Computational Photography

Assignment #2: Epsilon Photography

Ronak Patel

Spring 2019

Epsilon Project Overview

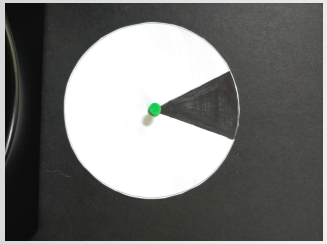


Image 1

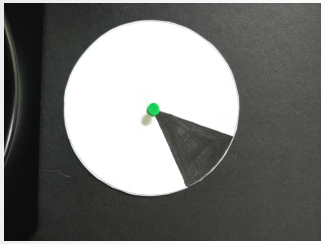


Image 2

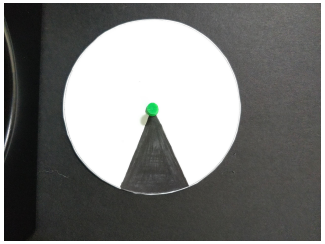


Image 3

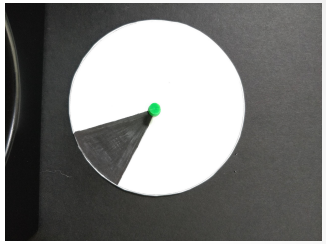


Image 4

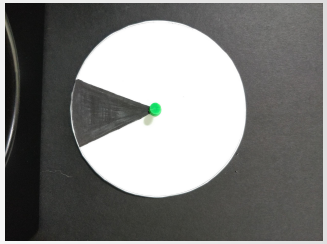
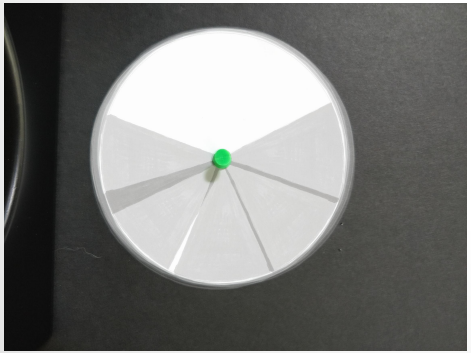


Image 5



Final Artifact

Description:

These photos reveal the position of a marked wheel rotating about an axis. The final artifact is a weighted sum of the pixels from each individual image.

Project Discussion

- What is your epsilon parameter? *Object position*
- Location of pictures? *Alpharetta, GA, USA*
- Date and time? January 22, 2019 from 10:00 am to 10:30 am
- How did you control the settings, the environment, and the camera to meet your epsilon requirement?

  To meet the epsilon requirement I placed my camera on a flat surface and used a weight to keep it in place. The camera was pointed towards the wheel I was rotating to capture movement. This was all done in my living room using my phone camera with a fixed exposure and focus settings. To keep the wheel rotating about the same axis through the pictures, I used a thumb tack to secure it in place and moved the object manually between pictures. I used a timer on the camera so I can rotate the wheel between captures without obstructing the camera's view. The goal here was to rotate and capture the wheel so that the black colored section of the wheel moves, so I can show the movement in my final artifact. I drew inspiration for this from disk readers found in computers and gaming consoles.

