EE6222 Assignment 2 Report

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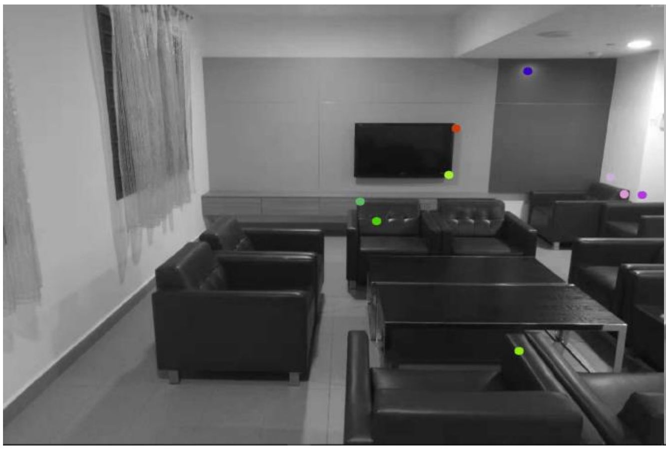
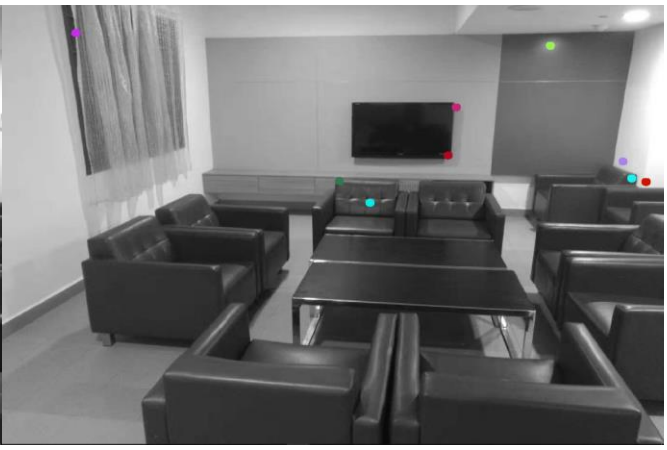
1. Hand Pick Points:

1.1 Take two pictures at the same focal length and set two picture's size scale down at the same proportion for better programming speed. Two pictures are shown below left and right respectively:

1.2 Put each picture into the same getting point coordinate python program and click 8 corresponding points, record their coordinates. Make sure the picking point's order are paired.

Get 8 points shown below left and right respectively:

Write down their coordinates as PL&PR:

PL=(u,v)=[1122,524];[764,548];[1314,97];[1206,482];

[777,482];[813,530];[1123,848];[404,340]

PR=(u',v') [1295,724];[810,523];[1302,29];[1203,442];

[734,432];[800;485]; [1203,442];[391,213]

Core codes are as flows:

```
frame1 = cv2.imread('./LEFT2.jpg')
def callback(event,x,y,flags,param):
    global display
    if event == cv2.EVENT_LBUTTONDOWN:
        display = frame1.copy()
        print(x,y)

cv2.putText(display,'(%d,%d)'%(x,y),(x+5,y),cv2.FONT_HERSHEY_COMPLEX_SM
ALL,1,(0,0,255),2)
        cv2.circle(display, tuple([x,y]), 5, (0,255,255), 2)
        cv2.imshow('display',display)

cv2.namedWindow('display')
cv2.imshow('display',frame1)
cv2.setMouseCallback('display',callback)
cv2.waitKey(0)
```

