

# Assignment 2 - Stitch Panorama

Krishanu Das Baksi  
2019ANZ8274

Deepak Raina  
2019MEZ8497

COL-780 Computer Vision  
30th September 2019

## Approach:

### 1. Feature point extraction:

This is done by using SIFT keypoint detector, which is a very efficient algorithm for feature detection when the images are taken in different lighting conditions. Also, it returns a vast amount of features which will be helpful for better estimation of homography. The OpenCV function for SIFT is used for this task.

### 2. Finding Matches between Image Pairs:

Every pair of images and their key points were taken and used to compute the matches among the keypoints. The image features are matched using KD Trees and the good feature matches were identified using Lowe's criteria. For every pair of images, the number of good matches and the corresponding matches were stored.

### 3. Finding Best Matches:

Using the above pairwise good feature matches, we use a heuristic method to filter out sub-optimal matches between  $N$  images. Firstly, we filter out the best possible  $100/(\text{number of images} - 1)$  percent of the matches depending on match distance from the good feature matches.

$$\text{best matches} = \text{top } \frac{100}{N-1} \% \text{ of good matches}$$

Now, these filtered possible matches are low in number, images with low/no intersection will have low/no matches. Using the image pairs which have a substantial number of filtered matches, we find the pairwise homography. Now, we only keep those image pairs that have a positive value in the (0, 2) position of the homography matrix as that corresponds to a left to right shift. These match pairs and the homography matrix are stored to be used later.

### 4. Finding Image Order:

From the above pairwise left to right image matches, we find an origin/start image, which does not have a corresponding matching image to the left. It is considered as the start image. Using the right image of the start, and then the right image of the former and so on, we find the image ordering from left to right.

In case one image has 2 left or right images, the corresponding image pairs are compared by the number of matches and only the one with the best matches are kept. Therefore, the ordering is checked and refined in this step.

### 5. Reference Frame Finding:

Once the order of images in the panorama is known, finding the reference image is comparatively straightforward. It should be near the middle of the image. However, we almost always have

more than once candidate. In our approach the best reference/central image candidate is the image who fulfils the following 2 criteria:

1. No homography between the reference and all the other target images causes the target to be flipped.
2. The size of the resultant image formed by fixing it as a reference is the least as compared to the other potential references.

**6. Finding Homographies:**

The pairwise homography between the reference and all other images are calculated using the best possible sequence of matches among the reference and the target.

Note that this step is used in finding a reference image as well.

**7. Finding Left out Images:**

We go through all the input images and verify if all the images are added to the sequence and their homography is calculated. If the image has both vertical and horizontal matches, there would be certain images that are left out. These images are again added to the processed list by finding the best possible match among the image and the already processed ones and then finding their homography with the reference.