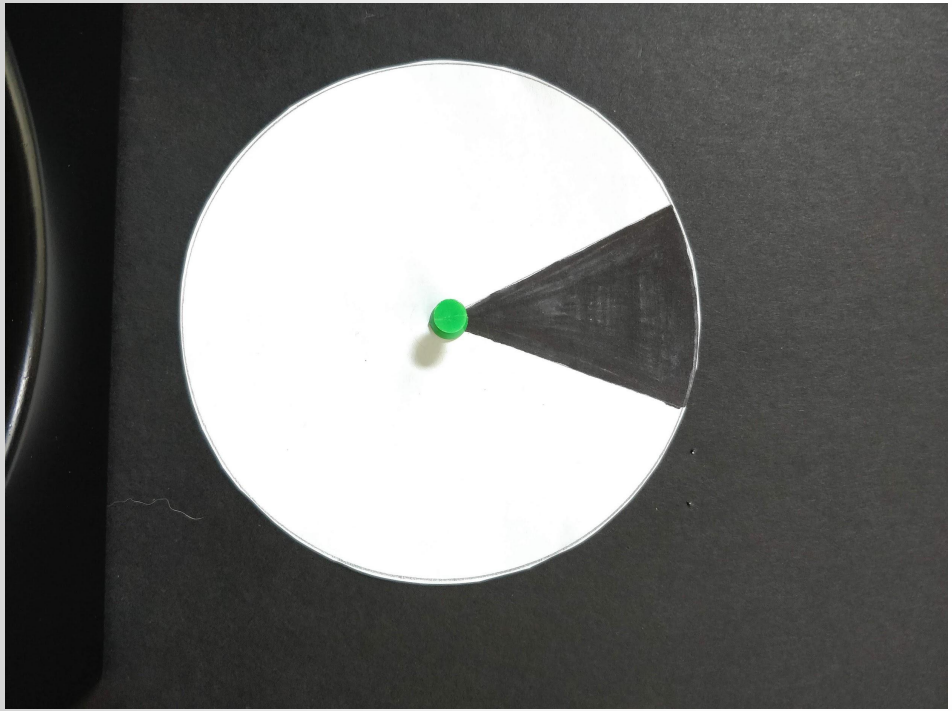


Image 1

Describe *this* photo and provide camera settings

Description: This is the first position of the wheel

Camera settings:

- Resolution: 4608x3456
- Focal Length: 4.10mm
- Aperture: f/1.7
- Exposure time: 1/31
- ISO: 1250

Image 2

Describe *this* photo and provide camera settings

Description: This is the second position of the wheel, we can see it has been rotated clockwise

Camera settings:

- Resolution: 4608x3456
- Focal Length: 4.10mm
- Aperture: f/1.7
- Exposure time: 1/31
- ISO: 1250

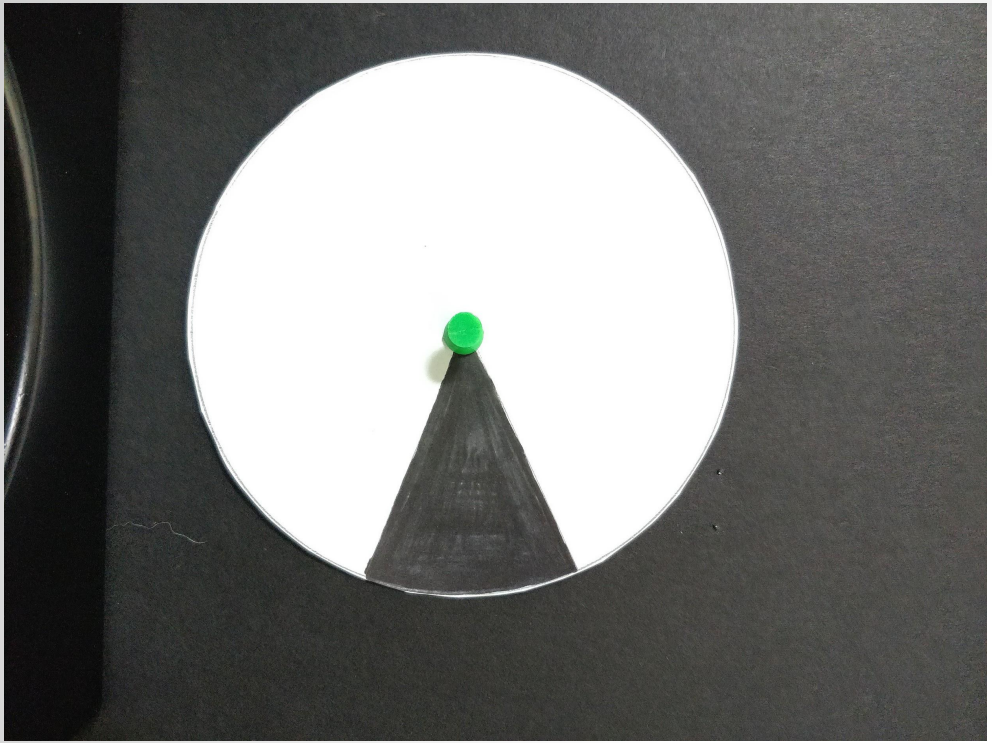


Image 3

Describe *this* photo and provide camera settings

Description: This is the third position of the wheel, we can see it has been rotated clockwise

