LAB 5

NIKHIL CHOWDARY GUTLAPALLI

1. Camera Calibration:

1.1. Calibration Images:

The 30mm dimensions of the squares of the checkerboard are used in the calibration process.

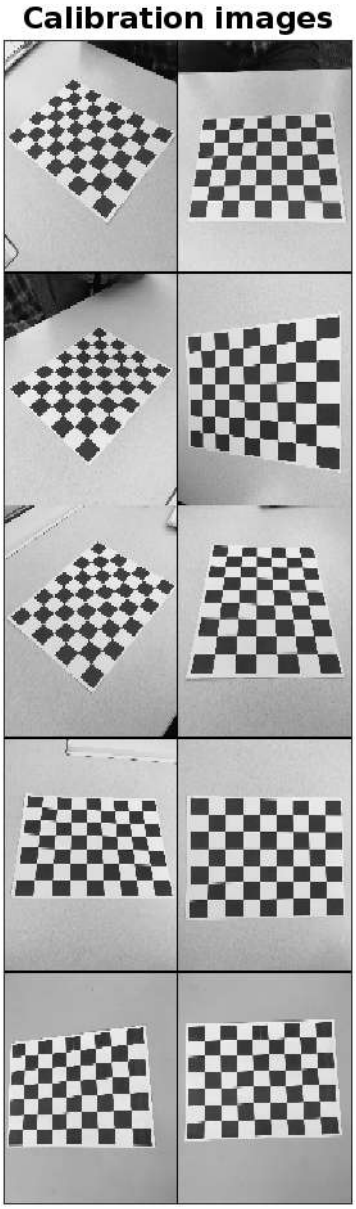

Fig 1: Images that were used for calibration

1.2. Reprojection pixel error:

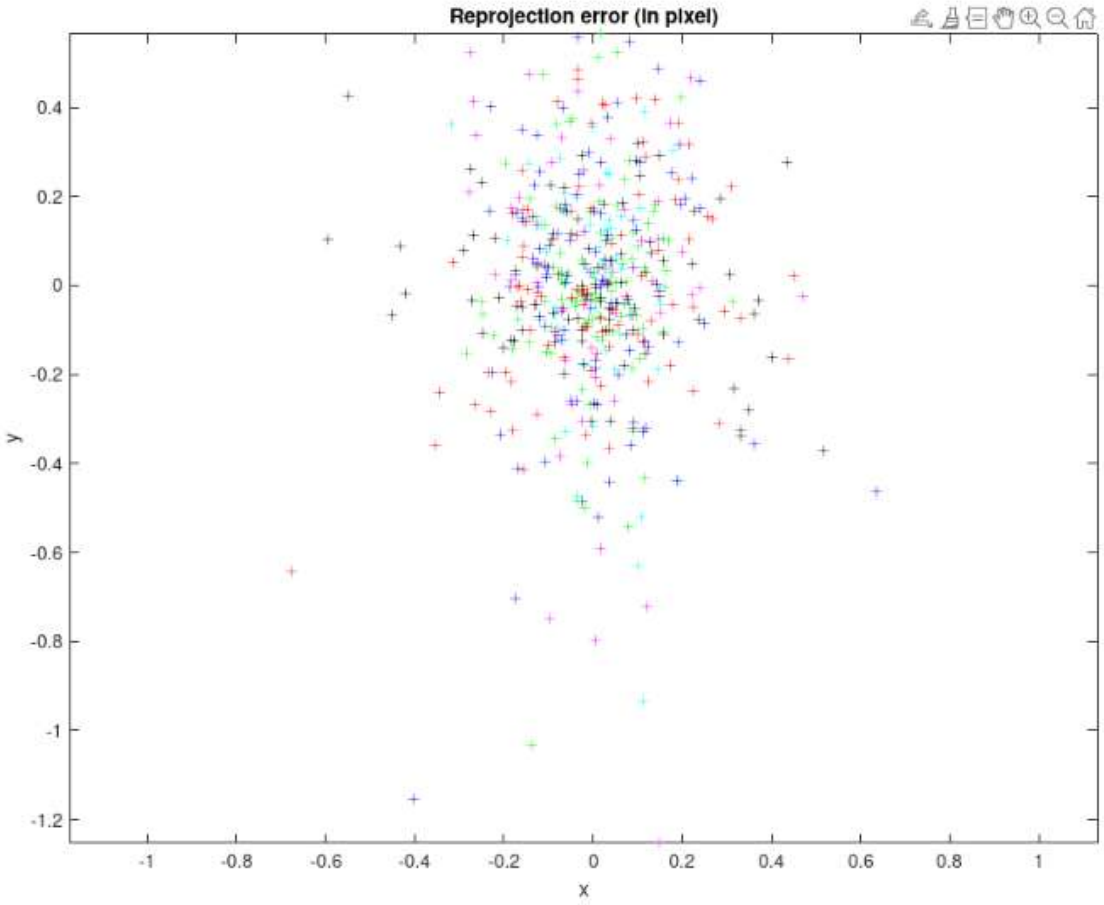

Fig 2: A plot of the Reprojection error (in pixels) obtained from the calibration images

1.3. Calibration parameters:

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Estimation of uncertainties...done


Calibration results after optimization (with uncertainties):

Focal Length:          fc = [ 883.61334   884.18554 ] +/- [ 4.38464   4.26880 ]
Principal point:       cc = [ 382.24815   508.80457 ] +/- [ 3.27072   3.21488 ]
Skew:             alpha_c = [ 0.00000 ] +/- [ 0.00000  ]   => angle of pixel axes = 90.00000 +/- 0.00000 degrees
