# LAB 5 Report

## Overview

This lab is an introduction to Computer Vision. We focus on calibrating a camera by taking images of a checkerboard and then using calibration data to stitch multiple images together into a panoramic image. The objective is to understand how the Harris corner detection algorithm and mosaic stitching algorithms work while also assessing the mosaics for good or bad scenarios.

## Camera Calibration

Images of a checkerboard were taken on a phone to understand the distortions presented by the phone camera. The Caltech Camera Calibration Toolbox was used to detect any distortions and calibration data was obtained with required errors and used to un-distort images. Initially with a default window size of 20 the pixel error was massive. The window size was then changed to 5 on all images as suggested and the error reduced drastically to [5.9388, 5.1299]. Window size was further reduced on images having higher error to 1.8 and the pixel error further decreased to [0.2365, 0.2731] as can be seen in the Calib results file.
The re-projection errors before and after are shown in the images below.

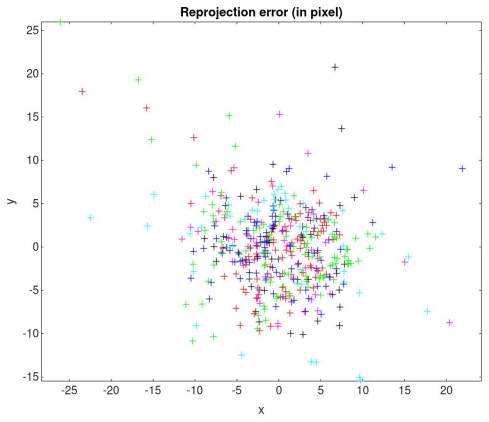


Figure 1: Errors Before Calibration

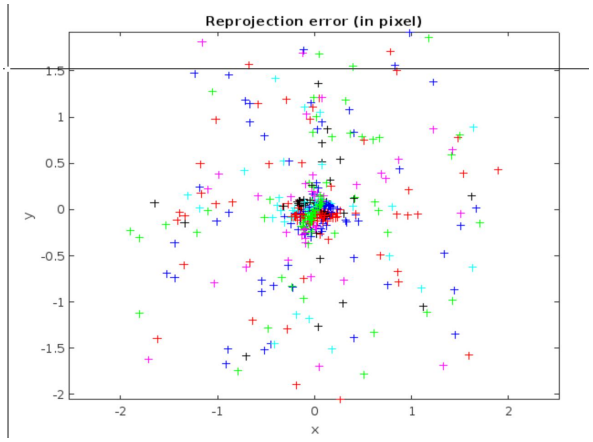


Figure 2: Errors After Calibration

## Latino Student Centre Mosaic

This section involved taking images of the Latino Student Centre wall art and stitching it together to form a panoramic image. Since the distance between the wall and camera was high, the entire wall was covered in 3 images despite having a 50% overlap. The image stitching algorithm was performed, and the resultant image obtained is shown below. The image obtained is stitched properly and we can see that there is only a very slight offset at the point of overlap that is negligible.