Camera settings:

- Resolution: 4608x3456
- Focal Length: 4.10mm
- Aperture: f/1.7
- Exposure time: 1/31
- ISO: 1250

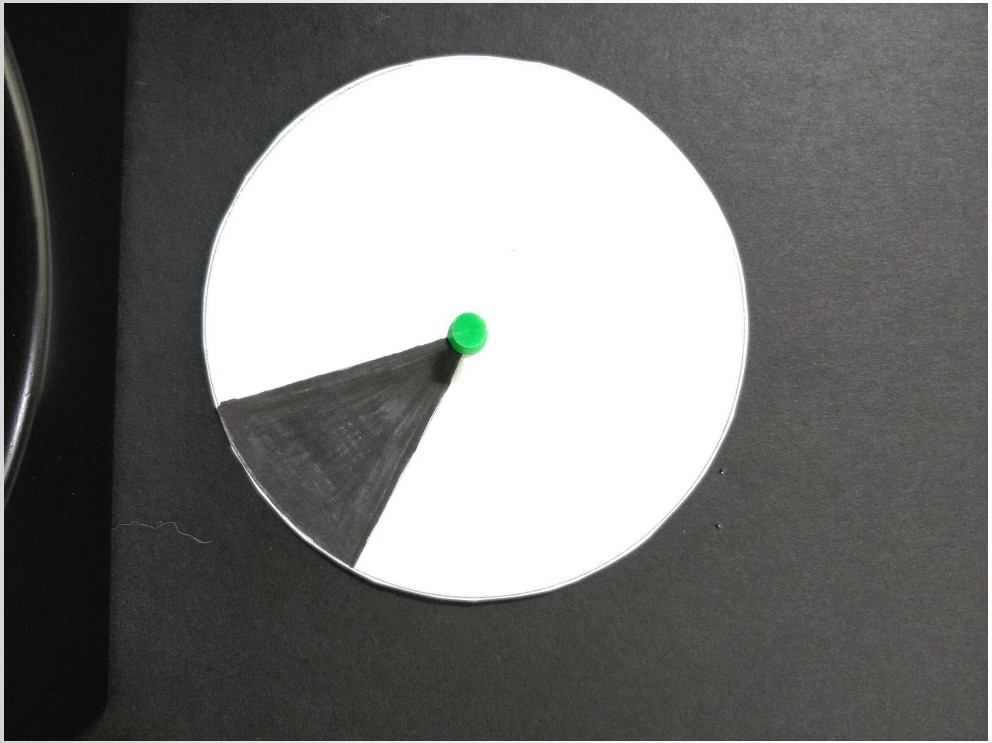


Image 4

Describe *this* photo and provide camera settings

Description: This is the fourth position of the wheel, we can see it has been rotated clockwise

Camera settings:

- Resolution: 4608x3456
- Focal Length: 4.10mm
- Aperture: f/1.7
- Exposure time: 1/31
- ISO: 1250