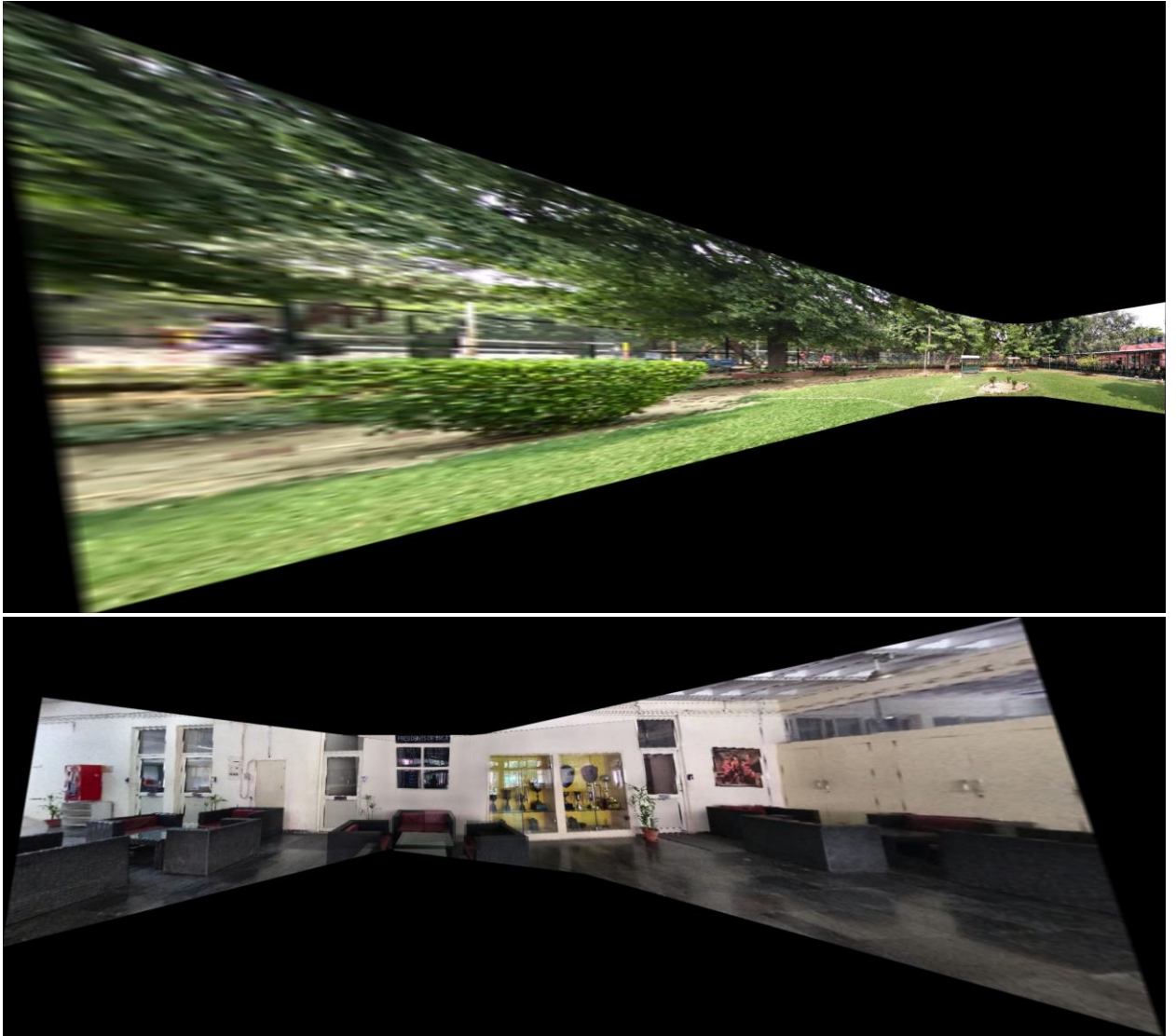
**8. Finding the total dimension of panorama**

