Report: Assignment - 0

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- All the input data used in this assignment has been zipped into a folder called **data** and can be downloaded here.
- All the results generated in this assignment have been zipped into a folder called **output** and can be downloaded here.

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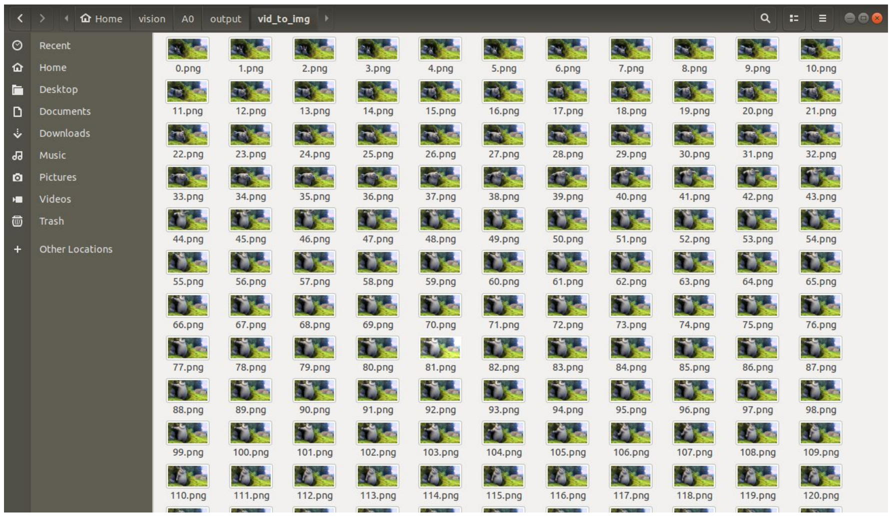
1. Conversion between videos and images:

- **Problem definition:** Write a program to convert a given video to its constituent images. Your output should be in a specified folder. Write another program that will merge a set of images in a folder into a single video. You should be able to control the frame rate in the video that is created.
- **Challenges faced:**
  - Compiling OpenCV from source.
  - Testing the video module in OpenCV.
  - Reading tutorials on using the video module in OpenCV.
- **Results:**
  - I took a sample video(**sample.mp4** in the **data** folder) and converted the entire video into frames.
  - These frames are then stored in an output folder(parameter) as numbered frames starting from 0. (**vid_to_img/** folder in **output** folder)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A0
output
vid_to_img
Recent
Home
Desktop
Documents
Downloads
Music
Pictures
Videos
Trash
Other Locations
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- For reconstruction of video from frames, we give a list of number frame images(starting from 0 to N) where the k^th frame is named as k.* where * is the image codec extension. We store these in a folder and pass the folder path as a parameter for the reconstruction. One such sample is there in **frames/** folder in the data folder.
- The video is reconstructed using a given frame rate(fps) which is also a parameter to control the speed of the video. The reconstructed video is stored in a specified output file.(**output.avi** in the **output** folder)

Results for these experiments can be found in the output folder.