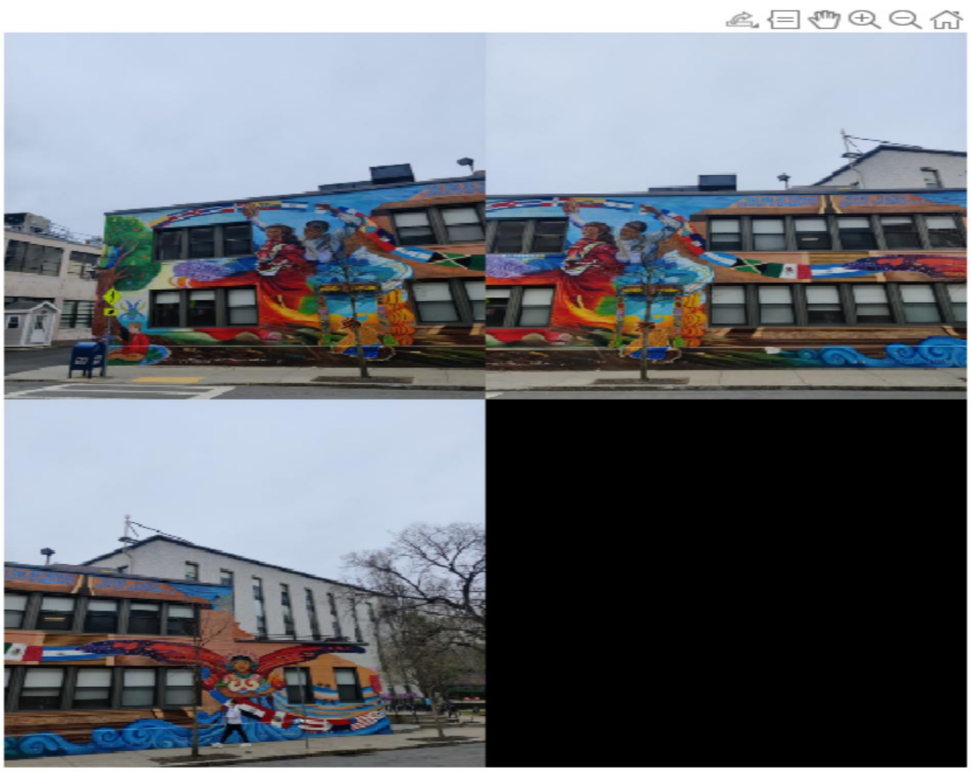

Figure 3: Latino Student Centre images

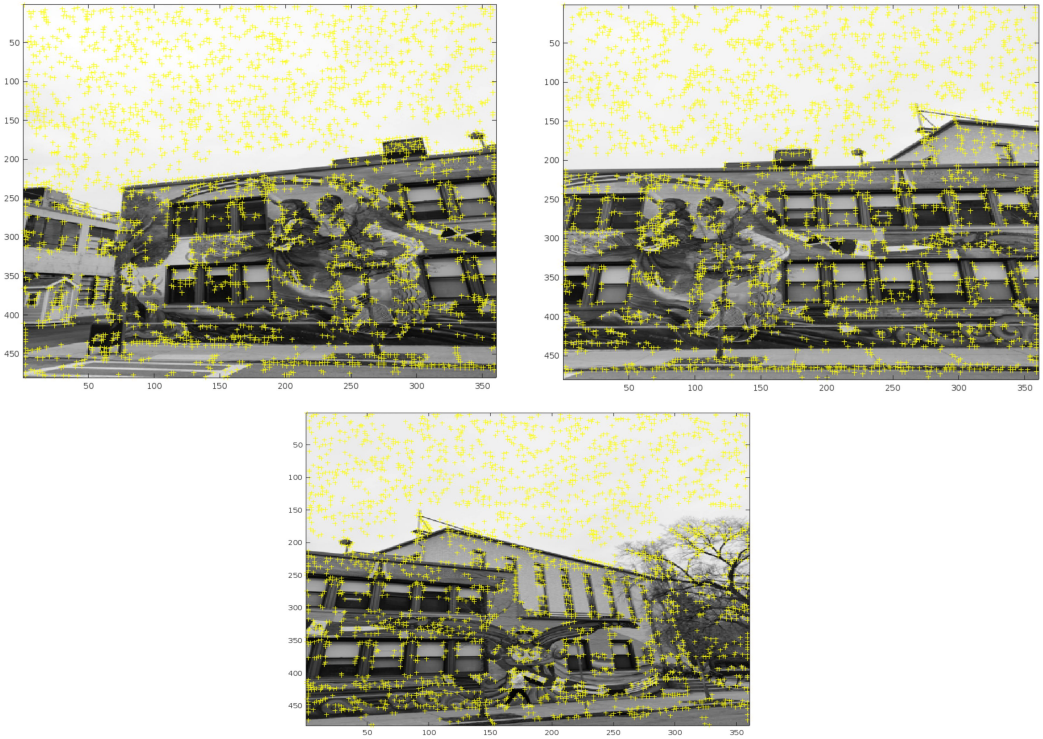

Figure 4: Harris corners detection on LSC

Figure 5: LSC final stitch

## Cinder block / Brick wall Mosaic

This section involved taking images of a brick wall and stitching the images together. The Harris corner detector detected multiple corners which made the stitching process easier by providing multiple features to match from. Another factor that added to the ease of stitching the images was the presence of additional features such as the plaque on the wall, the tree in the side which was an additional feature that crept into the final image due to misunderstanding of the problem statement. These extra features in the surroundings and the increase in corners detected added to the ease of stitching the images as compared to the Latino Student Centre mosaic.

