CSC420

Assignment 3

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In [2]:

```
import numpy as np
import matplotlib.pyplot as plt
import cv2
from scipy.spatial.distance import euclidean as euc
import matplotlib.patches as patches
from skimage import transform as tf
from skimage.transform import ProjectiveTransform
%matplotlib inline
```

Upload the images and transfrom from

In [3]:

```
reference = cv2.imread('reference.png', 1)
test1 = cv2.imread('test.png', 1)
test2 = cv2.imread('test2.png',1)
images = [reference, test1, test2]
```

In [4]:

```
def get_interest_points(img, showAllpoints=True):
    img1 = img.copy()
    sift = cv2.xfeatures2d.SIFT_create()
    gray = cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
    kp, des = sift.detectAndCompute(gray, None)
    if not showAllpoints:
        kp=kp[:100]
    return cv2.drawKeypoints(gray, kp, img1, flags=cv2.DRAW_MATCHES_FLAGS_DRAW_R
ICH_KEYPOINTS), kp, des
```

In [5]:

```
def matching(img1, img2):

    _, kp1, des1 = get_interest_points(img1)
    _, kp2, des2 = get_interest_points(img2)
    match = []
    kp_diff = []

    for j in range(0, len(kp1)):

        for i in range(0, len(kp2)):
            euc_dist = euc(des1[j], des2[i])
            if euc_dist < 100:
                kp_diff.append(euc_dist)
                match.append([kp1[j],kp2[i]])


    three_best = np.argpartition(kp_diff, 3)[:3]

    match1 = match[three_best[0]]

    match2 = match[three_best[1]]

    match3 = match[three_best[2]]


    return match1, match2, match3
```

In [6]:

```
def match_images(img1, img2):

    img1_show = img1.copy()
    img2_show = img2.copy()

    kp1, kp2, kp3 = matching(img1, img2)


    x1, y1 = kp1[0].pt
    x2, y2 = kp1[1].pt

    x3, y3 = kp2[0].pt
    x4, y4 = kp2[1].pt

    x5, y5 = kp3[0].pt
    x6, y6 = kp3[1].pt


    f = plt.figure(figsize=(20,20))
    f.add_subplot(1,2, 1)
    plt.scatter(x1, y1, color='r', linewidth=50)
    plt.scatter(x3, y3, color='b',  linewidth=50)
    plt.scatter(x5, y5, color='y',  linewidth=50)
    plt.imshow(img1_show[:,:,::-1])
    f.add_subplot(1,2,2)
    plt.imshow(img2_show[:,:,::-1])
    plt.scatter(x2, y2, color='r',  linewidth=20)
    plt.scatter(x4, y4, color='b',  linewidth=20)
    plt.scatter(x6, y6, color='y',  linewidth=20)
```

In [14]:

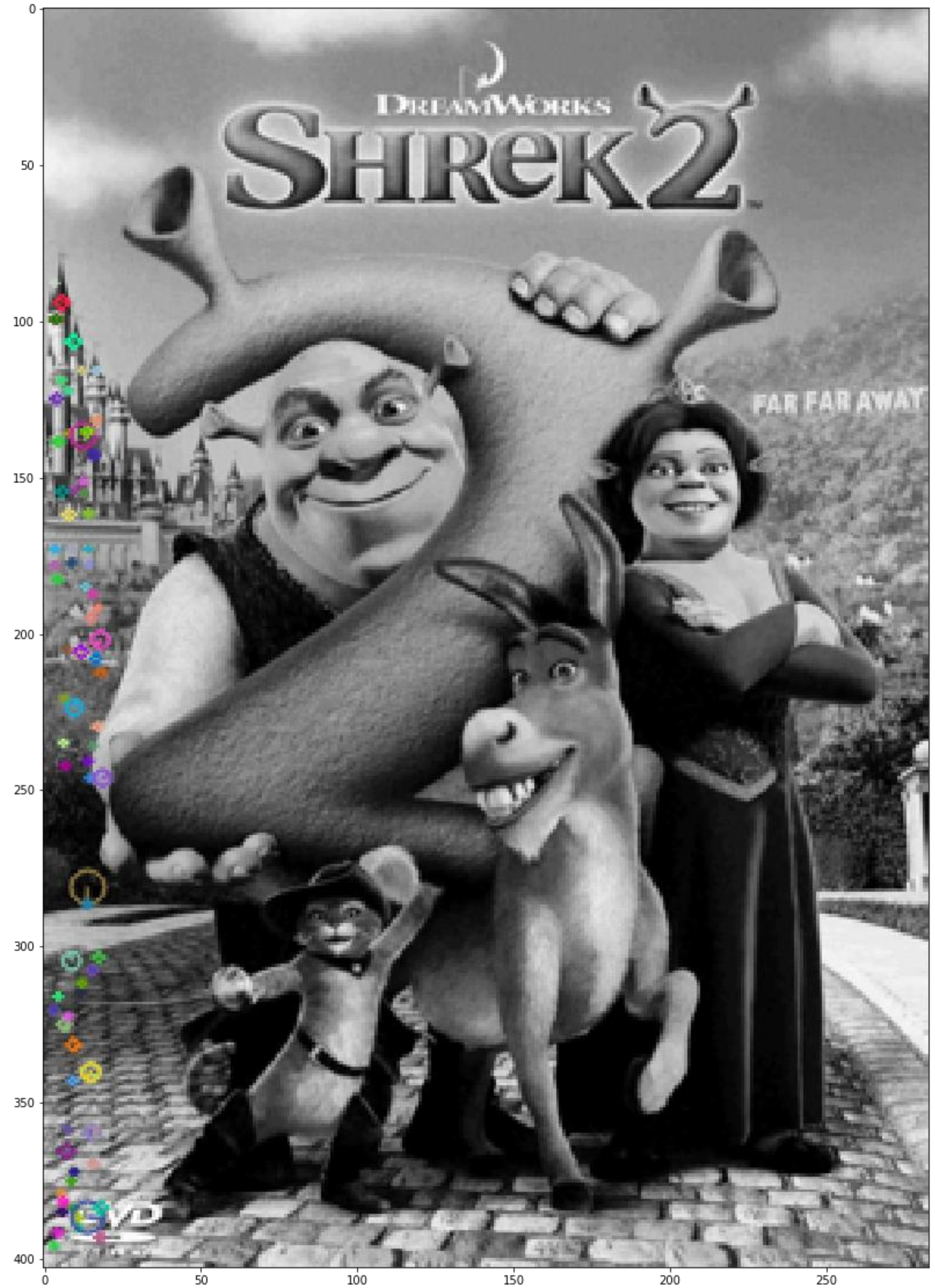
```
img1, _,_  = get_interest_points(images[0], False)
```