- **Code(video to images)**

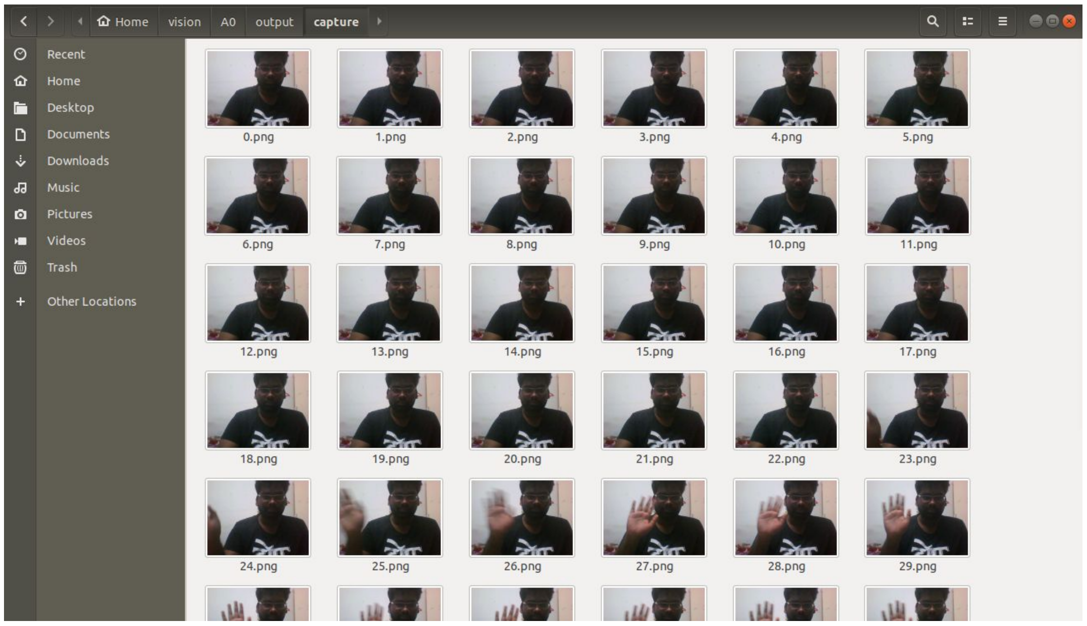
```
import cv2
import os

def convert_to_img(vid_file, output_folder):
    """Converts a video to a series of images and saves to a specified
location."""
    cam = cv2.VideoCapture(vid_file)
    counter = 0
    ret = True
    while(ret):
        ret, frame = cam.read()
        if not ret:
            break

        cv2.imshow('frame', frame)
        cv2.imwrite(os.path.join(output_folder, str(counter) + ".png"),
frame)
        counter += 1
        if cv2.waitKey(1) & 0xFF == ord('q'):
            break
    cam.release()
    cv2.destroyAllWindows()

if __name__ == "__main__":
    video_file = "data/sample.mp4"
    output_folder = "output/vid_to_img/"
    convert_to_img(video_file, output_folder)
```

- **<u>Code(images to video)</u>**

```
import cv2
import os


def convert_to_vid(frames_folder, video_file, fps=25, frame_size=(1280,
720)):
    """Converts a series of images to video and saves to a specified
location."""
    codec = cv2.VideoWriter_fourcc(*'XVID')
    out = cv2.VideoWriter(video_file, codec, float(fps), frame_size,
isColor=True)

    frames = os.listdir(frames_folder)
    filetype = "." + frames[0].split(".")[1]

    frames = [x.split(".")[0] for x in frames]
    frames.sort(key=int)
    frames = [x + filetype for x in frames]

    for f in frames:
        frame = cv2.imread(os.path.join(frames_folder, f))
        out.write(frame)

    out.release()
    cv2.destroyAllWindows()


if __name__ == "__main__":
    frames_folder = "data/frames/"
    video_file = "output/output.avi"
    fps = 10
    frame_size = (1280, 720)

    convert_to_vid(frames_folder, video_file, fps=fps,
frame_size=frame_size)
```

2. Capturing video from camera.

- **Problem definition:** Learn how to capture frames from a webcam connected to your computer and save them as images in a folder. You may use either the built-in camera of your laptop or an external one connected through USB. You should also be able to display the frames (the video) on the screen while capturing.
- **Challenges faced:**
  - Compiling OpenCV from source.
  - Testing the video module in OpenCV.
  - Reading tutorials on using the video module in OpenCV.
- **Results:**
  - I captured a video of myself using the webcam in my laptop and saved them as frames in the **capture/** folder in **output** folder.
  - These frames are stored in an output folder(parameter) as numbered frames starting from 0.

