

Camera Calibration

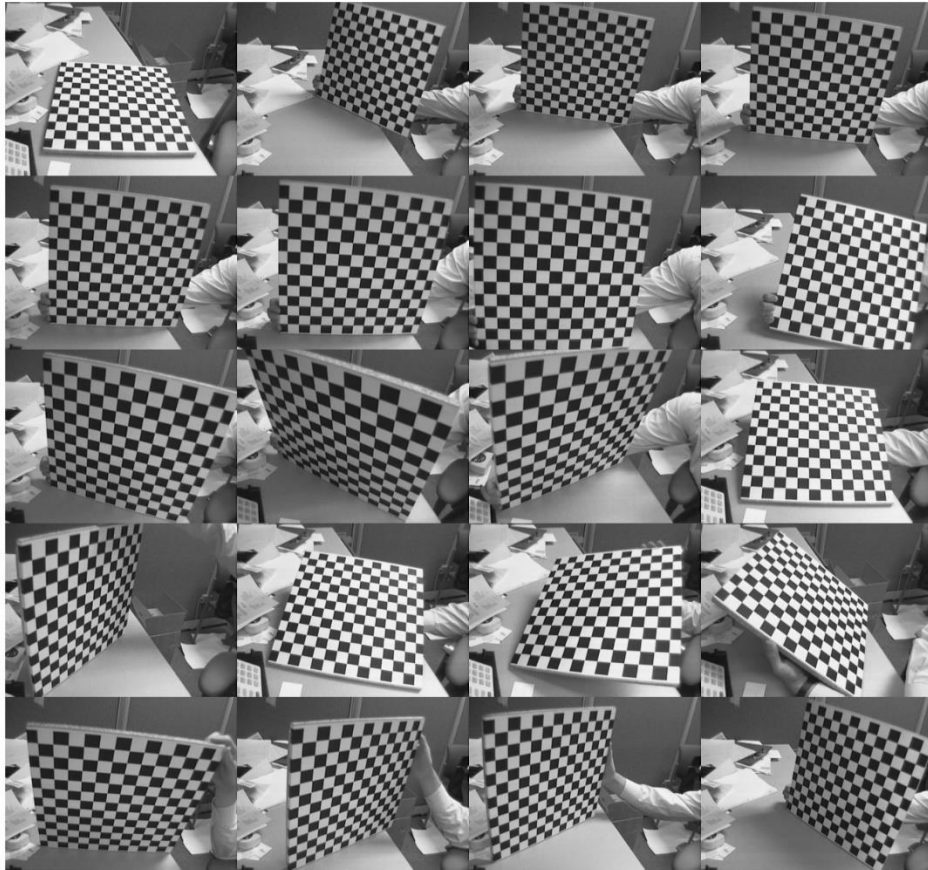


Figure 1. Image used for camera calibration

After processing all 20 images by using camera calibration tool.

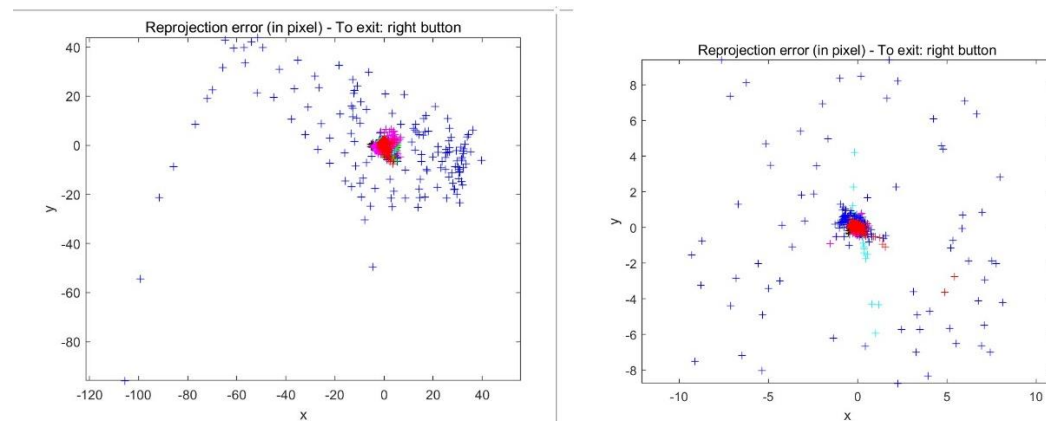


Figure 2. Calibration error analysis before and after

The calibrated result is showed below.

