Name: Rishikesh Vadodaria

Roll no: C114

Use descriptors to align images

Task 1: Use SIFT to determine interest points and descriptors for the given images

Task 2: Match key points of the images

Task 3: Generate Homography matrix using match key points

Task 4: Use Homography matrix to warp image to be aligned

Import libraries

In [132…

```
import cv2
import numpy as np
import matplotlib.pyplot as plt
```

In [133…

```
img1 = cv2.imread("car2.jpg")
img2 = cv2.imread("car1.jpg")
```

In [134…

```
img1_g = cv2.cvtColor(img1, cv2.COLOR_BGR2GRAY)
img2_g = cv2.cvtColor(img2, cv2.COLOR_BGR2GRAY)
```

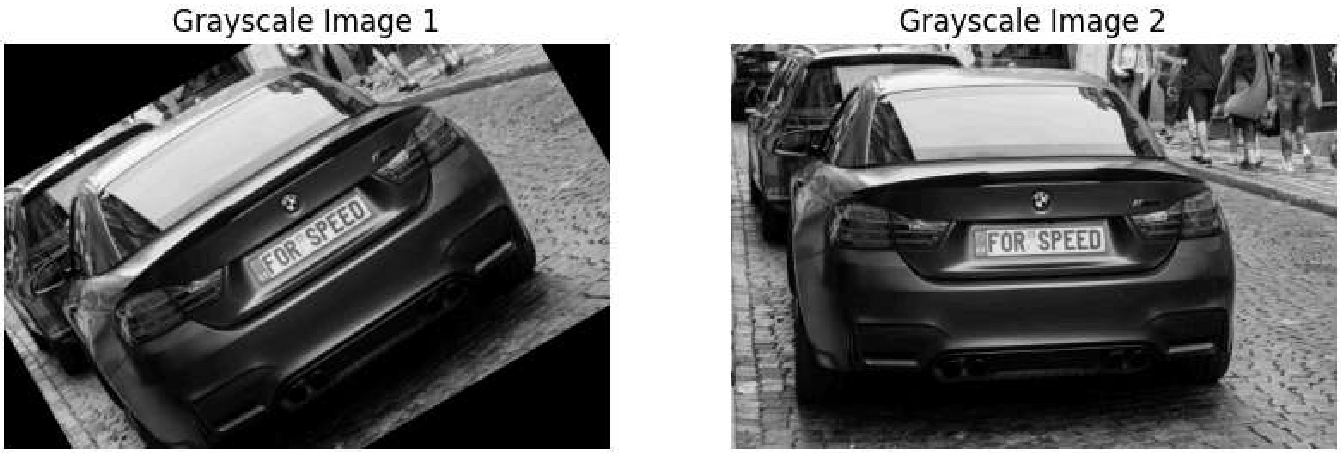
In [135…

```
plt.figure(figsize=(10, 5))

plt.subplot(1, 2, 1)
plt.imshow(img1_g, cmap="gray")
plt.title("Grayscale Image 1")
plt.axis("off")

plt.subplot(1, 2, 2)
plt.imshow(img2_g, cmap="gray")
plt.title("Grayscale Image 2")
plt.axis("off")

plt.show()
```



In [136...

```
orb = cv2.ORB_create(nfeatures=500)
k1, d1 = orb.detectAndCompute(img1_g, None)
k2, d2 = orb.detectAndCompute(img2_g, None)
```

In [137...

```
ln = len(k1)
ln
```

Out[137...

```
500
```

In [138...

```
len(d1[0])
```

Out[138...

```
32
```

In [139...

```
matcher = cv2.BFMatcher(cv2.NORM_HAMMING, crossCheck=True)
```

In [140...

```
matches = matcher.match(d1, d2)
```

In [141...

```
if len(matches) == 0:
    print("No matches found!")
    exit()
```

In [142...

```
matches = sorted(matches, key=lambda x: x.distance)
ln = min(len(matches), len(k1), len(k2))
```

In [143...

```
kp1_locations = np.zeros((ln, 2))
kp2_locations = np.zeros((ln, 2))
```