Figure 6: Images of wall for stitching

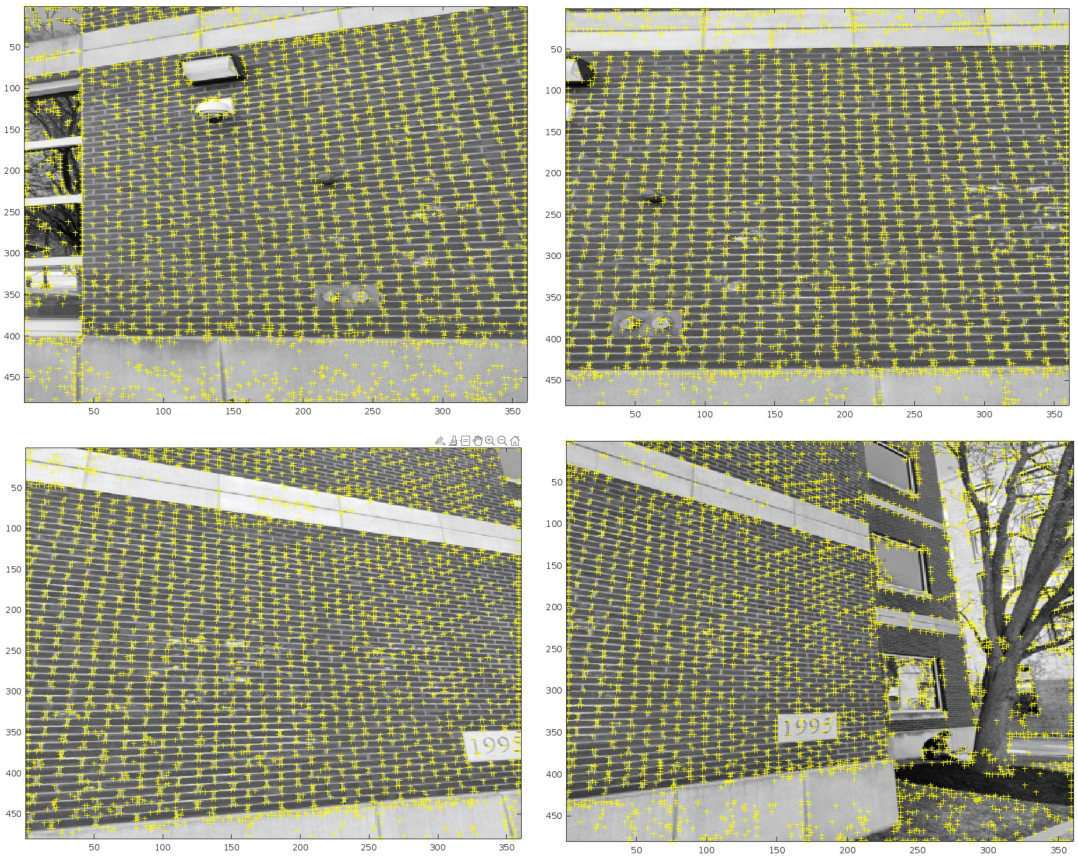

Figure 7: Harris corner detection on wall images

Figure 8: Cinder block / Brick wall final stitch

## Mosaic of self-selected Graffiti

By comparing the figures from 50% overlap and 15% overlap, we can observe that the mosaicing method yielded excellent results for both 50% and 15% picture overlap. Despite the 15% overlap example having fewer features, the program was still able to create seamless panoramic photos by utilizing image features. We can notice that the final image stitch of the 15% overlap images is bigger. This is because of human error where while collecting images for 50% overlap, the camera was not in the center of the frame and there are more images to one side of the camera leading to empty space on the other side while stitching the image. However, the overall result was smoother when the 50% overlap mosaic was used.