2. Calculate F Matrix and Epipole:

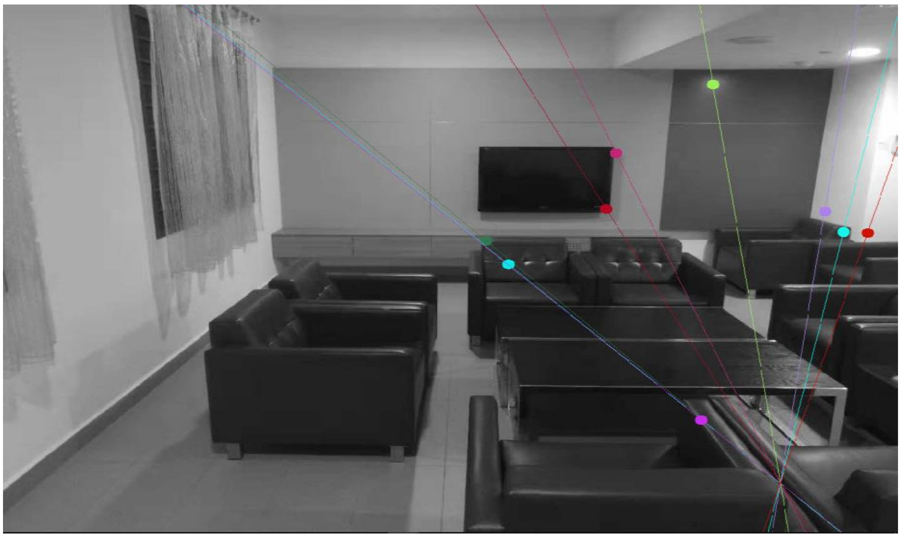
2.1 Use the eight-point algorithm to calculate Fundamental Matrix, the equation is as follow:

$$\begin{pmatrix} u_1u'_1 & u_1v'_1 & u_1 & v_1u'_1 & v_1v'_1 & v_1 & u'_1 & v'_1 \\ u_2u'_2 & u_2v'_2 & u_2 & v_2u'_2 & v_2v'_2 & v_2 & u'_2 & v'_2 \\ u_3u'_3 & u_3v'_3 & u_3 & v_3u'_3 & v_3v'_3 & v_3 & u'_3 & v'_3 \\ u_4u'_4 & u_4v'_4 & u_4 & v_4u'_4 & v_4v'_4 & v_4 & u'_4 & v'_4 \\ u_5u'_5 & u_5v'_5 & u_5 & v_5u'_5 & v_5v'_5 & v_5 & u'_5 & v'_5 \\ u_6u'_6 & u_6v'_6 & u_6 & v_6u'_6 & v_6v'_6 & v_6 & u'_6 & v'_6 \\ u_7u'_7 & u_7v'_7 & u_7 & v_7u'_7 & v_7v'_7 & v_7 & u'_7 & v'_7 \\ u_8u'_8 & u_8v'_8 & u_8 & v_8u'_8 & v_8v'_8 & v_8 & u'_8 & v'_8 \end{pmatrix} \begin{pmatrix} F_{11} \\ F_{12} \\ F_{13} \\ F_{21} \\ F_{22} \\ F_{23} \\ F_{31} \\ F_{32} \end{pmatrix} = - \begin{pmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{pmatrix}$$

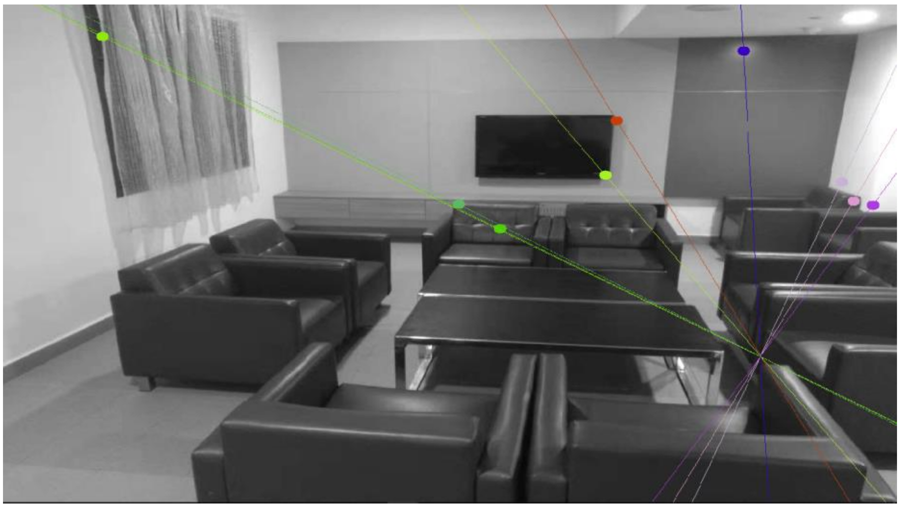
Here is the F result:

```
[[ 4.19791486e-07,   -2.98208562e-06,    2.39008664e-03]
 [ 4.48565311e-06,   -4.76079415e-07,   -5.14304123e-03]
 [-3.92803358e-03,    4.00129186e-03,    1.00000000e+00]]
```