Distortion:            kc = [ 0.04553   0.12796   -0.00130   -0.00102  0.00000 ] +/- [ 0.01810   0.11345   0.00129   0.00162  0.00000 ]
Pixel error:          err = [ 0.15641   0.24683 ]

Note: The numerical errors are approximately three times the standard deviations (for reference).


Number(s) of image(s) to show ([] = all images) =

Pixel error:      err = [0.15641   0.24683] (all active images)
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Figure 3: Calibration results determining the FL, Principal Point, Skew, Distortion and P error.

1.4. Before and After calibration:

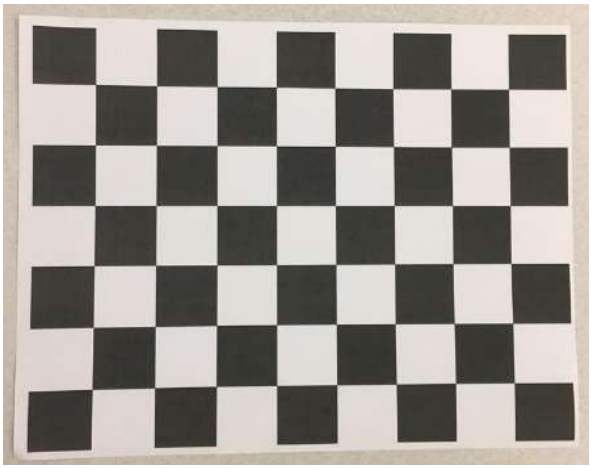

Fig 4: Before Calibration

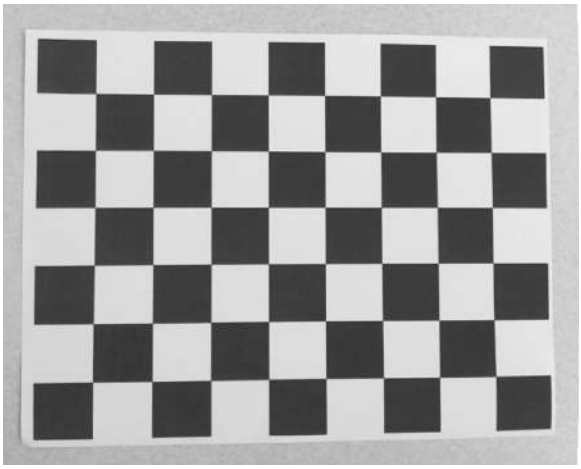

Fig 5: After Calibration

Because of the lower pixel error, I feel that there weren't any significant differences between the distorted and undistorted images.