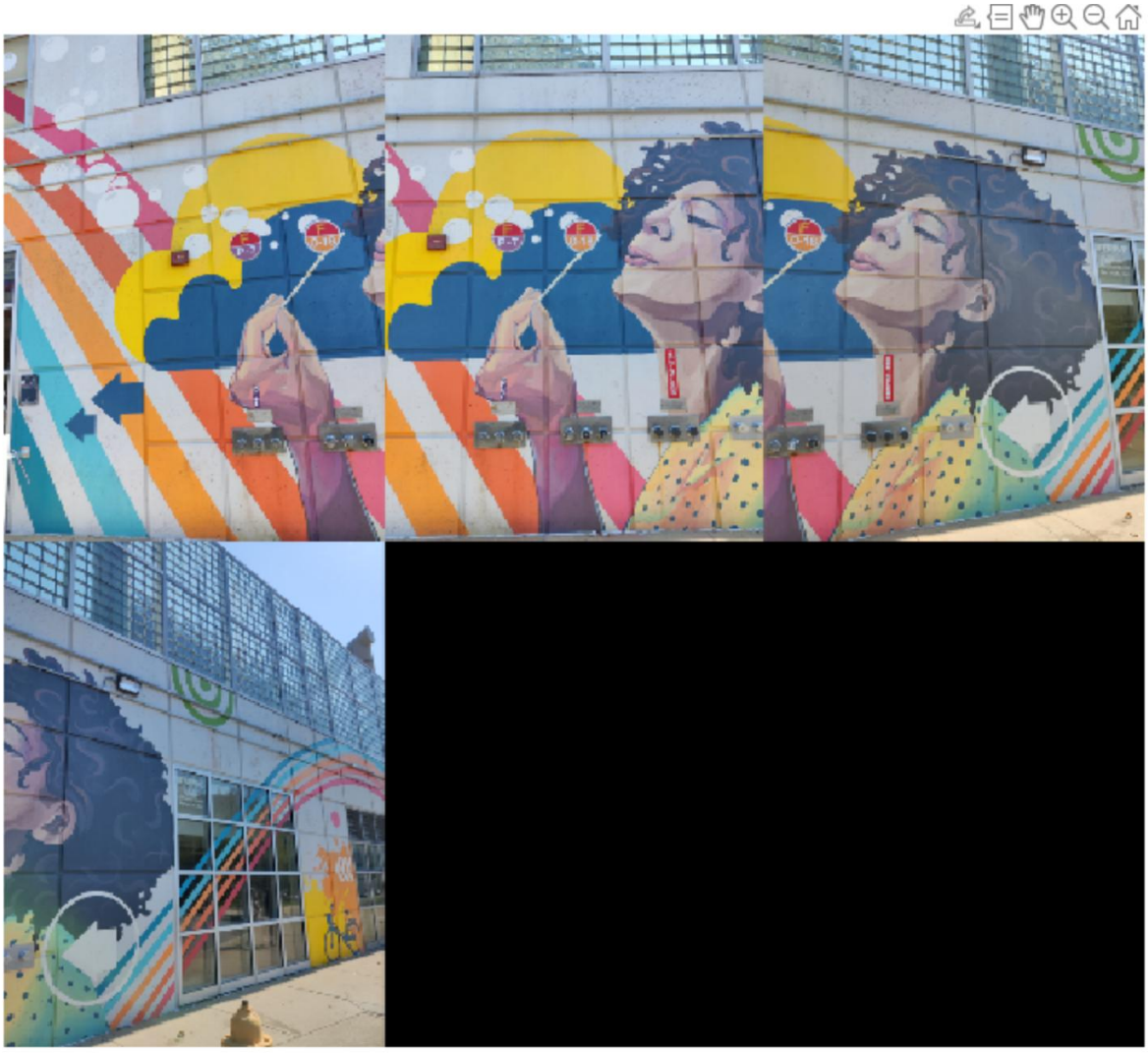

Figure 9: Images for 50% overlap

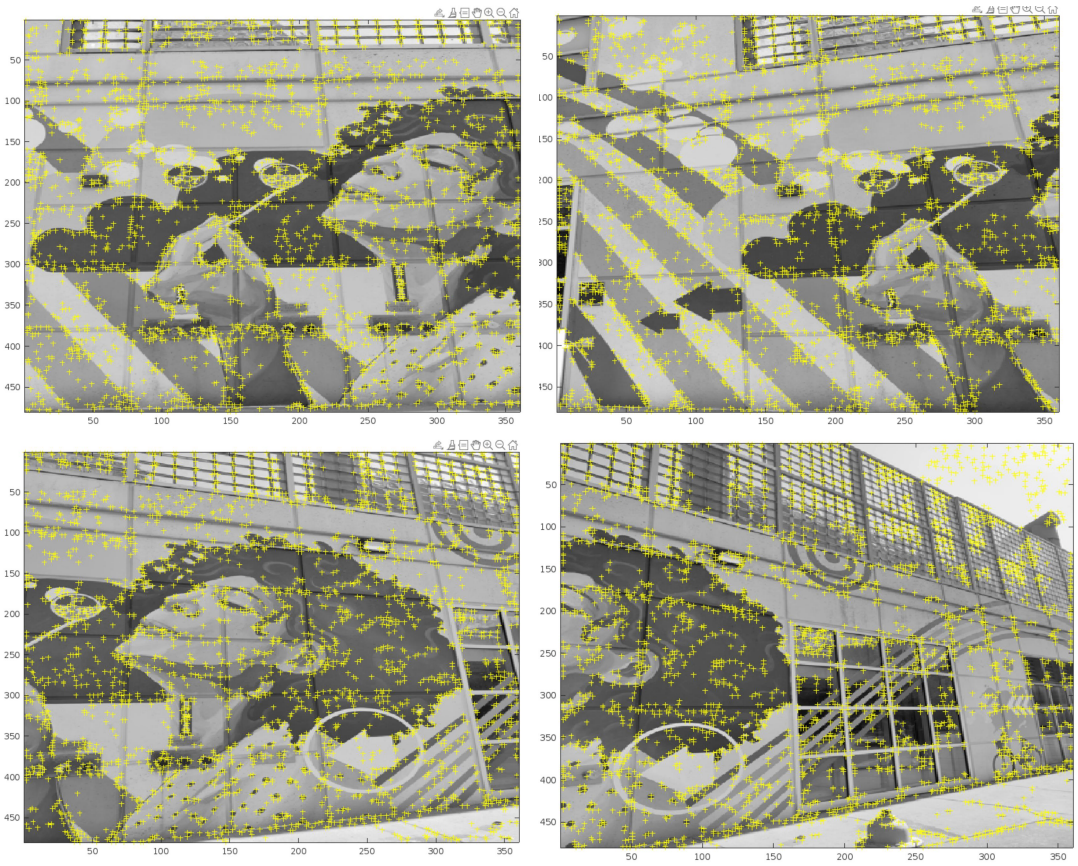

Figure 10: Harris corners on 50% overlap images

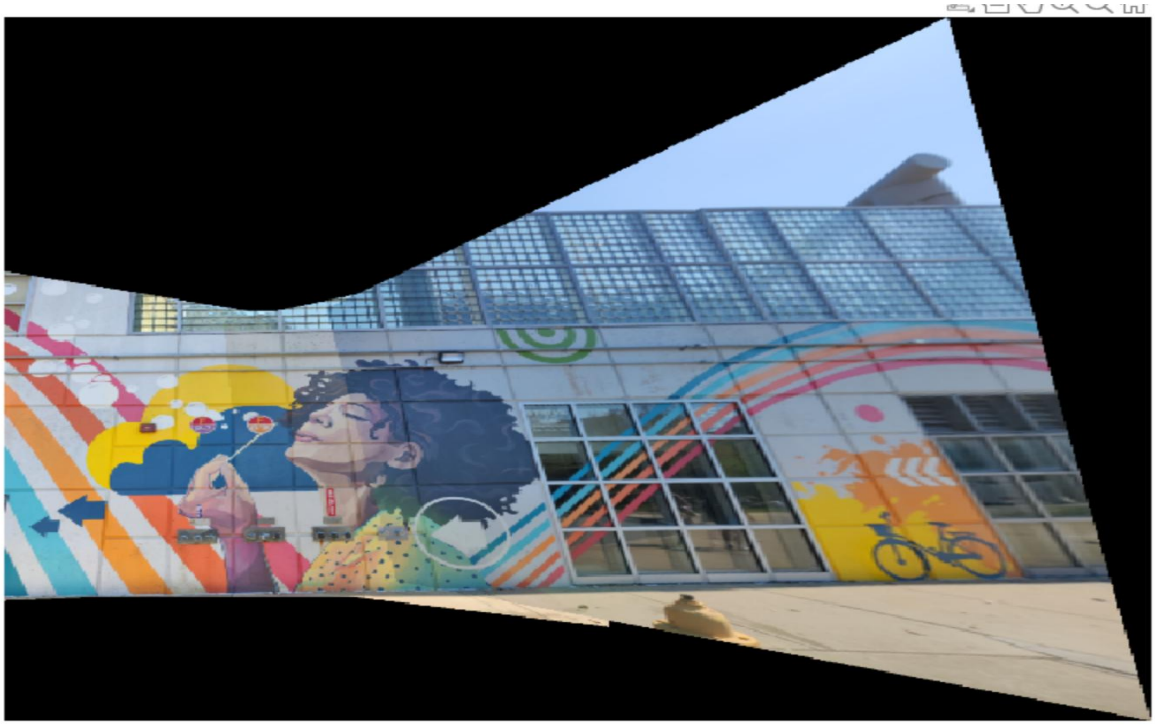

Figure 11: 50% overlap final stitch