In [144...

```
for i in range(ln):
    kp1_locations[i, :] = k1[matches[i].queryIdx].pt
    kp2_locations[i, :] = k2[matches[i].trainIdx].pt
```

In [145...

```
h,mask = cv2.findHomography(kp1_locations, kp2_locations, cv2.RANSAC, 5.0)
```

In [146...

```
img_aligned = cv2.warpPerspective(img1, h, (img2.shape[1], img2.shape[0]))
```

In [147…

```python
img1_rgb = cv2.cvtColor(img2, cv2.COLOR_BGR2RGB)
img2_rgb = cv2.cvtColor(img1, cv2.COLOR_BGR2RGB)
img_aligned_rgb = cv2.cvtColor(img_aligned, cv2.COLOR_BGR2RGB)
```

In [148…

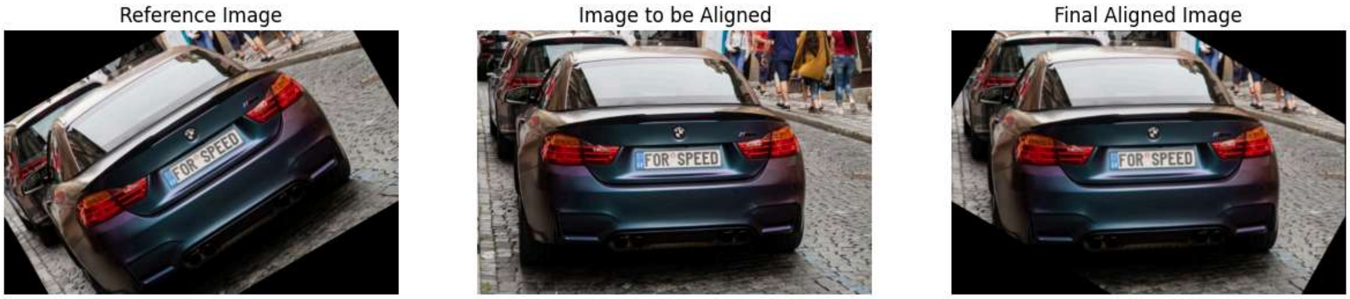
```python
plt.figure(figsize=(15, 5))

plt.subplot(1, 3, 1)
plt.imshow(img2_rgb)
plt.title("Reference Image")
plt.axis("off")

plt.subplot(1, 3, 2)
plt.imshow(img1_rgb)
plt.title("Image to be Aligned")
plt.axis("off")

plt.subplot(1, 3, 3)
plt.imshow(img_aligned_rgb)
plt.title("Final Aligned Image")
plt.axis("off")

plt.show()
```



Custom face image

Import libraries

In [165…

```python
img1 = cv2.imread("tavish2.jpeg")
img2 = cv2.imread("tavish1.jpeg")
```

In [166…

```python
img1_g = cv2.cvtColor(img1, cv2.COLOR_BGR2GRAY)
img2_g = cv2.cvtColor(img2, cv2.COLOR_BGR2GRAY)
```

In [167…

```python
plt.figure(figsize=(10, 5))

plt.subplot(1, 2, 1)
plt.imshow(img1_g, cmap="gray")
plt.title("Grayscale Image 1")
plt.axis("off")

plt.subplot(1, 2, 2)
plt.imshow(img2_g, cmap="gray")
plt.title("Grayscale Image 2")
plt.axis("off")

plt.show()
```

Grayscale Image 1

Grayscale Image 2

In [168…

```python
orb = cv2.ORB_create(nfeatures=500)
k1, d1 = orb.detectAndCompute(img1_g, None)
k2, d2 = orb.detectAndCompute(img2_g, None)
```

In [169…

```python
ln = len(k1)
ln
```

Out[169…

```
500
```

In [170…

```python
len(d1[0])
```

Out[170…

```
32
```

In [171…

```python
matcher = cv2.BFMatcher(cv2.NORM_HAMMING, crossCheck=True)
```

In [172…

```python
matches = matcher.match(d1, d2)
```

In [173…

```python
if len(matches) == 0:
    print("No matches found!")
    exit()
```

In [174…

```
matches = sorted(matches, key=lambda x: x.distance)
ln = min(len(matches), len(k1), len(k2))
```

