LAB 5 Report
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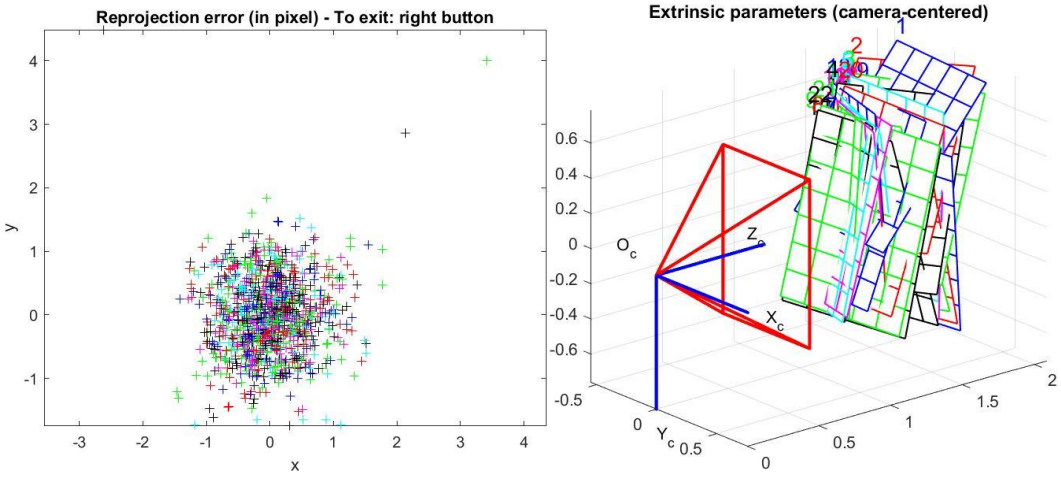
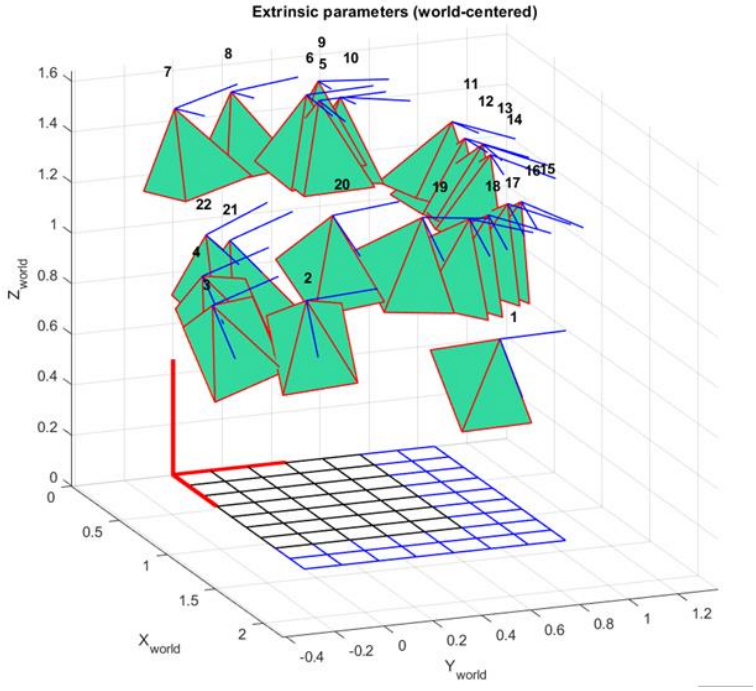
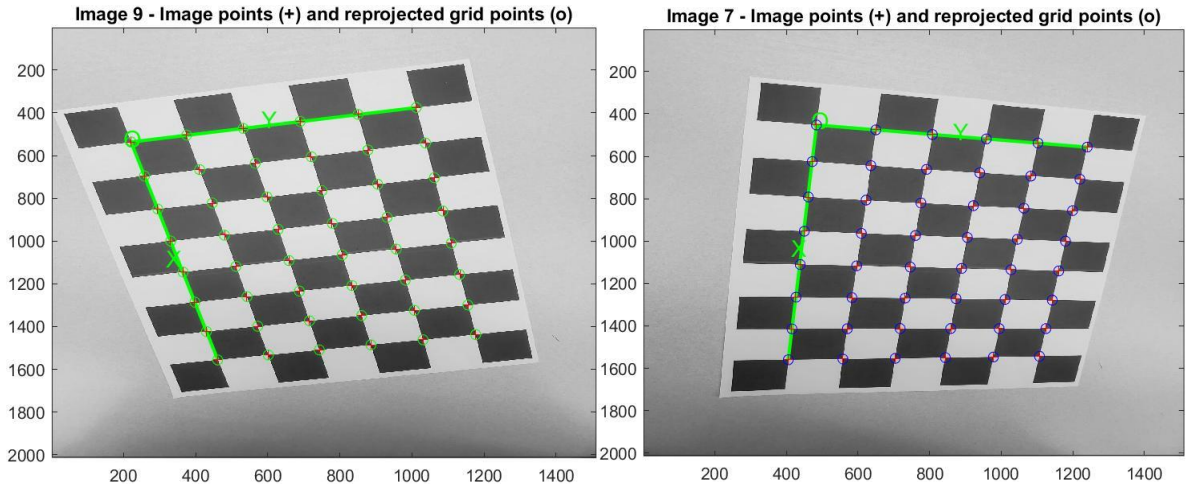
Part 2. Camera Calibration:

Camera calibration is mostly done to make sure the images don't come out distorted with errors due to the lens used . In our case the camera used is already calibrated, so this step is mostly to analyze and make sure that the camera used is calibrated.
The camera used to capture the data set: Samsung (android) phone
For calibration, we are using the camera calibration toolbox pattern, and the MATLAB codes.
Below graph we are manually extracting the corners. We can observe that the error is as below:
Pixel error: err = [0.25035 0.23864]
The few isolated points are the images responsible for the error.

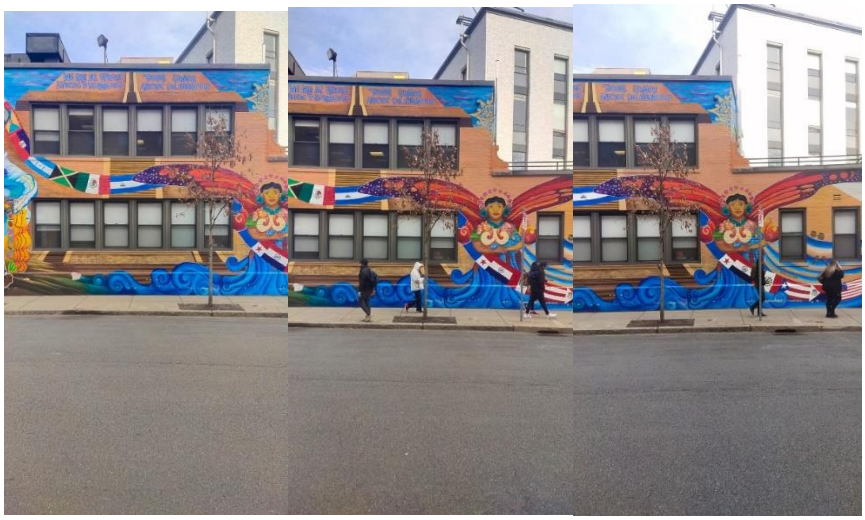


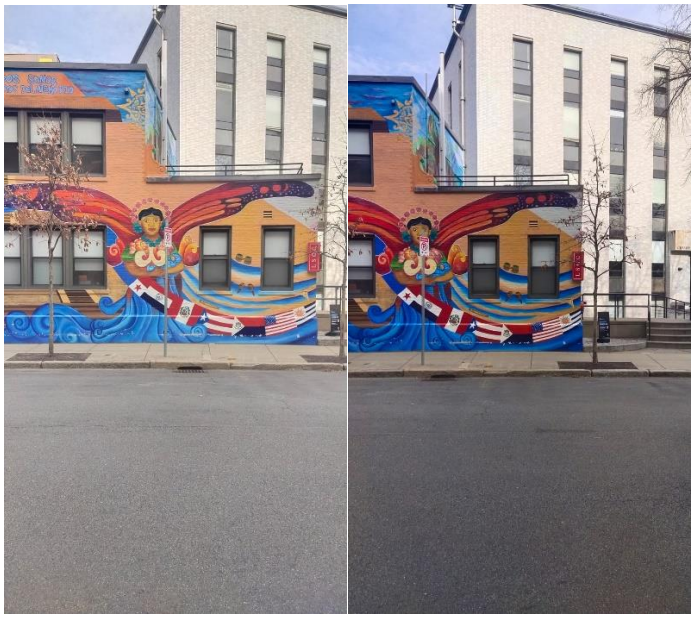




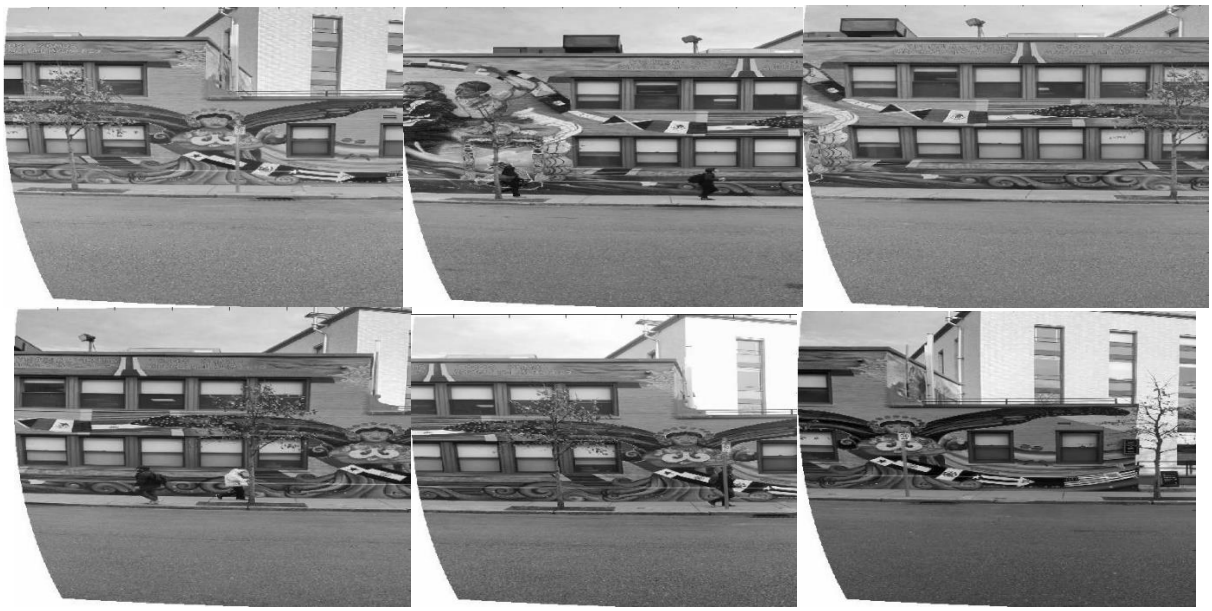
Part 3 Data Collection:

The data set for this part of the lab are collected on the Forsyth Street Latino Student Culture Centre.