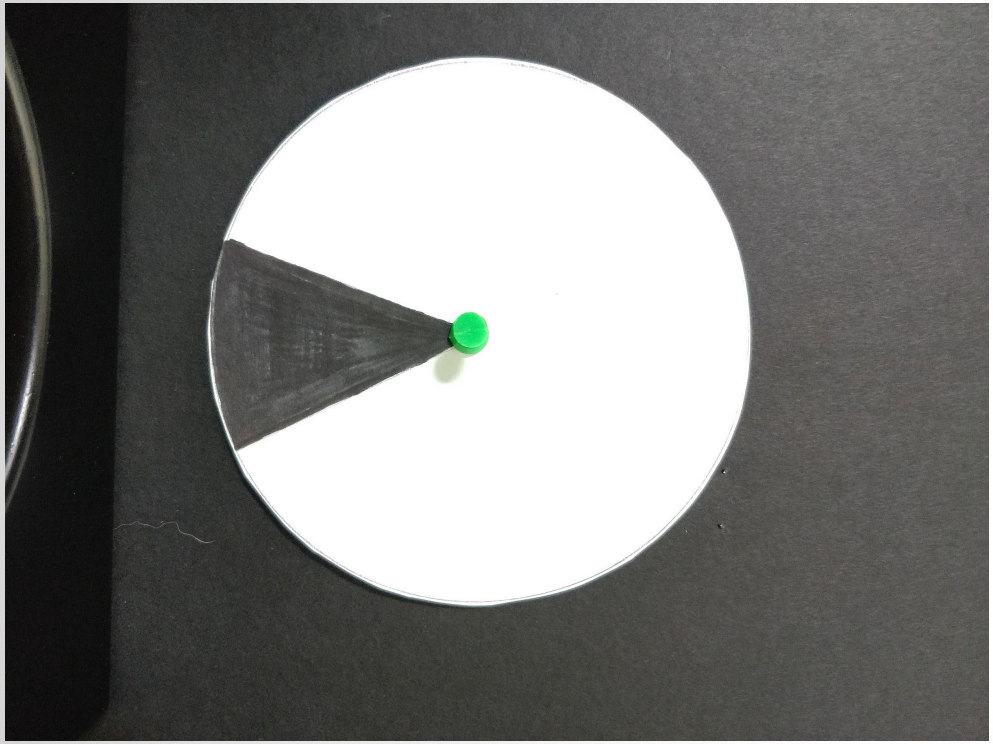


Image 5

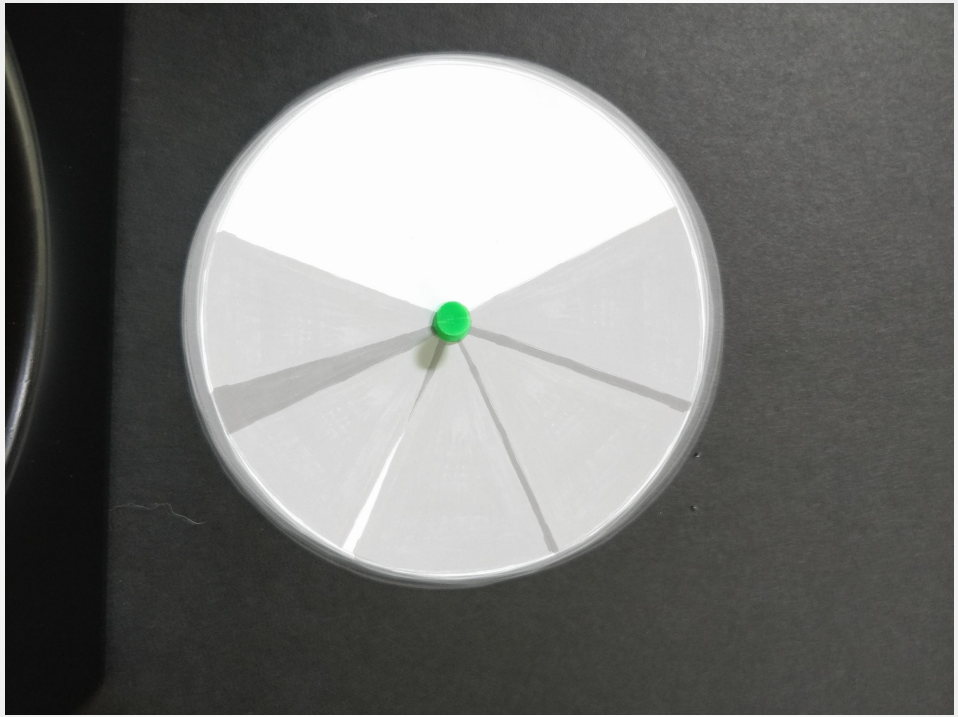
Describe *this* photo and provide camera settings