In [175…

```
kp1_locations = np.zeros((ln, 2))
kp2_locations = np.zeros((ln, 2))
```

In [176…

```
for i in range(ln):
    kp1_locations[i, :] = k1[matches[i].queryIdx].pt
    kp2_locations[i, :] = k2[matches[i].trainIdx].pt
```

In [177…

```
h,mask = cv2.findHomography(kp1_locations, kp2_locations, cv2.RANSAC, 5.0)
```

In [178…

```
img_aligned = cv2.warpPerspective(img1, h, (img2.shape[1], img2.shape[0]))
```

In [179…

```
img1_rgb = cv2.cvtColor(img2, cv2.COLOR_BGR2RGB)
img2_rgb = cv2.cvtColor(img1, cv2.COLOR_BGR2RGB)
img_aligned_rgb = cv2.cvtColor(img_aligned, cv2.COLOR_BGR2RGB)
```

In [181…

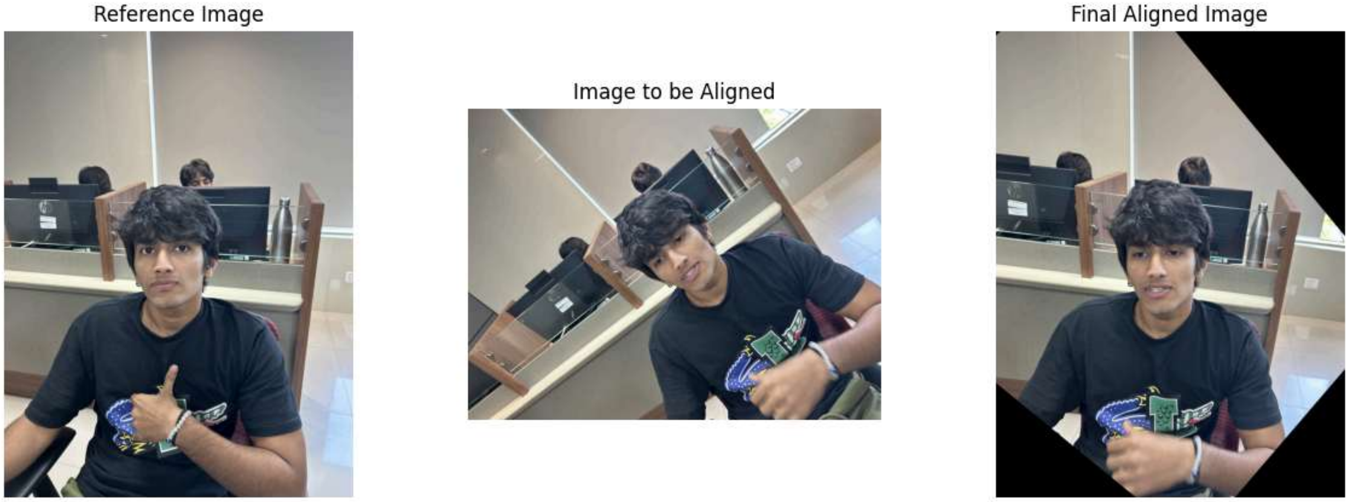
```
plt.figure(figsize=(15, 5))

plt.subplot(1, 3, 1)
plt.imshow(img1_rgb)
plt.title("Reference Image")
plt.axis("off")

plt.subplot(1, 3, 2)
plt.imshow(img2_rgb)
plt.title("Image to be Aligned")
plt.axis("off")

plt.subplot(1, 3, 3)
plt.imshow(img_aligned_rgb)
plt.title("Final Aligned Image")
plt.axis("off")

plt.show()
```



Reference Image

Image to be Aligned

Final Aligned Image

Conclusion:

- ORB Detector is used to detect the location of the key point and their corresponding descriptor
- 500 key points are used to match the corresppoding location of the key points of the reference and tilted image
- Based on the location of the matching key points homography matrix is determined which is used to warp the tilted image to align with the refernce image
- The above technique will apply on the given image of the car and the output image shows aligned image
- The same technique is applied on own image an it shows even if the image is tilted and rotated, the aligned image is similar to reference image.