The images captured are perfect with no distortion, as they have been collected from a calibrated camera. So, the data set I am working with is flawless. If these images were distorted, it could be fixed by using the 'undistort image' feature of the calibration toolbox. To see the difference, we are using the undistorted feature on the original captured undistort images.





Captured data set

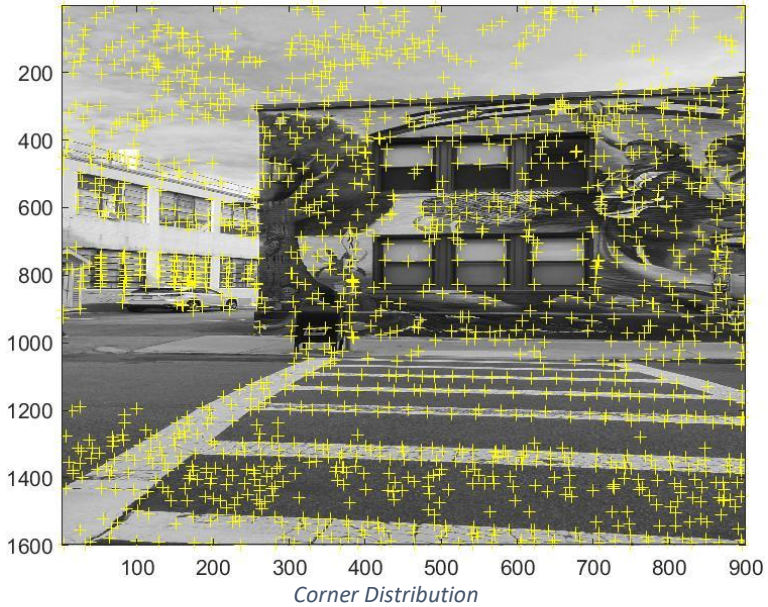


After using 'Undistort'' function1

These are the nine imaged used to demonstrate the aim for the experiment. We can see that the captured images are undistorted and looks closely the actual site. It is observed that the black and white images turned out to be more distorted. It is evident from the corners of the images; the corners are curved.

Part 4. Harris Corner Distribution:

We are using the Harris corner detection feature to detect the corners in the image. We can adjust the number of corners in the code. The code applies Harris feature on each of the 9 original images to detect prominent corners. The below is one of the 9 images demonstrating the Harris Corner Detection.



