("Video Feed", frame)
            if cv.waitKey(100) == ord('q'):
                print(f"Break encountered")
                break
            if args.num_imgs == 0 or fnum < args.num_imgs:
                # Write to disk
```

(a) Image 1 (b) Image 5 (c) Image 10

Figure 2: Sequence of images
First, fifth, and tenth image in the 10-image sequence produced by listing 2.

```
                cv.imwrite(f"{args.out_prefix}{fnum+1}.jpg", frame)
                fnum += 1
            else:
                print(f"Reached {fnum} frames")
                break
        print(f"Wrote {fnum} frames under {args.out_prefix}*.jpg")
    finally:
        # Cleanup
        cap.release()
        cv.destroyAllWindows()

# %%
```

Listing 2: vid_to_imgs.py

The above script (listing 2) gives the following output (along with a GUI window to show the images of the video)

```
Folder ./out is being created
Reached 10 frames
Wrote 10 frames under ./out/img*.jpg
```

2.1.2 Images to Video

Problem Given a folder with images, create a video where the FPS (frame rate) can be adjusted

Experiments & Learning Experiments performed are listed below

1. Getting images into the program: It was decided that the user will place the images, labelled in a sorted order (numerically), in a dedicated folder. For this demo, the folder name is `./seq`
2. All user inputs are given through `argparse`
3. FPS will be handled by the `VideoWriter` in the saved video file. However, the preview FPS has to be manually adjusted (using `waitKey` delay)

Solution Store images in a numerical order from 1.jpg to N.jpg (where N is any number) in a dedicated folder, like `./seq`. Then run the following (for 5 FPS)

```
python .\imgs_to_vid.py -i "./seq" -f 5.0 -o "./out-5.avi"
```

The code is shown in listing 3. A snapshot of the generated video is shown in figure 3a. The following is an example for 10 FPS

```
python .\imgs_to_vid.py -i "./seq" -f 10.0 -o "./out-10.avi"
```

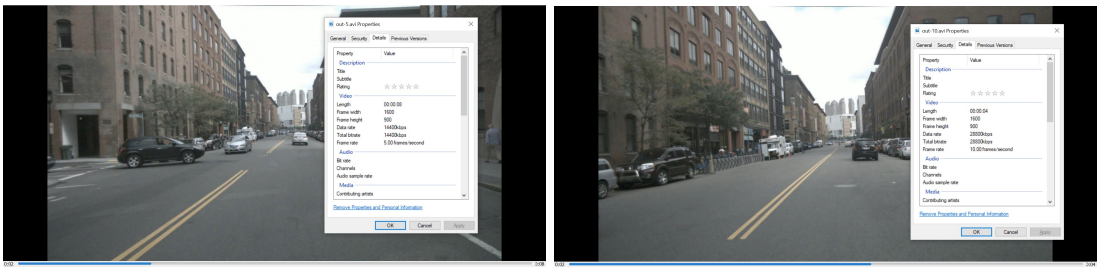
A snapshot of the video generated is shown in figure 3b. See figure 3 for more information.

```python
# Create video from images in a given folder
"""
    Given images (numerically sorted 1 through N) in a folder, read
    them and create a video (no audio, only video)
"""

# %% Import everthing
import cv2 as cv
import os
import glob
import argparse

# %% Argparse parser
parser = argparse.ArgumentParser(
    formatter_class=argparse.ArgumentDefaultsHelpFormatter)
parser.add_argument('-i', '--imgs-folder', default="./seq",
    help="Path to folder in which images are stored (all jpg files)")
parser.add_argument('-o', '--out-file', default="./out.avi",
    help="Output file (uses AVI, XVID fourcc)")
parser.add_argument('-f', '--vid-fps', default=10.0, type=float,
    help="The desired FPS (as float) for the output file")

# %% Main entrypoint
if __name__ == "__main__":
    # Parse arguments
    args, unknown_args = parser.parse_known_args()

    # Variables
    imgs_path = f"{os.path.realpath(args.imgs_folder)}/*.jpg"
    fps = args.vid_fps
    out_file = args.out_file
    # File names (sorted numerically)
    img_fnames = sorted(glob.glob(imgs_path), key=len)
    shape_w_h = cv.imread(img_fnames[0]).shape[-2::-1]  # (W, H) of video
    # Video writer
    fourcc = cv.VideoWriter_fourcc(*"XVID")
    out_fhdlr = cv.VideoWriter(out_file, fourcc, fps, shape_w_h)

    # For ever image found, write it to the video file
    for i, img_file in enumerate(img_fnames):
        # Read file
        frame = cv.imread(img_file)
        if frame is None:
            print(f"Unable to read '{img_file}', skipping it!")
            continue
        # Write the image to video writer
        out_fhdlr.write(frame)
        # Preview
        cv.imshow("Video", frame)
        if cv.waitKey(int(1000/fps)) == ord('q'):
            print(f"Quit received after {i} frames")
            break
    # Cleanup
    out_fhdlr.release()
    cv.destroyAllWindows()

# %%
```

Listing 3: imgs_to_vid.py

3 Capture Images through Webcam

Problem Use a webcam, capture images and save them to a folder



(a) 5 FPS (b) 10 FPS

Figure 3: Saved videos
Image a is a screenshot of the `5 FPS` playback (see the properties and the video frame). Image b is a screenshot of the `10 FPS` playback. Notice that the `10 FPS` version is faster, therefore a greater number of frames elapsed (for the 2 second point) compared to the `5 FPS` version.