# Source Code:

## matchers.py

```
import cv2
import numpy as np

class matchers:
  def __init__(self):
     self.surf = cv2.xfeatures2d.SURF_create()
     FLANN_INDEX_KDTREE = 0
     index_params = dict(algorithm=0, trees=5)
     search_params = dict(checks=50)
     self.flann = cv2.FlannBasedMatcher(index_params, search_params)

  def match(self, i1, i2, direction=None):
     imageSet1 = self.getSURFFeatures(i1)
     imageSet2 = self.getSURFFeatures(i2)
     print ("Direction : ", direction)
     matches = self.flann.knnMatch(
        imageSet2['des'],
        imageSet1['des'],
        k=2
        )
     good = []
     for i , (m, n) in enumerate(matches):
        if m.distance < 0.7*n.distance:
           good.append((m.trainIdx, m.queryIdx))

     if len(good) > 4:
        pointsCurrent = imageSet2['kp']
        pointsPrevious = imageSet1['kp']

        matchedPointsCurrent = np.float32(
           [pointsCurrent[i].pt for (__, i) in good]
        )
        matchedPointsPrev = np.float32(
           [pointsPrevious[i].pt for (i,___) in good]
           )

        H, s = cv2.findHomography(matchedPointsCurrent, matchedPointsPrev, cv2.RANSAC, 4)
        return H
     return None

  def getSURFFeatures(self, im):
     gray = cv2.cvtColor(im, cv2.COLOR_BGR2GRAY)
     kp, des = self.surf.detectAndCompute(gray, None)
     return {'kp':kp, 'des':des}
```

## pano.py

```
import numpy as np
import cv2
import sys
from matchers import matchers
import time
import matplotlib.pyplot as plt

class Stitch:
  def __init__(self, args):
     self.path = args
     fp = open(self.path, 'r')
     filenames = [each.rstrip('\r\n') for each in fp.readlines()]
     print (filenames)
     self.images = [cv2.resize(cv2.imread(each),(427, 320)) for each in filenames]
     self.count = len(self.images)
     self.left_list, self.right_list, self.center_im = [], [],None
     self.matcher_obj = matchers()
     self.prepare_lists()

  def prepare_lists(self):
     print ("Number of images : %d"%self.count)
     self.centerIdx = self.count/2
     print ("Center index image : %d"%self.centerIdx)
     self.center_im = self.images[int(self.centerIdx)]
     for i in range(self.count):
        if(i<=self.centerIdx):
           self.left_list.append(self.images[i])
        else:
           self.right_list.append(self.images[i])
     print ("Image lists prepared")

  def leftshift(self):
     # self.left_list = reversed(self.left_list)
     a = self.left_list[0]
     for b in self.left_list[1:]:
        H = self.matcher_obj.match(a, b, 'left')
        print ("Homography is : ", H)
        xh = np.linalg.inv(H)
        print ("Inverse Homography :", xh)
        ds = np.dot(xh, np.array([a.shape[1], a.shape[0], 1]));
        ds = ds/ds[-1]
        print ("final ds=>", ds)
        f1 = np.dot(xh, np.array([0,0,1]))
        f1 = f1/f1[-1]
        xh[0][-1] += abs(f1[0])
        xh[1][-1] += abs(f1[1])
        ds = np.dot(xh, np.array([a.shape[1], a.shape[0], 1]))
        offsety = abs(int(f1[1]))
        offsetx = abs(int(f1[0]))
        dsize = (int(ds[0])+offsetx, int(ds[1]) + offsety)
        print ("image dsize =>", dsize)
        tmp = cv2.warpPerspective(a, xh, dsize)
        # cv2.imshow("warped", tmp)
        # cv2.waitKey()
        tmp[offsety:b.shape[0]+offsety, offsetx:b.shape[1]+offsetx] = b
        a = tmp
```

```
      self.leftImage = tmp


  def rightshift(self):
      for each in self.right_list:
         H = self.matcher_obj.match(self.leftImage, each, 'right')
         print ("Homography :", H)
         txyz = np.dot(H, np.array([each.shape[1], each.shape[0], 1]))
         txyz = txyz/txyz[-1]
         dsize = (int(txyz[0])+self.leftImage.shape[1],
int(txyz[1])+self.leftImage.shape[0])
         tmp = cv2.warpPerspective(each, H, dsize)
         plt.imshow(tmp)
         plt.show()
         #cv2.waitKey()
         # tmp[:self.leftImage.shape[0], :self.leftImage.shape[1]]=self.leftImage
         tmp = self.mix_and_match(self.leftImage, tmp)
         print ("tmp shape",tmp.shape)
         print ("self.leftimage shape=", self.leftImage.shape)
         self.leftImage = tmp
      # self.showImage('left')

  def mix_and_match(self, leftImage, warpedImage):
      i1y, i1x = leftImage.shape[:2]
      i2y, i2x = warpedImage.shape[:2]
      print (leftImage[-1,-1])

      t = time.time()
      black_l = np.where(leftImage == np.array([0,0,0]))
      black_wi = np.where(warpedImage == np.array([0,0,0]))
      print (time.time() - t)
      print (black_l[-1])

      for i in range(0, i1x):
         for j in range(0, i1y):
            try:
               if(np.array_equal(leftImage[j,i],np.array([0,0,0])) and
np.array_equal(warpedImage[j,i],np.array([0,0,0]))):
                  # print "BLACK"
                  # instead of just putting it with black,
                  # take average of all nearby values and avg it.
                  warpedImage[j,i] = [0, 0, 0]
               else:
                  if(np.array_equal(warpedImage[j,i],[0,0,0])):
                     # print "PIXEL"
                     warpedImage[j,i] = leftImage[j,i]
                  else:
                     if not np.array_equal(leftImage[j,i], [0,0,0]):
                        bw, gw, rw = warpedImage[j,i]
                        bl,gl,rl = leftImage[j,i]
                        # b = (bl+bw)/2
                        # g = (gl+gw)/2
                        # r = (rl+rw)/2
                        warpedImage[j, i] = [bl,gl,rl]
            except:
               pass
      # cv2.imshow("waRPED mix", warpedImage)
      # cv2.waitKey()
```