2. LSC mosaic:

2.1. LSC image set:

Fig 6: Used Images of LSC for Panoramic Image Stitching

2.2. Harris corners across LSU:

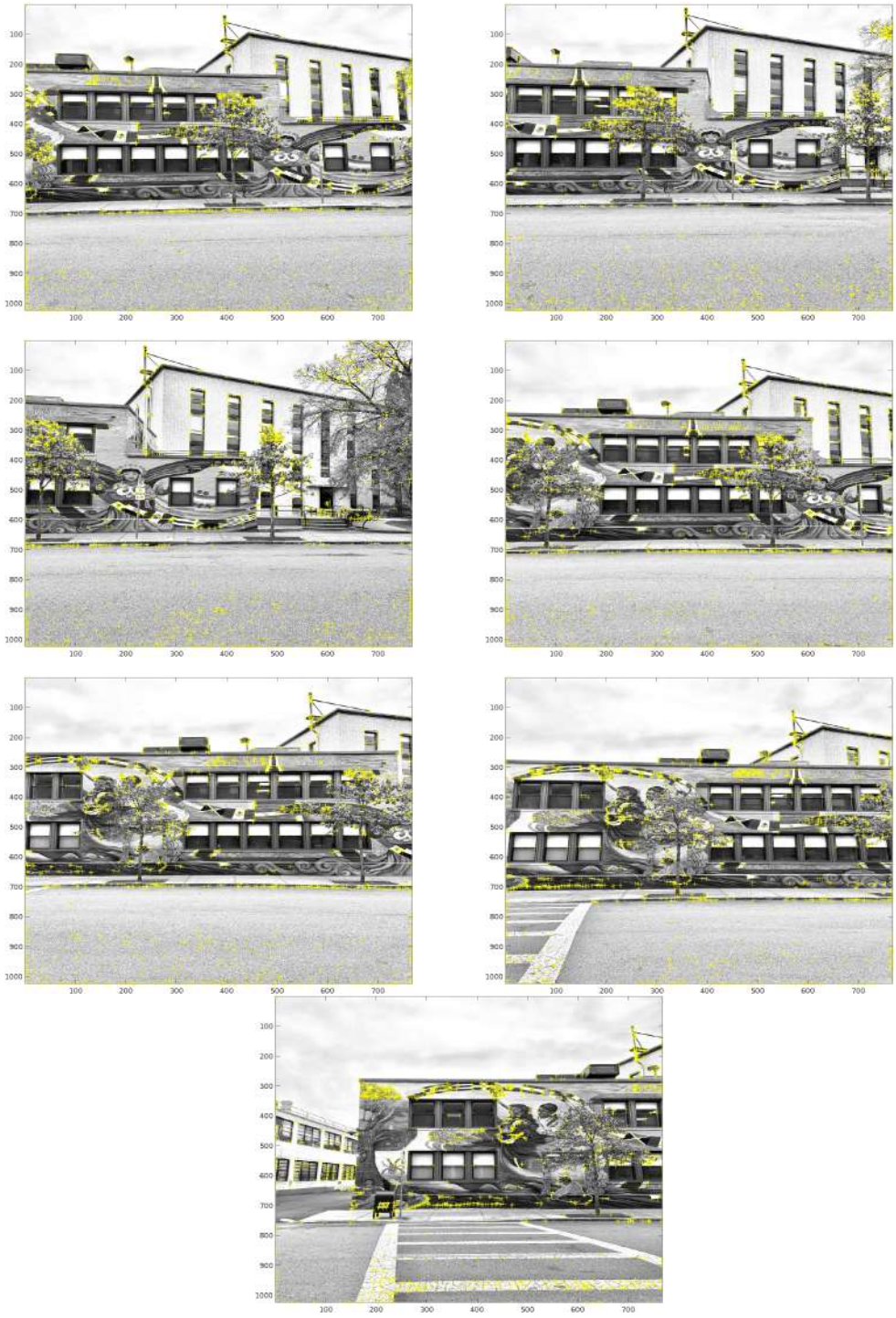

Fig 7: Harris corners detected on the images

2.3. Final LSC mosaic:

Fig 8: LSC Panoramic mosaic

2.4. Discussion:

2.4.1. Downscaling: Images were around 4k x 3k size, when taken from the phone camera. Due to this high resolution, the harris detector was detecting some irrelevant features, such as roads, trees too clearly, by which we observed that the final mosaic was not properly stitched. So, to avoid this, we downscaled the image, such that it would lose some information and detect paintings clearly. Clear detections were observed in the fig 7.

2.4.2. Parameters for Harris Corner: N = 1500

Tile size = [3 3]

Image Resolution = 1024 x 768 pixels

2.4.3. The final mosaic can be seen at the fig 8. The top right buildings were not featured properly, because of the decrease in the resolution, of which the features on buildings were not able to be detect properly.