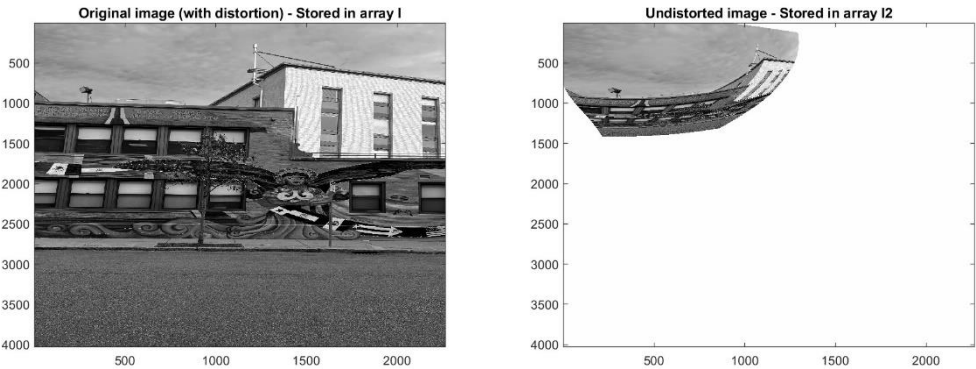
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Calibration results after optimization (with uncertainties):

Focal Length:      fc = [ 624.82239   621.58074 ] +/- [ 15.68946   16.56992 ]
Principal point:    cc = [ 301.22565   256.88574 ] +/- [ 22.69134   21.51315 ]
Skew:              alpha_c = [ 0.00000 ] +/- [ 0.00000 ] => angle of pixel axes = 90.00000 +/- 0.00000 degrees
Distortion:         kc = [ -0.42966   0.61556   0.01203   -0.02103   0.00000 ] +/- [ 0.10374   0.35870   0.00599   0.00523   0.00000 ]
Pixel error:        err = [ 7.07148   4.36081 ]

Note: The numerical errors are approximately three times the standard deviations (for reference).
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Figure 3. Calibrated parameter

The image calibrated before and after are showed below:



The image ready to stitch together is showed below.

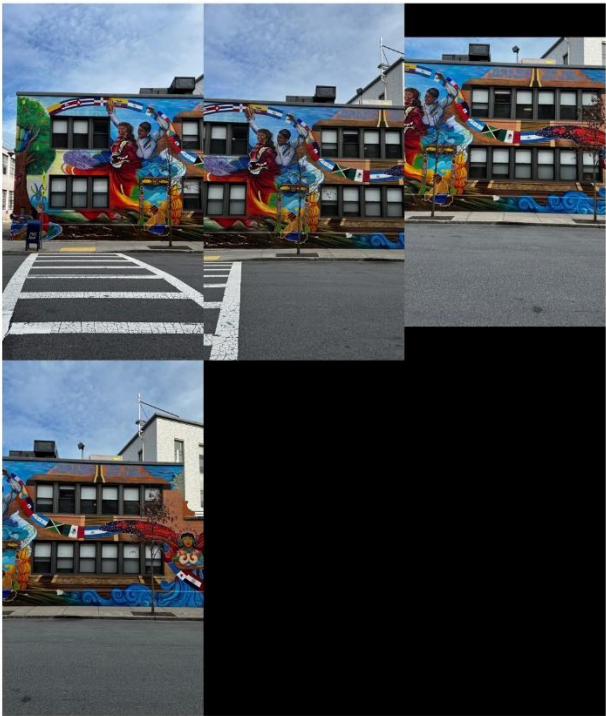


Figure 4. Images ready to stitch

After Harris corner detection, the result is showed below.