Corner Distribution

Part 5. Final Mosaic Image:

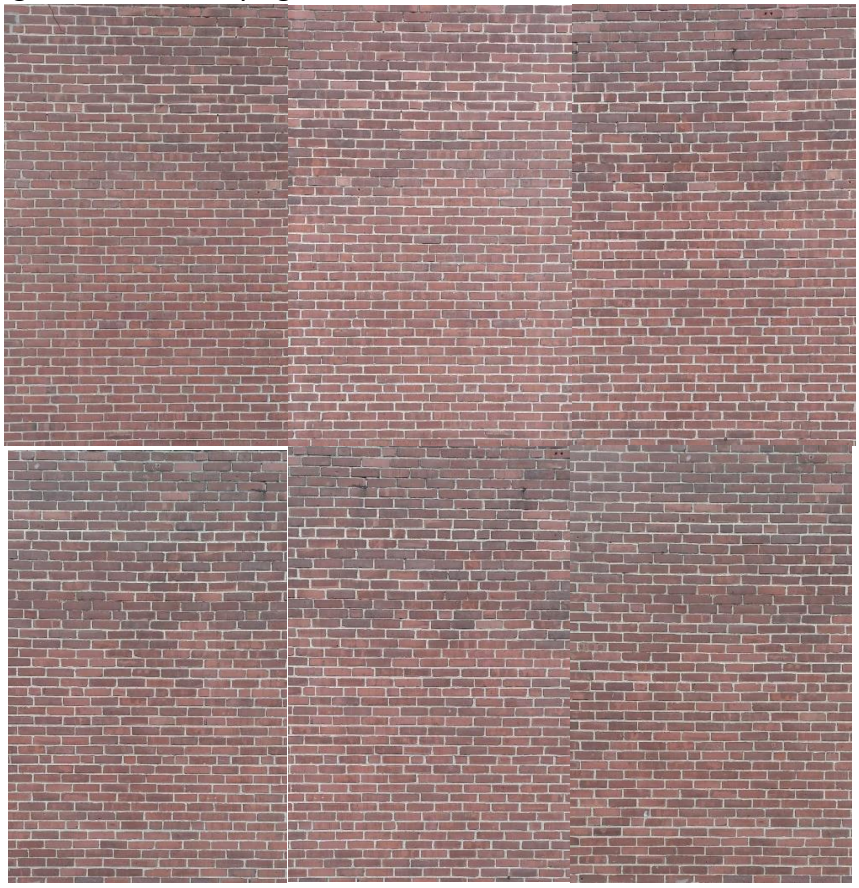
To stitch the panorama image, I am using the original undistorted images captured.
Below is the result of stitching together the original images. We are using the Harris feature detector to stitch the image together. This feature detects the corners of buildings, windows, and the other graffiti details. The Harris code matches the prominent corners detected to get a full image. The stitched image is close to the original. There are a few places it is not perfectly aligned, but very close. The detector used is a 2D detector and cannot detect the 3D features in the image. The zebra-crossing mismatch is because the road does not offer a lot of detectable corners for the Harris feature to do a good job.

Resultant Mosaic Image

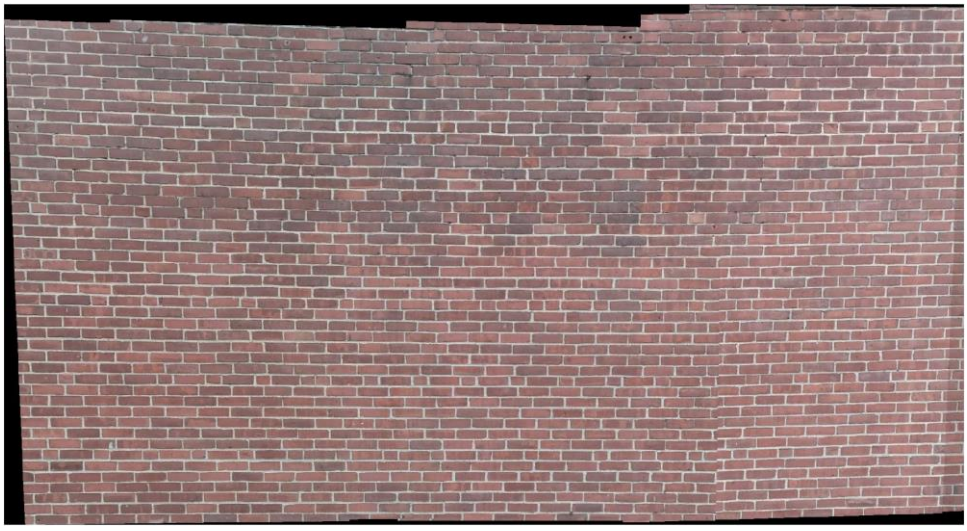
Part 6. Mosaic Overlap: Cider Brick wall