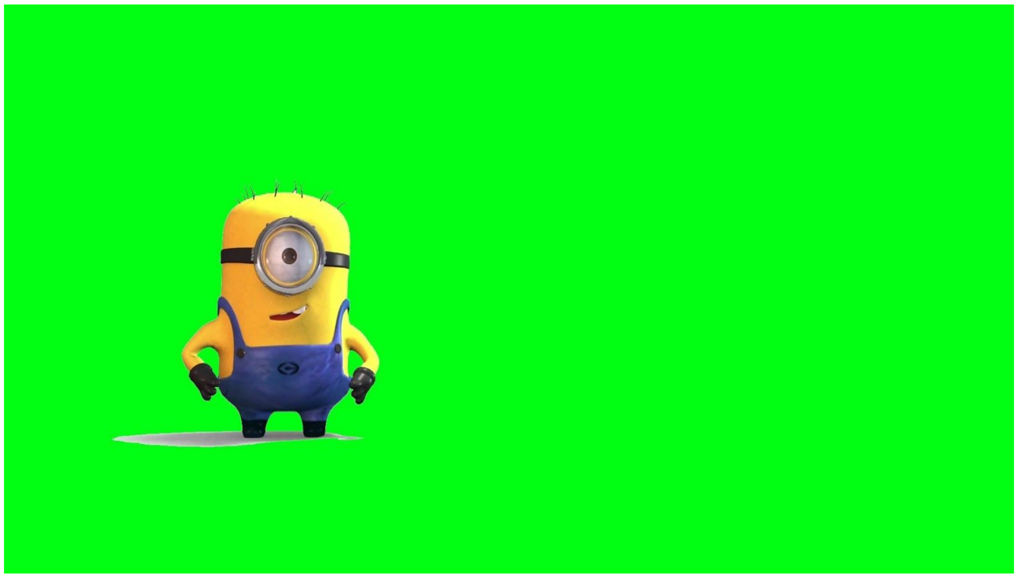


Results for these experiments can be found in the output folder.

- **Code:**

```python
import cv2
import os


def capture_video(output_folder):
    """Capture frames from camera and saves to a specified 
location."""
    cap = cv2.VideoCapture(0)
    counter = 0

    while(True):
        ret, frame = cap.read()

        cv2.imshow('frame', frame)
        cv2.imwrite(os.path.join(output_folder, str(counter) + 
".png"), frame)
        if cv2.waitKey(1) & 0xFF == ord('q'):
            break

    cap.release()
    cv2.destroyAllWindows()


if __name__ == "__main__":
    output_folder = "output/capture/"

    capture_video(output_folder)
```

3. Chroma Keying:

- **Problem definition:** Chroma key compositing, or chroma keying, is a visual effects/post-production technique for compositing (layering) two images or video streams together based on color hues (chroma range). Usually there is a green/blue screen in a stream/image which is replaced with another stream/image from a different source. This is also called a green screen image and is recorded/shot with a green background that is later replaced with some other content using chroma keying.
  Here is a sample of a green screen image:
  
  The green part of the image is later replaced with some other content.