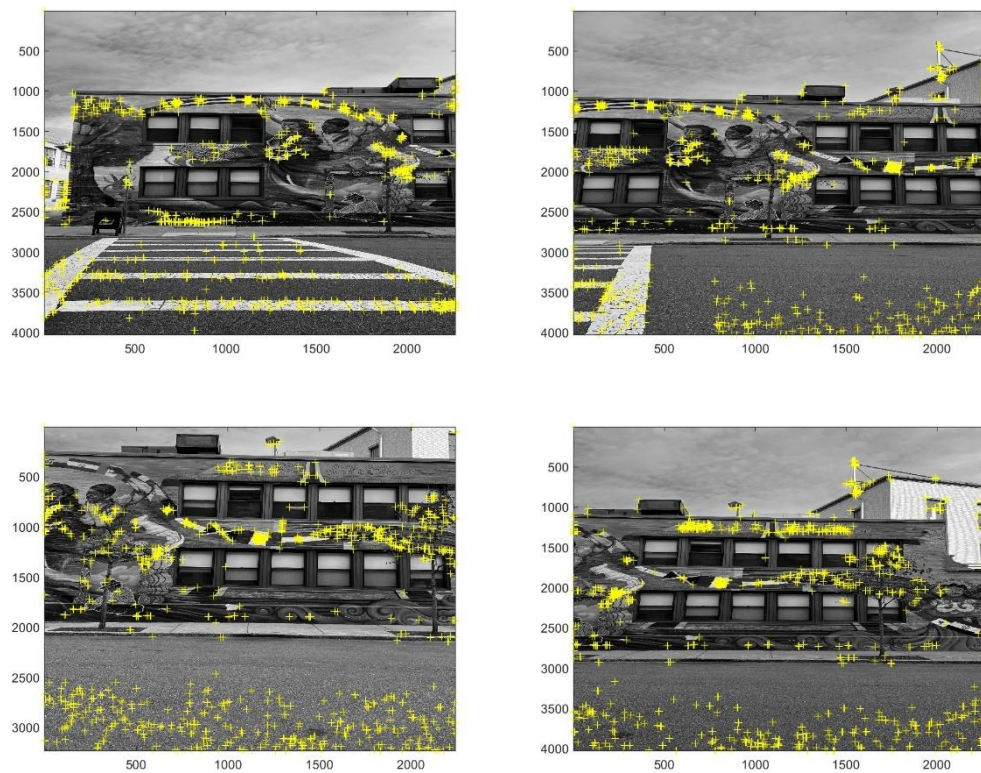


Figure 5. Harris distribution

The result shows that the most points of interest are on the ground, some of them are on the mural, some are on the building.

The stitched panorama outcome is showed below.



Figure 6. Stitched panorama

As for brick wall, the original image for stitching is showed below.