The images collected are from one of the plain walls of the Ryder Hall. We are using 6 images with 50% overlap to see the outcome. The stitched image is as below.
It is clearly evident that the stitched imaged is not perfectly aligned. The images are a match in the mid-section signifying the stitching taking place near the 50% mark.
For this part of the lab the parameters were the same as the previous. The feature detected are well distributed, due to the uniform design the stitched image looks aligned. The Harris feature detects the corner but fails to match it with the next image because they all look alike and the

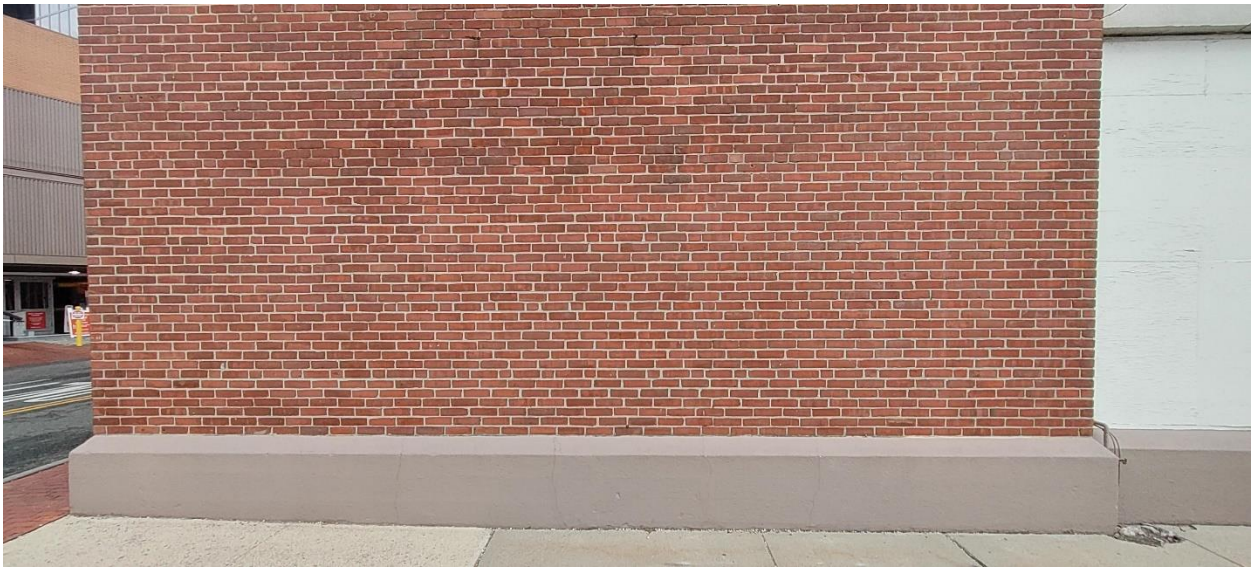
features are alike. This is noticed only looking at the boarders where we can see the images placed a little higher and lower trying to match the features.



Data images



Resultant Image



Original

Part 7. Mosaic 15% Overlap:

For this part we are using the mural from East Village. We are using 8 images to generate the panorama image. The images are captured with an overlap of approximately 15%. With all the parameters unchanged, the panoramic outcome is not coming out well.
Changing the display parameters resulted in some improvement in the resultant panoramic image.

Stitched Image

One of the issues observed was that there were fewer features detected over the overlapped area. To overcome that the N corner detection value was changed to check for better outcomes. On the other hand, increasing the N value throws a running out of memory error. Balancing both the issues, a moderate value was selected.

Another issue observed was that overcrowding of points detected in the overlapped area. This caused the resultant panorama mismatch even though the corners were detected efficiently. As a measure to overcome this mismatch, the tile value was manipulated to find a sweet spot, where the panorama image is perfect. Large tile values accommodate many features leading to a well stitched image. The tile value was [3,3] for this part of the lab.

Original

Conclusion:

This lab gives us insight on image manipulation using MATLAB Calibration Tools, to calibrate images captured by a calibrated or an uncalibrated camera. We also learn concept of corner detection and feature detection to get a better understanding of the stitched panoramic image.