3. Brick wall mosaic:

3.1. Initial images with Harris corners:

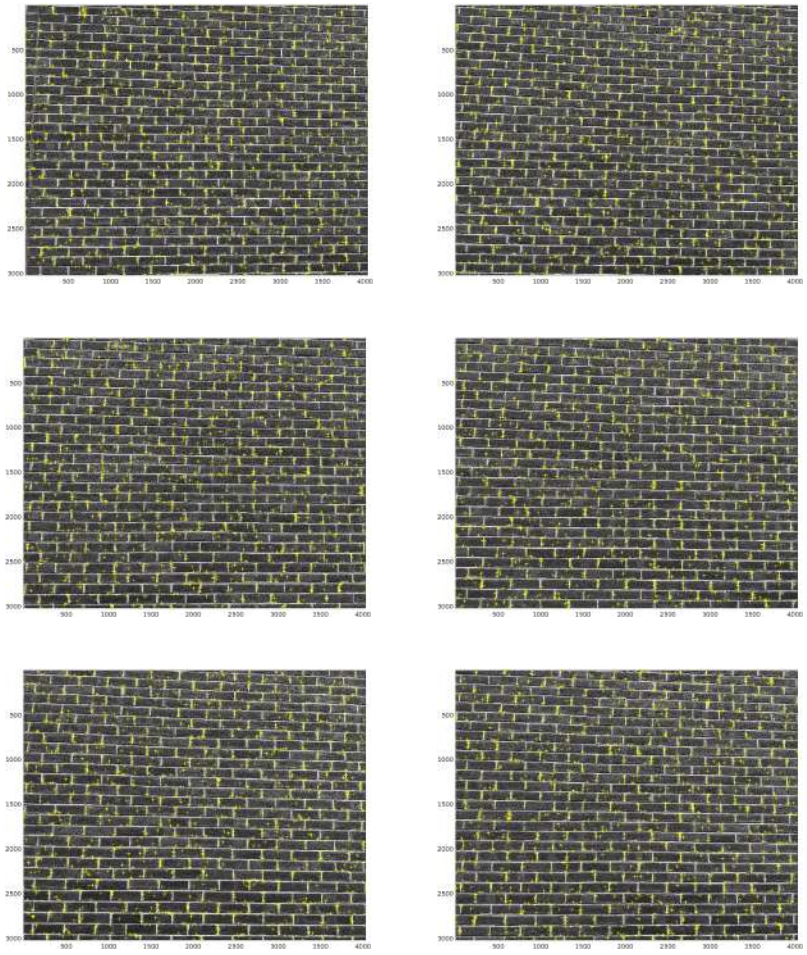

Fig 9: Harris Corners Pattern on Brick walls.

3.2. Final cinder block image:

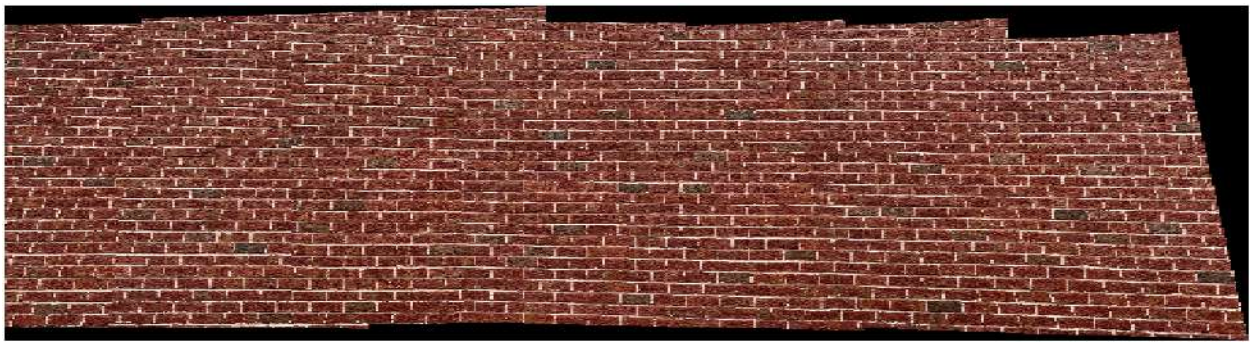

Fig 10: Final cinder block image

3.3. Discussion:

3.3.1. Feature Reputation: This experiment would be the trickiest and toughest problem for the Harris algorithm because of finding feature matching. These brick wall images look alike and would be confusing for the algorithm to overlap images. If we observe the images of Harris detections (Fig 9), all the images look similar.