Description: This is the fifth position of the wheel, we can see it has been rotated clockwise, it has been rotated ~210° from the original position

Camera settings:

- Resolution: 4608x3456
- Focal Length: 4.10mm
- Aperture: f/1.7
- Exposure time: 1/31
- ISO: 1250

Final Artifact



Final Artifact Details

- Discuss how your final artifact demonstrates your epsilon.
  - My final artifact demonstrates my epsilon by showing a merged image of all the positions captured. We can see that there were some positions where the black section of the wheel overlapped between pictures (shown by the darker gray areas on the wheel).

- Did you do anything to prepare your N images? (e.g. cropping, alignment) If yes, describe your process and mention if you used any image editing software (e.g. Photoshop). If you did not do any processing to your N images beforehand, say so.
  - Yes each image was scaled down by 50% in the Python code.

- Walk through the code you wrote to create the final artifact. You may provide code snippets to help in your discussion. Do NOT just copy and paste your code with in-line comments. **Explain** the purpose of the code that you're presenting.
  - See next slide

Final Artifact Details

Code

```
disk1 = cv2.imread("disk1.jpg", cv2.IMREAD_COLOR)
disk1 = cv2.resize(disk1, None, fx=0.5, fy=0.5)

disk2 = cv2.imread("disk2.jpg", cv2.IMREAD_COLOR)
disk2 = cv2.resize(disk2, None, fx=0.5, fy=0.5)

disk3 = cv2.imread("disk3.jpg", cv2.IMREAD_COLOR)
disk3 = cv2.resize(disk3, None, fx=0.5, fy=0.5)

disk4 = cv2.imread("disk4.jpg", cv2.IMREAD_COLOR)
disk4 = cv2.resize(disk4, None, fx=0.5, fy=0.5)

disk5 = cv2.imread("disk5.jpg", cv2.IMREAD_COLOR)
disk5 = cv2.resize(disk5, None, fx=0.5, fy=0.5)


add1 = cv2.addWeighted(disk1,0.5, disk2,0.5,0)
add2 = cv2.addWeighted(add1,0.66, disk3,0.33,0)
add3 = cv2.addWeighted(add2,0.75, disk4, 0.25,0)
add4 = cv2.addWeighted(add3,0.80, disk5, 0.20,0)

#plt.imshow(add4)

cv2.imwrite("final_artifact2.jpg", add4)
```

Initially I read all 5 images and reduced their size by 50% since I found the original image too large. Next, I used openCV's addWeighted function to add two images together at a time until the final image was put together. When adding each image together, the weights had to be adjusted to keep the color of the first image added against the new image that was added.

Project Retrospective

- In what ways was your project successful?
  - Yes, my project was successful. I was able to show my final artifact and all the positions captured on the wheel. I found showing the overlap between positions particularly interesting as it created an additional effect I did not expect around the edge of the wheel and the overlapping black colored areas.

- If you were to repeat the project, is there anything you do differently knowing what you do now?
  - *Yes, I would use a tripod to mount my camera. I found that setting up the environment to take the pictures required some creativity and more time than expected.*

Above & Beyond *(Optional)*

- What is your epsilon parameter? *Object position*
- Location of pictures? *Alpharetta, GA, USA*
- Date and time? January 22, 2019 from 9:00 am to 10:00 am
- How did you control the settings, the environment, and the camera to meet your epsilon requirement?

  To meet the epsilon requirement I placed my camera vertically up against a two flat surfaces. The camera was pointed towards the monkey I was moving to capture images. This was all done in my living room using my phone camera with a fixed exposure and focus settings. I used a timer on the camera so I can move and stop the monkey between captures. The goal here was to show the effects of object distance on images and to put together a different final artifact given the same epsilon variation from the wheel project. I drew inspiration for this from King Kong and I thought it would be interesting to see the monkey getting closer and "attacking" the camera.