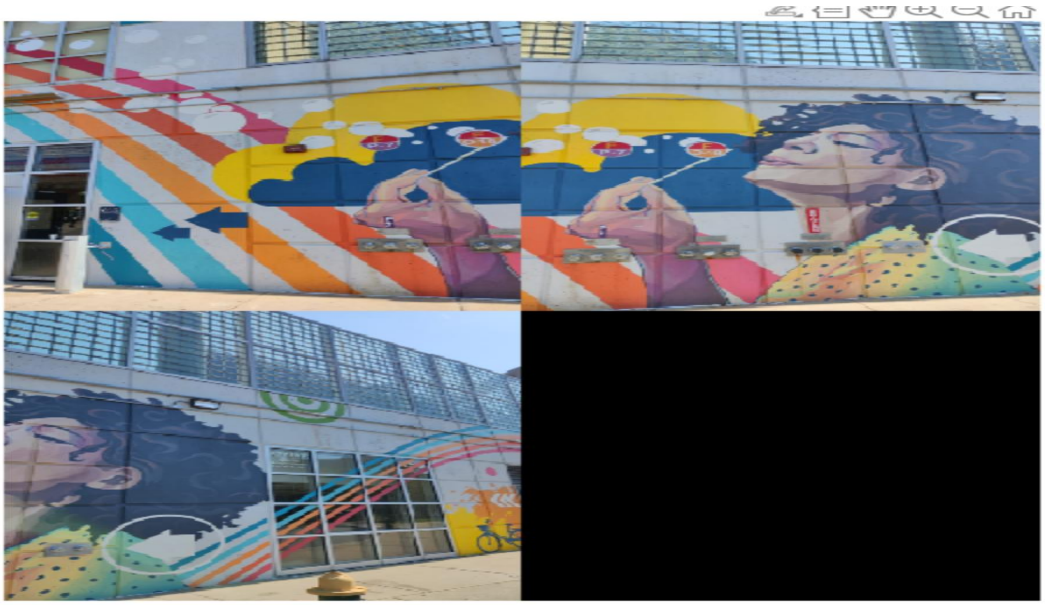

Figure 12: Images for 15% overlap

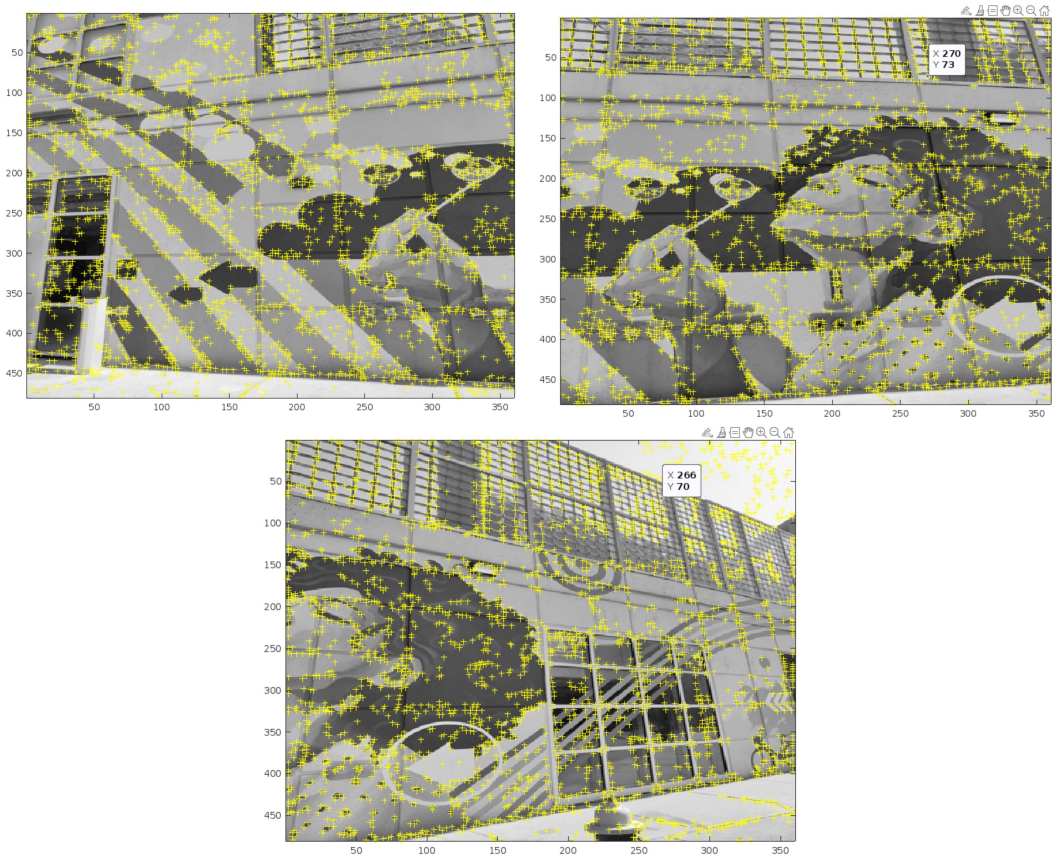


Figure 13: Harris corners on 15% overlap images

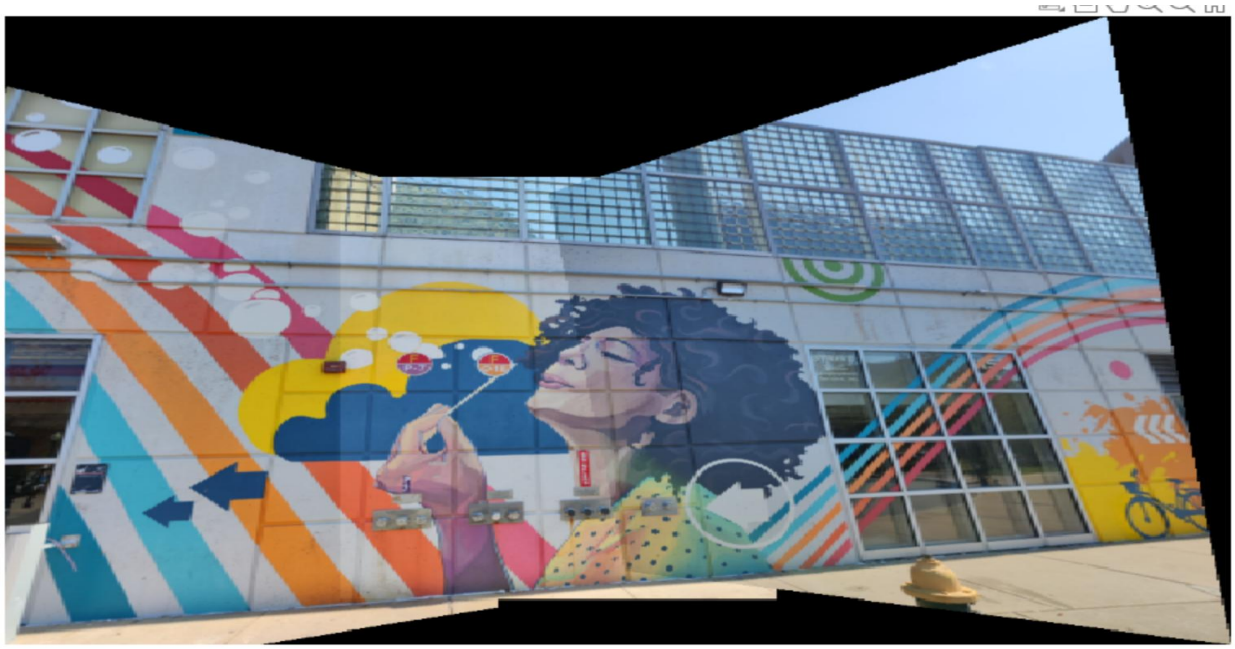

Figure 14: 15% overlap final stitch

## Conclusion

In conclusion, the Harris corner detector technique, which identifies corner features in an image based on changes in pixel brightness, and image mosaic algorithms like ICP, used to stitch together multiple photos to create panoramas, are effective methods. Sufficient overlap between the photographs of the subject, such as a mural, is crucial for successful image mosaicing. Understanding which scenes or images perform well for image mosaicing is important for obtaining optimal results.

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