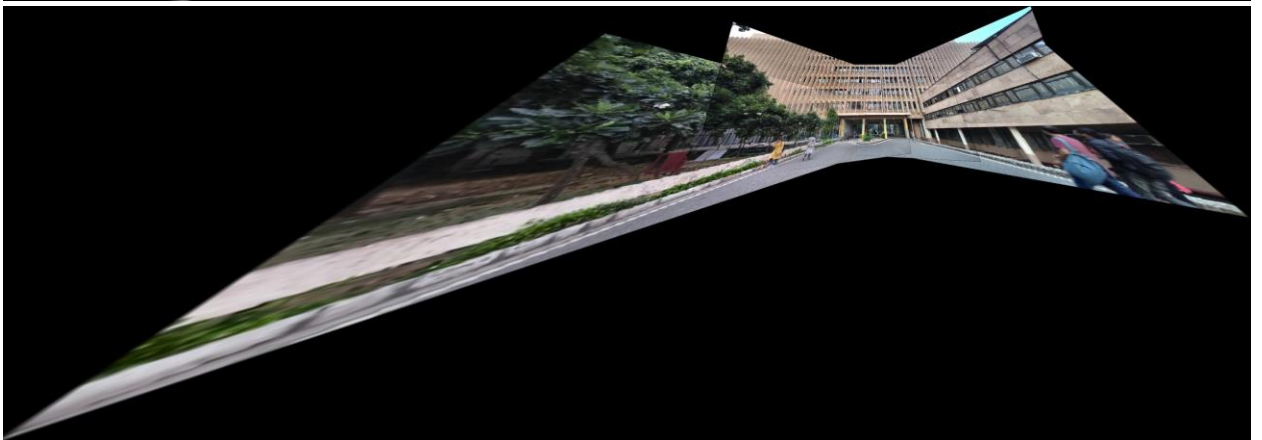
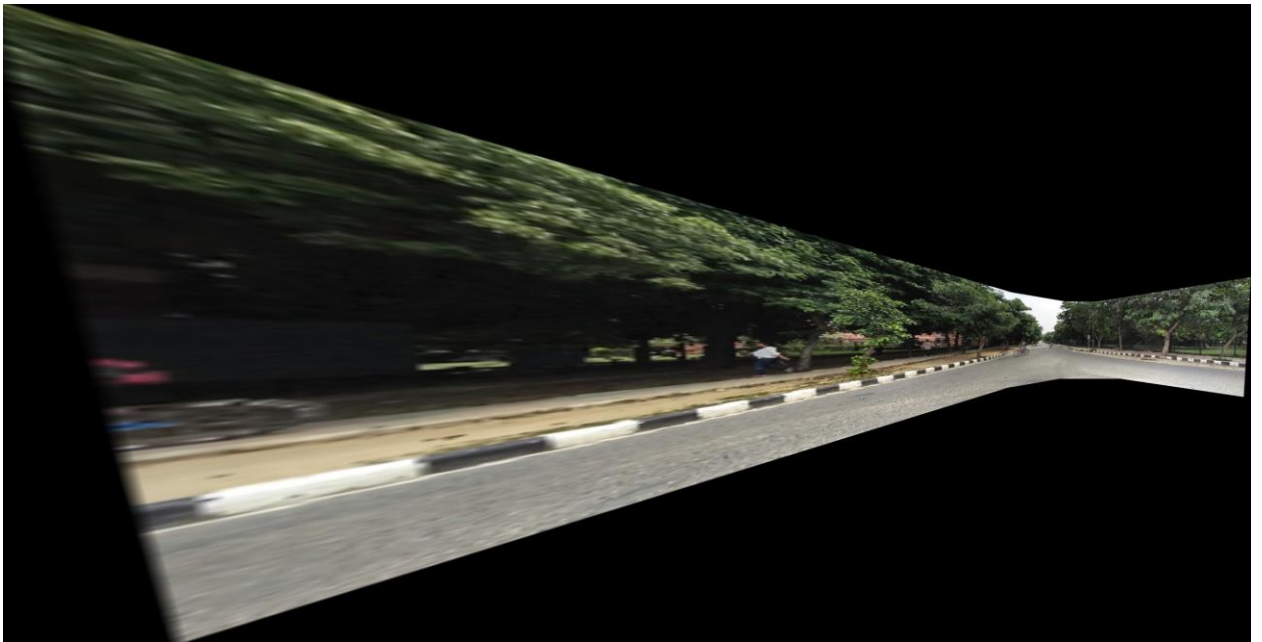
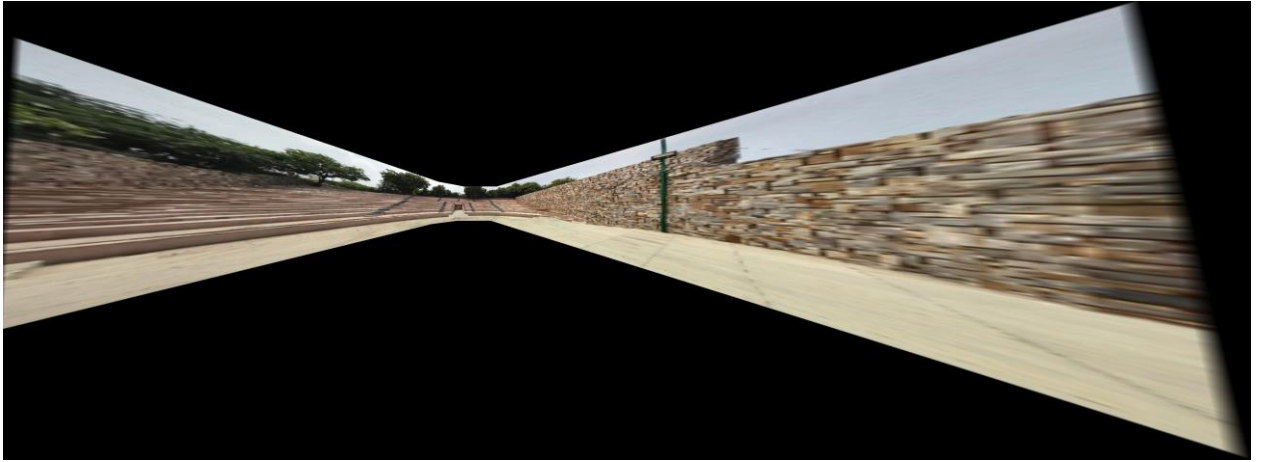
Once all the images are processed and their homography with the central image is found, all these homography are used to find the total dimension of the image. Using the total dimension and the pairwise homography and translation (due to change in size of the resultant image), we can sequentially add images left to right to the resultant image, making sure they are blended properly.