In [15]:

```
f = plt.figure(figsize=(20,20))
plt.imshow(img1)
```

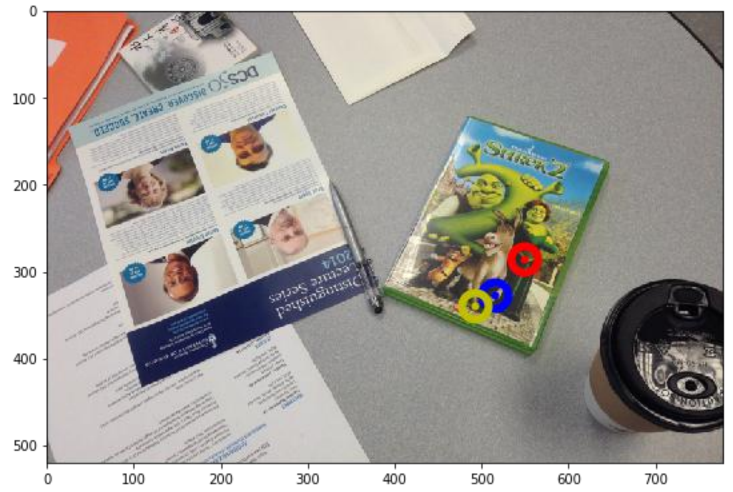
Out[15]:

<matplotlib.image.AxesImage at 0x132eccf10>



In [16]:

```
match_images(images[0], images[1])
```



In [17]:

```
match_images(images[0], images[2])
```

[2 points] Affline transformation: Use the top 3 correspondences from part (b) to solve for the ane transformation between the features in the two images.

In [18]:

```
def affine_transformation(x, y, tran):

    A  = np.array([[x, y, 1, 0, 0 , 0], [0, 0, 0, x, y, 1]])

    sol = np.dot(A, tran)

    return sol[0], sol[1]
```

In [19]:

```
kp1, kp2, kp3 = matching(images[0], images[1])
```

In [20]:

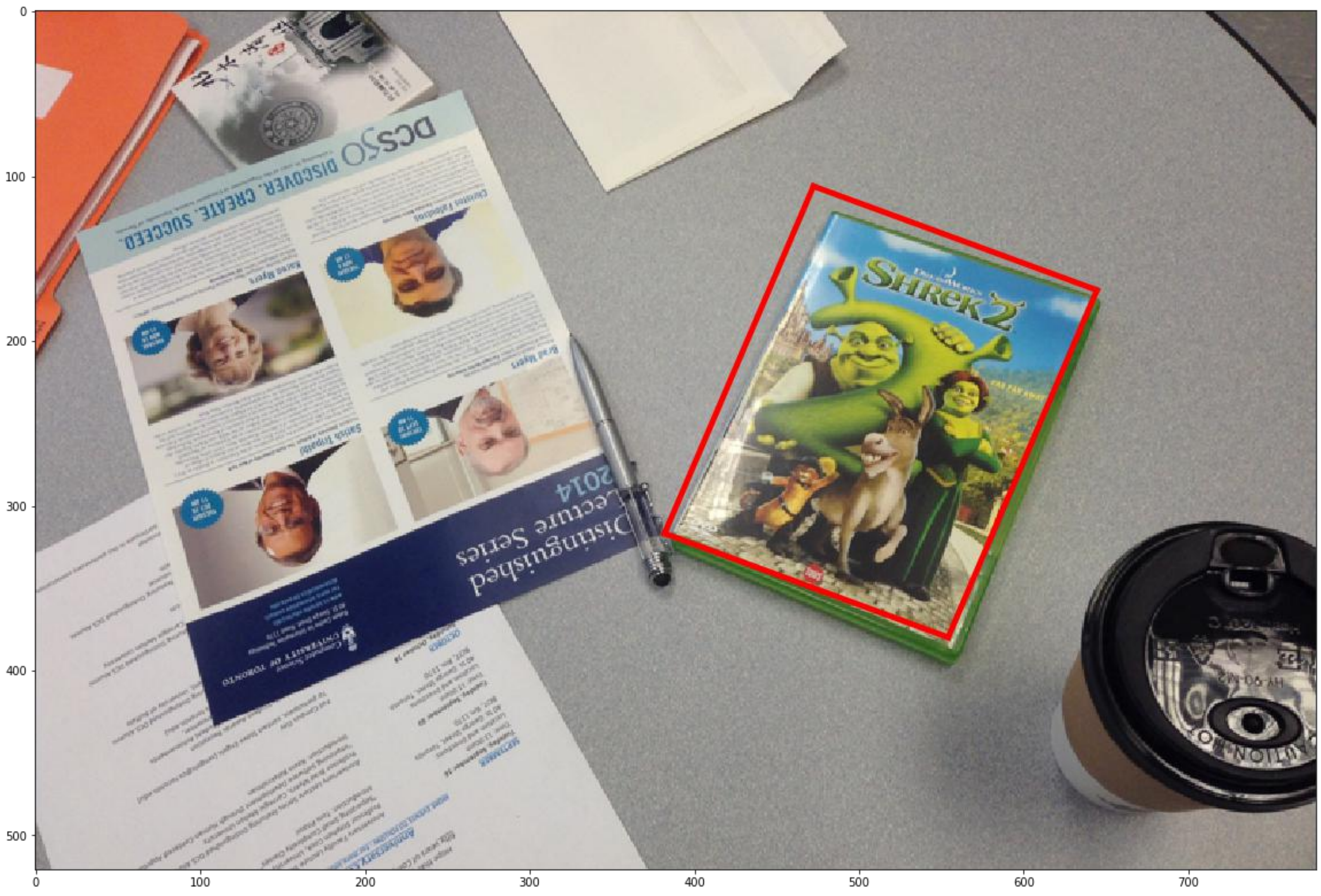
```
def solve_for_A(img1, img2, k1, kp2, kp3):


    #kp1, kp2, kp3 = matching(img1, img2)

    # First Image Key Points
    x1, y1 = kp1[0].pt
    x3, y3 = kp2[0].pt
    x5, y5 = kp3[0].pt

    #Second Image Key Points
    x2, y2 = kp1[1].pt
    x4, y4 = kp2[1].pt
    x6, y6 = kp3[1].pt

    b = np.array([x2,y2,x4,y4,x6,y6])

    A = np.array([[x1, y1, 1, 0, 0, 0], [0, 0, 0, x1, y1, 1],
                  [x3, y3, 1, 0, 0, 0], [0, 0, 0, x3, y3, 1],
                  [x5, y5, 1, 0, 0, 0], [0, 0, 0, x5, y5, 1]])

    transformation = np.linalg.solve(A, b)

    img1x, img1y, _ = img1.shape

    left_up_x, left_up_y = 0, 0
    left_bottom_x, left_bottom_y = 0, img1x
    right_up_x, right_up_y = img1y, 0
    right_bottom_x, right_bottom_y = img1y, img1x


    p1 = affine_transformation( 0, 0 , transformation)
    p2 = affine_transformation(0, img1x, transformation)
    p3 = affine_transformation(img1y, 0, transformation)
    p4 = affine_transformation(img1y, img1x, transformation)

    f = plt.figure(figsize=(20,20))
    plt.imshow(img2[:,:,::-1])
    plt.plot((p1[0], p2[0]), (p1[1], p2[1]), c='r', linewidth=5)
    plt.plot((p1[0], p3[0]), (p1[1], p3[1]), c='r', linewidth=5)
    plt.plot((p2[0], p4[0]), (p2[1], p4[1]), c='r', linewidth=5)
    plt.plot((p3[0], p4[0]), (p3[1], p4[1]), c='r', linewidth=5)

    plt.show()
```