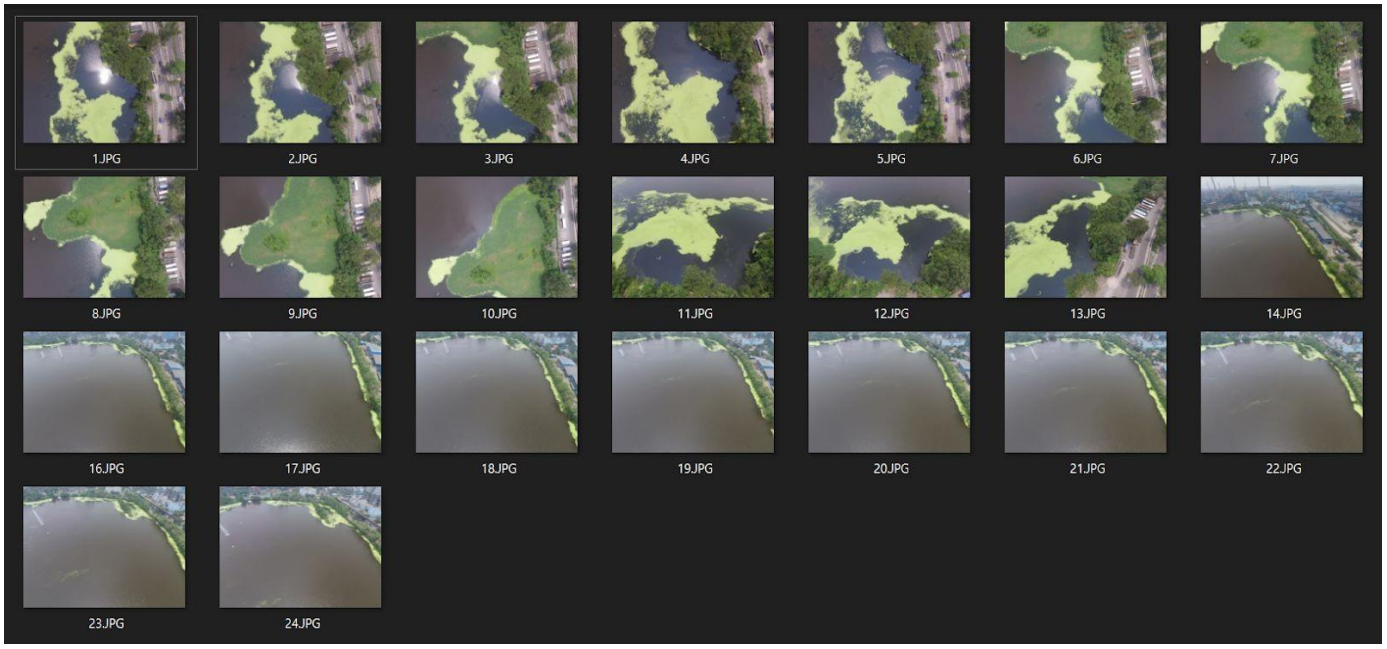
```
        return warpedImage

    def trim_left(self):
        pass

    def showImage(self, string=None):
        if string == 'left':
            plt.imshow(self.leftImage)
            plt.show()
            # cv2.imshow("left image", cv2.resize(self.leftImage, (400,400)))
        elif string == "right":
            plt.imshow(self.rightImage)
            plt.show()
        #cv2.waitKey()

if __name__== '__main__':
    try:
        args = sys.argv[1]
    except:
        args = "txtlists/files1.txt"
    finally:
        print ("Parameters : ", args)
    s = Stitch(args)
    s.leftshift()
    # s.showImage('left')
    s.rightshift()
    print ("Done")
    cv2.imwrite("image_mosaic1.jpg", s.leftImage)
    print ("Image written")
    #cv2.destroyAllWindows()
```

# images



# txtlists

1. files1.txt

```
../images/1.jpg
../images/2.jpg
../images/3.jpg
../images/4.jpg
../images/5.jpg
../images/6.jpg
../images/7.jpg
../images/8.jpg
../images/9.jpg
../images/10.jpg
```

2. files2.txt

```
../images/14.JPG
../images/16.JPG
../images/17.JPG
../images/18.JPG
../images/19.JPG
../images/20.JPG
../images/21.JPG
../images/22.JPG
../images/23.JPG
../images/24.JPG
```

3. files3.txt

```
../images/11.JPG
../images/12.JPG
../images/13.JPG
```

# Output