3.3.2. Parameters: N = 2000
Tile size = [10 10]
Resolution = 1365 x 1008 pixels

4. Third Mosai:

4.1. 50% overlap images with Harris corners:

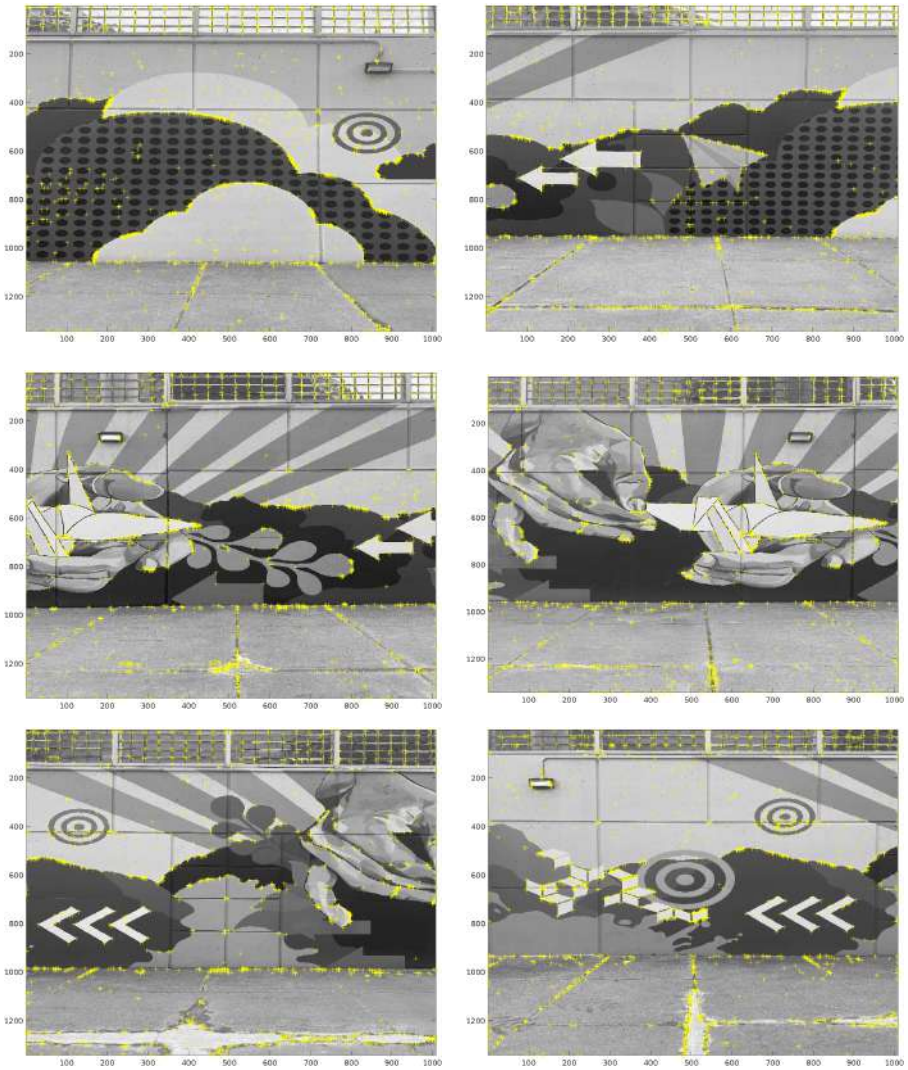

Fig 11: Harris Corner Detection for 50% overlap images.

4.2. 15% overlap Images with Harris corners:

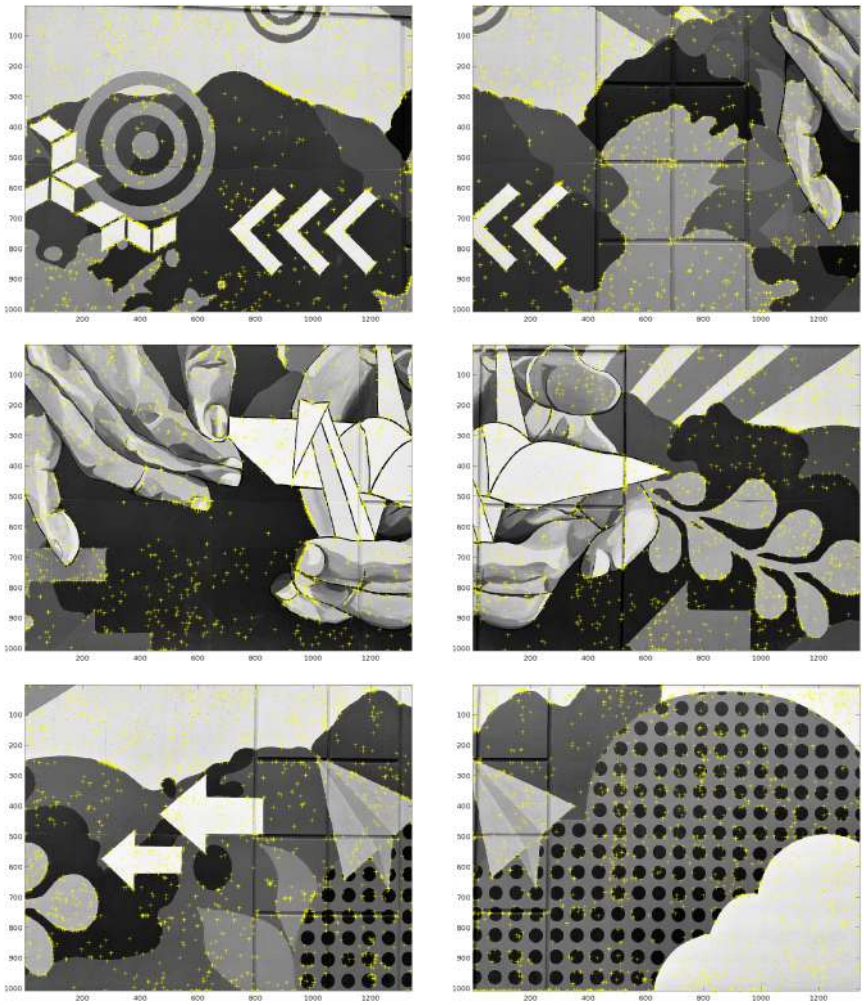

Fig 12: Harris Corner Detection for 15% overlap images.

4.3. Final mosaic with 15% overlap:

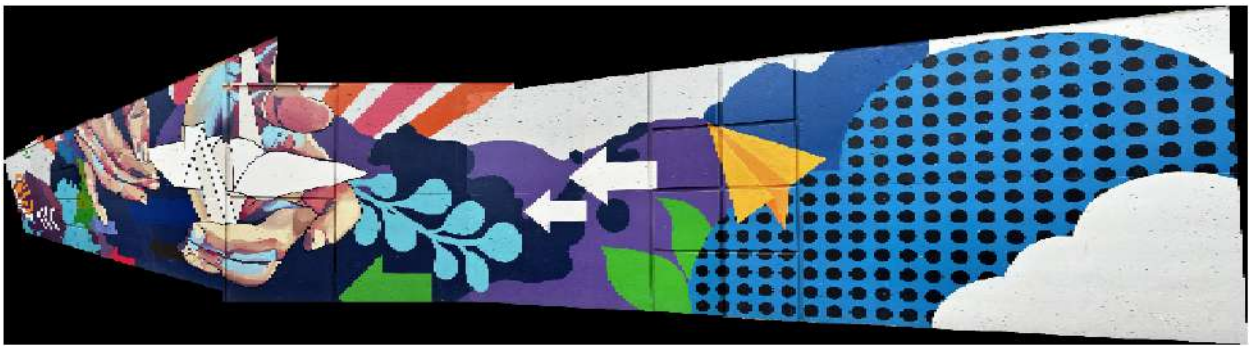

Fig 13: Final mosaic with the images of 15% overlap.

4.4. Final mosaic with 50% overlap:

Fig 14: Final mosaic with the images of 50% overlap.

4.5. Discussion between 50% and 15% overlap mosaic:

The panoramic image generated using images with a 50% overlap showed significantly better results compared to the one generated using images with only a 15% overlap. The reason behind this lies in the number of common features between successive images. In the case of a 15% overlap, there are very few common features, resulting in lower confidence in stitching the images together seamlessly.

With a 50% overlap, there are more common features between the images, which allows for more accurate and confident stitching. The larger overlap ensures that there are enough matching points for the software to align and blend the images smoothly, resulting in a visually appealing panorama.

On the other hand, the panorama created with a 15% overlap performs better when there are distinct differences closer to the edges of the images, where the overlapping sections are present. In this case, the images may have larger, more noticeable features, but they may not be enough to achieve precise stitching.

4.6. Adjustments:

4.6.1. Rescaling: Both images were rescaled from 4032 x 3024 to 1344 x 1008.

4.6.2. Parameters for 15% overlap images: N = 2000
Tile = [4 4]

4.6.3. Parameters for 50% overlap images: N = 1500
Tile = [4 4]