In [21]:

```
def plot_rect(p1,p2,p3,p4,color,linewidth=2):
    plt.plot((p1[0], p2[0]), (p1[1], p2[1]), c=color, linewidth=linewidth)
    plt.plot((p1[0], p3[0]), (p1[1], p3[1]), c=color, linewidth=linewidth)
    plt.plot((p2[0], p4[0]), (p2[1], p4[1]), c=color, linewidth=linewidth)
    plt.plot((p3[0], p4[0]), (p3[1], p4[1]), c=color, linewidth=linewidth)
```

In [22]:

```
solve_for_A(images[0], images[1], kp1, kp2, kp3)
```



[2.5 points] Take an item for which you know the width and height (in cm), for example a piece of paper or a dollar bill. Place the item next to or in front of the door. Take a picture of the door such that all four corners of the door are visible on the photo. Take this picture in an oblique view, ie, the door is not a perfect rectangle but rather a quadrilateral in the photo. Estimate the width and height of the door (in cm) from the picture.

In [23]:

```
door1 = cv2.imread('door3.png', 1)[:,:,::-1]
```

In [24]:

```
f = plt.figure(figsize=(30,30))
door_coordinates =  np.array([[1145, 373], [1919, 758], [1696,3439 ], [938, 3876
]])
paper_coordinates = np.array([ [1348, 1798],[1617, 1800],  [1603, 2086],[1342, 2
128]])
x = list(paper_coordinates[:,[0]].flatten())
y = list(paper_coordinates[:,[1]].flatten())
xt = list(door_coordinates[:,[0]].flatten())
yt = list(door_coordinates[:,[1]].flatten())
plt.plot(x+x[:1], y+y[:1], 'r')
plt.plot(xt+xt[:1], yt+yt[:1], 'b')
plt.imshow(door1)
```

Out[24]:

```
<matplotlib.image.AxesImage at 0x111085d90>
```

In [25]:

```
f=30 # each cm is f pixels
x2=[0+1,   29.7*f+1, 29.7*f+1 , 0+1  ]
y2=[0+1,   0+1,   22*f+1, 22*f+1 ]
```

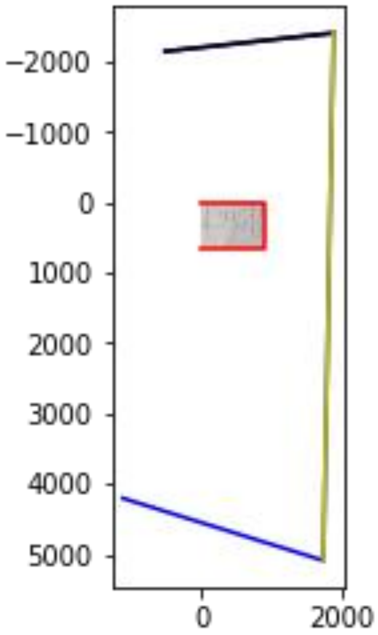
In [26]:

```
src = np.vstack((x, y)).T
dst = np.vstack((x2, y2)).T
tform = tf.estimate_transform('projective', src, dst)
```

In [28]:

```
warped = tf.warp(door1, inverse_map=tform.inverse, output_shape=(f*22, f*29.7) )
src_door = np.row_stack((xt, yt, [1]*4))
X_hom = tform.params.dot(src_door)
X_hom = X_hom / X_hom[2,:]
plt.imshow(warped)
plt.plot(x2, y2, 'r')
plt.plot(X_hom[0,:], X_hom[1,:], 'b')


# Getting the coordinates of the corners to estimate the width and the height
upper_right_corner = [X_hom[0,:][np.argmin(X_hom[1,:])], X_hom[1,:][np.argmin(X_
hom[1,:])]]

bottom_right_corner = [X_hom[0,:][np.argmax(X_hom[1,:])], X_hom[1,:][np.argmax(X
_hom[1,:])]]

upper_left_corner = [X_hom[0,:][0], X_hom[1,:][0]]

# Plot the estimated width
plt.plot([upper_left_corner[0], upper_right_corner[0]] , [upper_left_corner[1],
upper_right_corner[1]], 'black')

plt.plot([bottom_right_corner[0], upper_right_corner[0]] , [bottom_right_corner[
1], upper_right_corner[1]], 'y')


# Compute the distance between the points and divide by the number of pixels to
get cm
width = euc(upper_left_corner, upper_right_corner) / f

height = euc(upper_right_corner, bottom_right_corner) / f

print('width of the door {}'.format(width))
print('height f the door {}'.format(height))
```

```
width of the door 80.2974586403
height f the door 249.745611008
```



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