Above & Beyond *(Optional)*

Image 1

Describe *this* photo and provide camera settings

Description: This is the first position of the monkey. We can see he is the furthest away in the picture and the camera was taking in more light from the environment.

Camera settings:

- Resolution: 3456x4608
- Focal Length: 4.10mm
- Aperture: f/1.7
- Exposure time: 1/28
- ISO: 1600

Above & Beyond *(Optional)*

Image 2

Describe *this* photo and provide camera settings

Description: This is the second position of the monkey. We can see he is the moving closer towards the camera and there is still sufficient light from the environment. The image is still had good focus.

Camera settings:

- Resolution: 3456x4608
- Focal Length: 4.10mm
- Aperture: f/1.7
- Exposure time: 1/28
- ISO: 1600

Above & Beyond *(Optional)*

Image 3

Describe *this* photo and provide camera settings

Description: This is the third position of the monkey. We can see he is the moving even closer towards the camera. Like the first two photos, there is still sufficient light from the environment and the camera is still in focus on the monkey.

Camera settings:

- Resolution: 3456x4608
- Focal Length: 4.10mm
- Aperture: f/1.7
- Exposure time: 1/28
- ISO: 1600

Above & Beyond *(Optional)*

Image 4

Describe *this* photo and provide camera settings

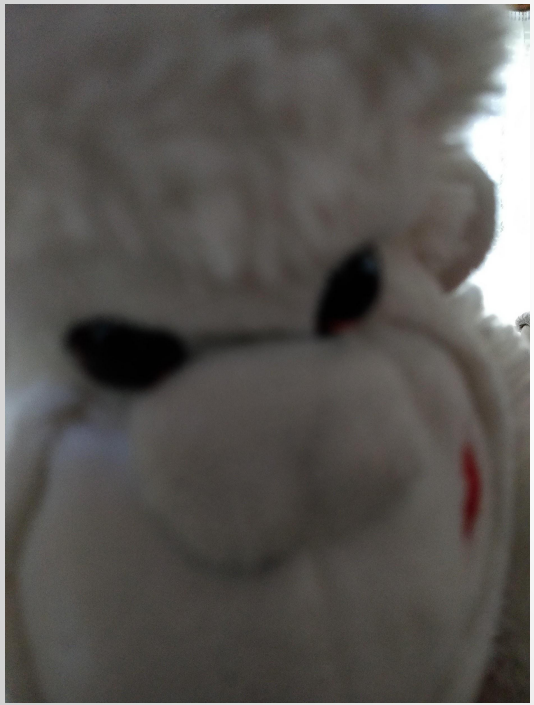
Description: This is the fourth position of the monkey. We can see he has moved close to the camera. Here we still have sufficient light from the environment, but the camera is slightly out of focus due to fixed focus needed to capture the epsilon variation (the epsilon here is the movement of the monkey).

Camera settings:

- Resolution: 3456x4608
- Focal Length: 4.10mm
- Aperture: f/1.7
- Exposure time: 1/28
- ISO: 1600

Above & Beyond *(Optional)*

Image 5



Describe *this* photo and provide camera settings

Description: This is the final picture of the monkey. We can see that the camera has significantly less light from the environment and the picture is out of focus. This is because the camera did not have it's auto-focus feature on.

Camera settings:

- Resolution: 3456x4608
- Focal Length: 4.10mm
- Aperture: f/1.7
- Exposure time: 1/28
- ISO: 1600

Above & Beyond *(Optional)*

Final Artifact (stitched stop motion image)

The final artifact here is a stop motion stitched image of all five individual images. A padding of 300 pixels was adding between each image to give the stop motion effect. The purpose of this exercise was to produce a different final artifact given the same epsilon requirement as the wheel artifact mentioned in previous slides. When producing this artifact, there was some obvious differences between the monkey and the wheel. Camera focus, shake, and lighting played a much bigger role on the monkey pictures even though they were kept constant throughout each image. Although I wish the focus was better for pictures 4&5 of the monkey, lighting added to the grimacing effect of bringing the monkey up close.