2.2 For every p_r, we can find corresponding e_l and draw each pair of them as a line. That is our left and right eight epipolar line.
Result epipolar line poltted on the page follows:



Left epipolar line



Right epipolar line

This part's codes is as follows:

```
import numpy as np
import cv2 as cv
img1 = cv.imread('./LEFT2.jpg',0)
img2 = cv.imread('./RIGHT2.jpg',0)

sift = cv.xfeatures2d.SIFT_create()

kp1, des1 = sift.detectAndCompute(img1,None)
kp2, des2 = sift.detectAndCompute(img2,None)

FLANN_INDEX_KDTREE = 1
index_params = dict(algorithm = FLANN_INDEX_KDTREE, trees = 5)
search_params = dict(checks=50)
flann = cv.FlannBasedMatcher(index_params,search_params)
matches = flann.knnMatch(des1,des2,k=2)
good = []; pts1 = []; pts2 = []
```

```
for i,(m,n) in enumerate(matches):
    if m.distance < 0.62*n.distance:
        good.append(m)
        pts2.append(kp2[m.trainIdx].pt)
        pts1.append(kp1[m.queryIdx].pt)

pts1 = np.int32(pts1)
pts2 = np.int32(pts2)
F, mask = cv.findFundamentalMat(pts1,pts2,cv.FM_LMEDS)

print(F)

pts1 = pts1[mask.ravel()==1]
pts2 = pts2[mask.ravel()==1]
print(pts1)
print(pts2)
def drawlines(img1,img2,lines,pts1,pts2):
    r,c = img1.shape
    img1 = cv.cvtColor(img1,cv.COLOR_GRAY2BGR)
    img2 = cv.cvtColor(img2,cv.COLOR_GRAY2BGR)
    for r,pt1,pt2 in zip(lines,pts1,pts2):
        color = tuple(np.random.randint(0,255,3).tolist())
        x0,y0 = map(int, [0, -r[2]/r[1] ])
        x1,y1 = map(int, [c, -(r[2]+r[0]*c)/r[1] ])
        img1 = cv.line(img1, (x0,y0), (x1,y1), color,1)
        img1 = cv.circle(img1,tuple(pt1),10,color,-1)
        img2 = cv.circle(img2,tuple(pt2),10,color,-1)
    return img1,img2
#left
lines1 = cv.computeCorrespondEpilines(pts2.reshape(-1,1,2), 2,F)
lines1 = lines1.reshape(-1,3)
img5,img6 = drawlines(img1,img2,lines1,pts1,pts2)
#right
lines2 = cv.computeCorrespondEpilines(pts1.reshape(-1,1,2), 1,F)
lines2 = lines2.reshape(-1,3)
img3,img4 = drawlines(img2,img1,lines2,pts2,pts1)

cv.namedWindow('rightline',cv.WINDOW_NORMAL); cv.imshow('rightline',
img3)
cv.namedWindow('left',cv.WINDOW_NORMAL); cv.imshow('left', img4)
cv.namedWindow('leftline',cv.WINDOW_NORMAL); cv.imshow('leftline', img5)
cv.namedWindow('right',cv.WINDOW_NORMAL); cv.imshow('right', img6)
cv.waitKey(0)
```