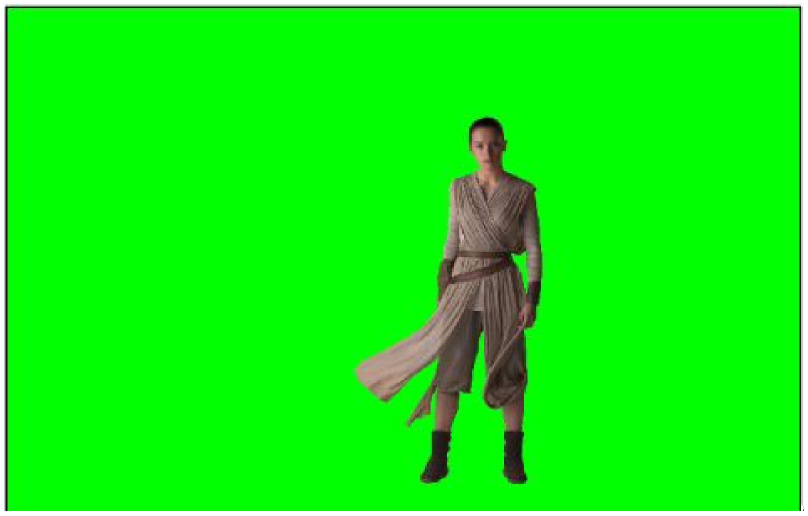
- **Challenges faced:**
  - The main problem in Chroma Keying is to create a binary map that separates the foreground pixels(character) from the background(green screen) once this map is created we can combine the two image by multiplying with the map.
  - For map creation, we need to first specify the color of the background, this is the keycolor. Once we know the key color, we try and identify which pixel is a keycolor and which is not.
  - I compared the Euclidian distance from the pixel color to the keycolor. Pixels that are below a certain distance threshold are classified as background pixels and the remaining are classified as foreground.
  - The threshold parameter needs to be manually set as different videos will have different quality of the green screen(uniform or uneven colored).

- The keycolor also needs to be set, in our experiments we used green screens and so the key color is set to BGR green (0, 255, 0). If a blue screen is used, it needs to be set to BGR blue (255, 0, 0). Note that OpenCV uses the BGR color scheme rather than the commonly used RGB scheme.

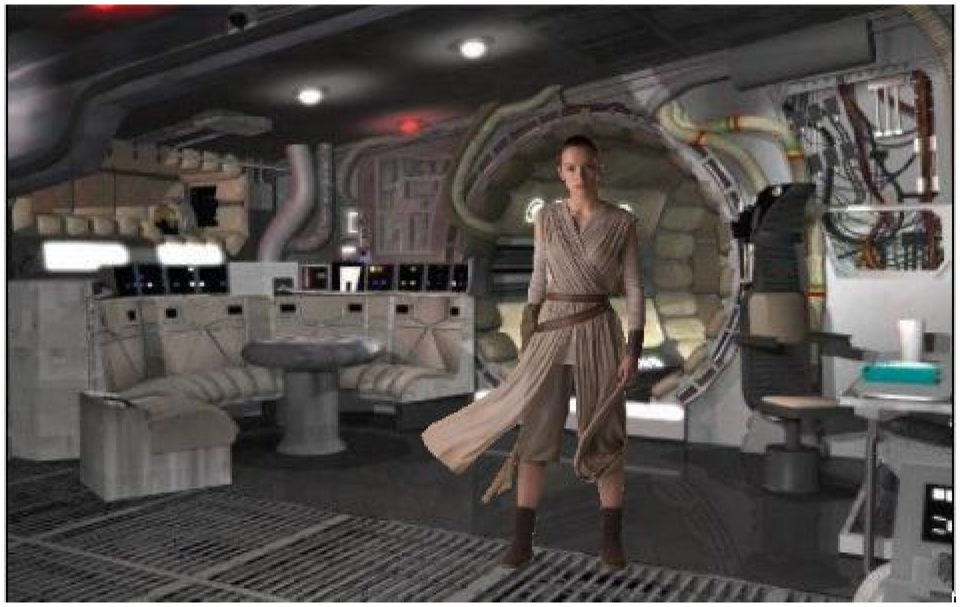
- **Results:**
    - I first tried chroma keying with a few images to test if it worked before working on videos. Here is one set of images that I tested(distance threshold is set to 200)

      Background:

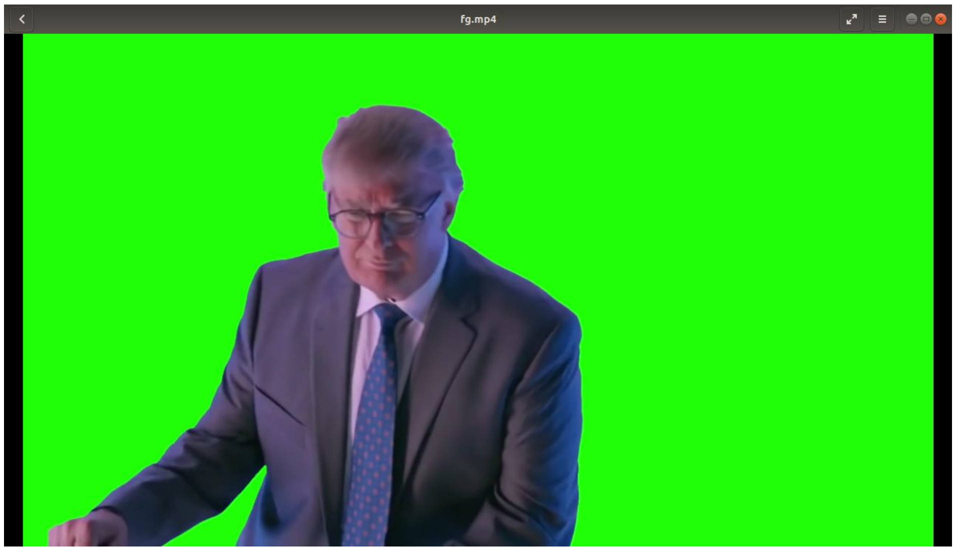
      Foreground:

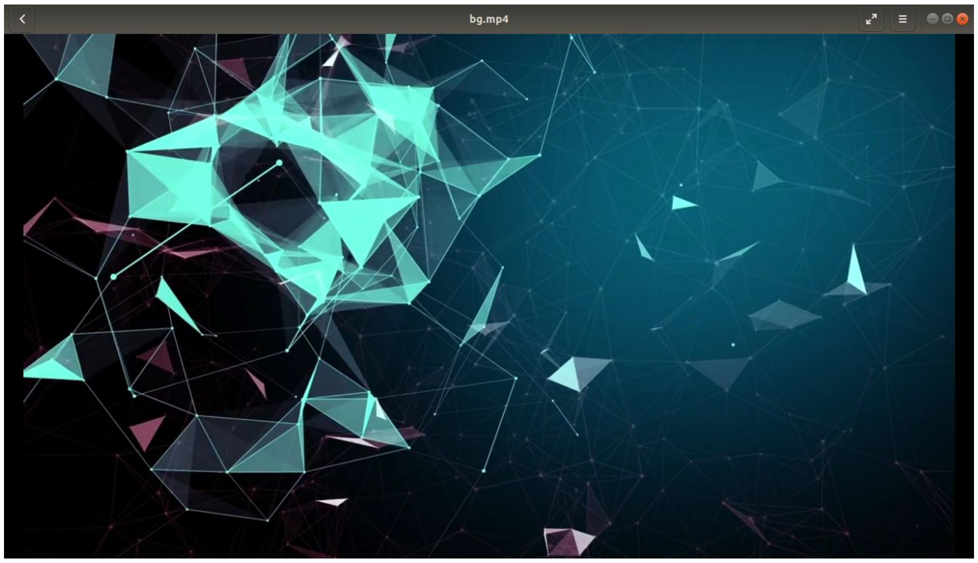
      

Result:



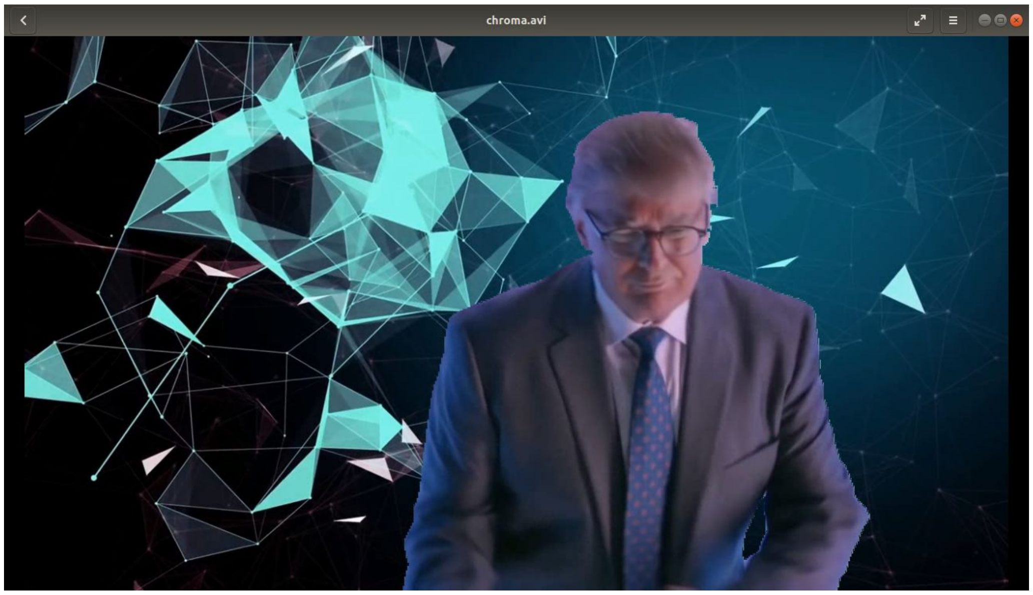
- Once I could get the images to combine, I then moved on to videos. For videos, I selected one of Donald Trump dancing in front of a green screen along with a funky music video background.





These are stored as **fg.mp4** and **bg.mp4** in the **data** folder.

Here is the result:



chroma.avi in the **output** folder.

- **Code:**

```
import cv2
import numpy as np


def get_frames(vid_file, title):
    """Converts a video to a series of images and saves to a
specified location."""
    cam = cv2.VideoCapture(vid_file)
    frames = list()
    ret = True
    while(ret):
        ret, frame = cam.read()
        if not ret:
            break
        frames.append(frame)

    cam.release()
    cv2.destroyAllWindows()
    return frames


def convert_to_vid(frames, video_file, fps=25, frame_size=(1280,
720)):
    """Converts a series of images to video and saves to a specified
location."""
    codec = cv2.VideoWriter_fourcc(*'XVID')
    out = cv2.VideoWriter(video_file, codec, float(fps), frame_size,
isColor=True)

    for frame in frames:
        out.write(frame)

    out.release()
    cv2.destroyAllWindows()
```

```python
def ChromaKey(fg, bg, keyColor, threshold=200):
    """Replace keyColor in fg with bg."""
    color_diff = fg.astype(np.float) - keyColor.astype(np.float)
    color_dist = np.sqrt(np.sum(color_diff * color_diff, axis=2))
    color_pixels = (color_dist > threshold).nonzero()

    transform_map = np.zeros(fg.shape, dtype=np.uint8)
    transform_map[color_pixels] = 1
    inverse_map = 1 - transform_map
    transform_map = transform_map * fg
    inverse_map = inverse_map * bg
    final_image = transform_map + inverse_map

    return final_image

def compose(fg_vid, bg_vid, keyColor, output_vid):
    print("Getting frames from FG video")
    fg_frames = get_frames(fg_vid, "Foreground video")
    print("Getting frames from BG video")
    bg_frames = get_frames(bg_vid, "Background video")

    bg_len = len(bg_frames)
    output = list()

    print("Chroma keying two videos")
    for i, f in enumerate(fg_frames):
        out = ChromaKey(f, bg_frames[i % bg_len], keyColor)
        output.append(out)
    print("Saving video at", output_vid)
    convert_to_vid(output, output_vid)

if __name__ == "__main__":
    output_vid = "output/chroma.avi"
    fg_vid = "data/fg.mp4"
    bg_vid = "data/bg.mp4"
    keyColor = np.array([0, 255, 0], dtype=np.uint8)
    compose(fg_vid, bg_vid, keyColor, output_vid)
```