Above & Beyond *(Optional)*

Final Artifact Details

- Discuss how your final artifact demonstrates your epsilon.
  - My final artifact demonstrates my epsilon by showing a stitched stop motion image of all the individual images taken. It is clear that distance of the object had a big effect on lighting and focus even though both were constant through each photo.

- Did you do anything to prepare your N images? (e.g. cropping, alignment) If yes, describe your process and mention if you used any image editing software (e.g. Photoshop). If you did not do any processing to your N images beforehand, say so.
  - Yes, each image was scaled down by 50% and a padding of 300 pixels was added in-between each image to produce the final artifact.

- Walk through the code you wrote to create the final artifact. You may provide code snippets to help in your discussion. Do NOT just copy and paste your code with in-line comments. **Explain** the purpose of the code that you're presenting.
  - See next slide

Above & Beyond *(Optional)*

Final Artifact Details

Code

In [1]:
```
%load_ext autoreload
%autoreload 2
%matplotlib inline
```

In [2]:
```
import cv2
import numpy as np
import scipy as sp

import matplotlib as mpl
import matplotlib.pyplot as plt
```

In [3]:
```
monkey_img1 = cv2.imread("monkey1.jpg", cv2.IMREAD_COLOR)
monkey_img1 = cv2.resize(monkey_img1, None, fx=0.5, fy=0.5)

monkey_img2 = cv2.imread("monkey2.jpg", cv2.IMREAD_COLOR)
monkey_img2 = cv2.resize(monkey_img2, None, fx=0.5, fy=0.5)

monkey_img3 = cv2.imread("monkey3.jpg", cv2.IMREAD_COLOR)
monkey_img3 = cv2.resize(monkey_img3, None, fx=0.5, fy=0.5)

monkey_img4 = cv2.imread("monkey4.jpg", cv2.IMREAD_COLOR)
monkey_img4 = cv2.resize(monkey_img4, None, fx=0.5, fy=0.5)

monkey_img5 = cv2.imread("monkey5.jpg", cv2.IMREAD_COLOR)
monkey_img5 = cv2.resize(monkey_img5, None, fx=0.5, fy=0.5)

r, c, d= monkey_img1.shape
#print(r,c,d)

buffer_matrix = 255*np.ones((r, 300, d), dtype=int)
#print(buffer_matrix)

new_img = np.concatenate((monkey_img1, buffer_matrix, monkey_img2, buffer_matrix, monkey_img3, buffer_matrix, monkey_img4, buffer_

#plt.imshow(new_img);plt.axis("off")

cv2.imwrite("final_artifact.jpg", new_img)
```

Initially all five images were read and resized by 50%. Then the size of image 1 was taken to create a buffer of 300 pixel between each image. Numpy's concatenation function was used to combined all the images together along with a buffer between each.

Above & Beyond *(Optional)*

Project Retrospective

- In what ways was your project successful?
  - Yes, my project was successful. I was able to show my final artifact and all the positions captured on the monkey. Although I found distance had a big effect on lighting and focus, the overall grimacing effect I was going for was still captured.

- If you were to repeat the project, is there anything you do differently knowing what you do now?
  - *Yes, I would use a tripod to mount my camera. I found that setting up the environment to take the pictures required some creativity and more time than expected. I would also try to regulate the lighting environment more. In these pictures I used natural light, but perhaps some faux lighting closer to the camera would have been helpful too so the final images would not have come out so dark.*

Resources

Record your sources here. We accept all reasonable formats that would allow us to verify your sources. Our class lectures do not have to be referenced. If you are reusing work from a prior semester, mention it here.

- Mishra, K. (2018, February 06). Addition and Blending of images using OpenCV in Python. Retrieved January 22, 2019, from https://www.geeksforgeeks.org/addition-blending-images-using-opencv-python/