**9. Blending of images**

Once the images are stitched, alpha blending is done on the pair of images to obtain the seamless blending. The mask for alpha blending is obtained by taking the distance of the pixel from the edge of the paired images as the weight function.

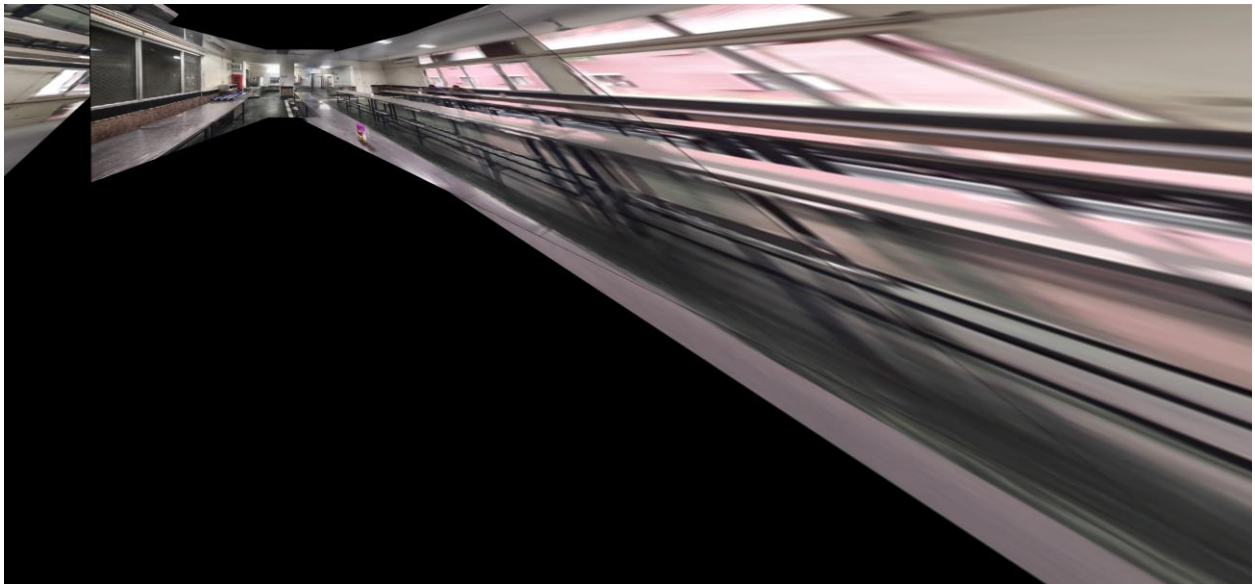
**Panoramas of in-sample:**





## Stitching - Best and Failed case

Link for the sample dataset for these cases - [OurSample](#)



**Reasons for failed case:**

The above image has failed due to the following reason:

The camera pan has moved more than 90 degrees, so the homography calculated was inaccurate.

Due to which the leftmost image has flipped, and as such the stitching was inappropriate