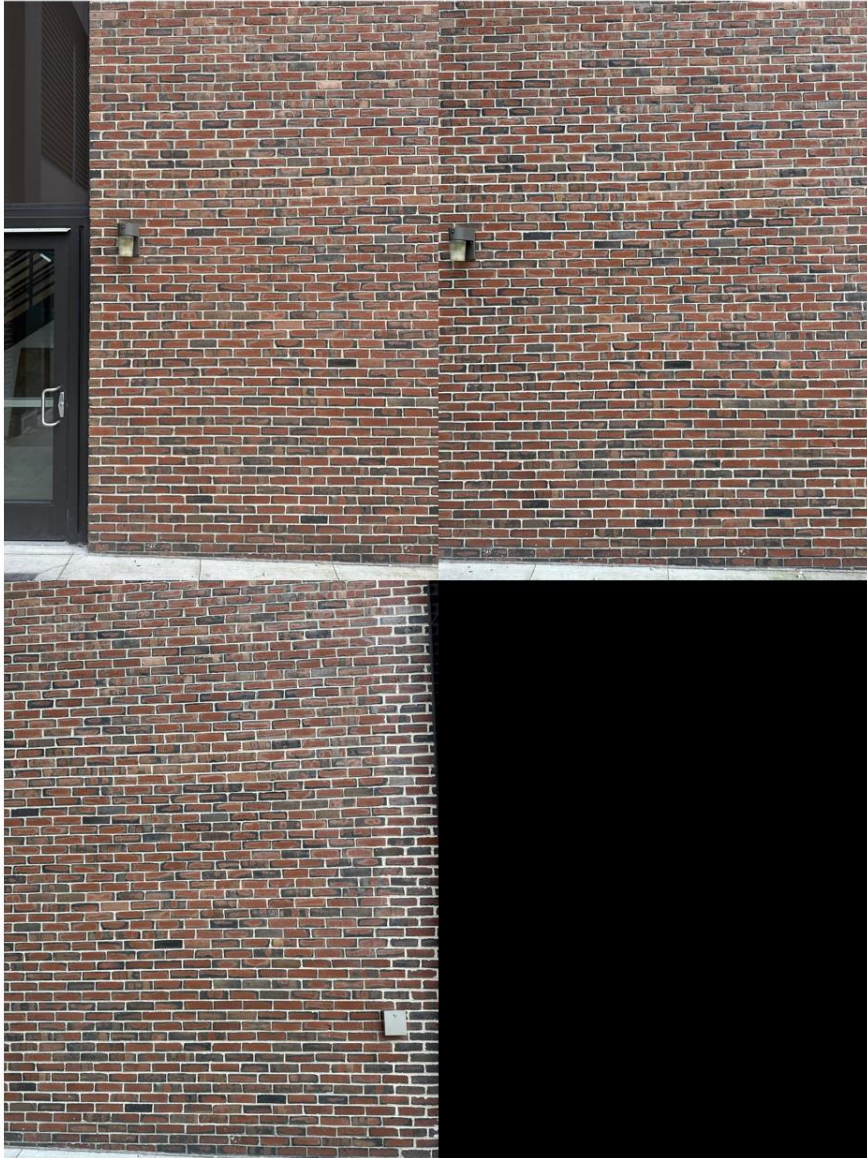
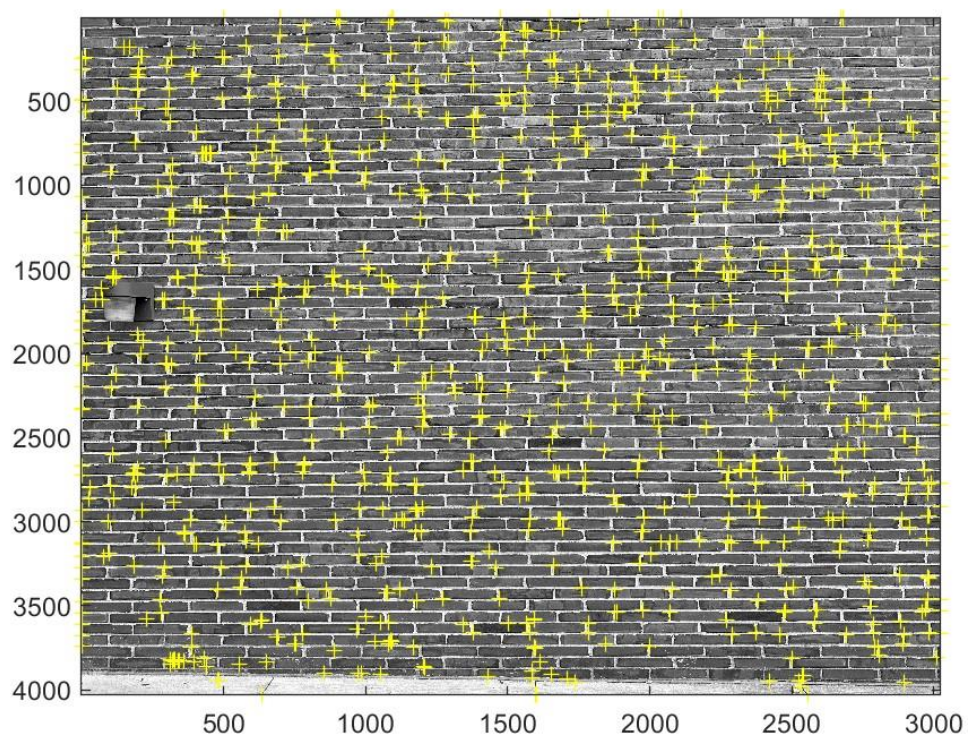
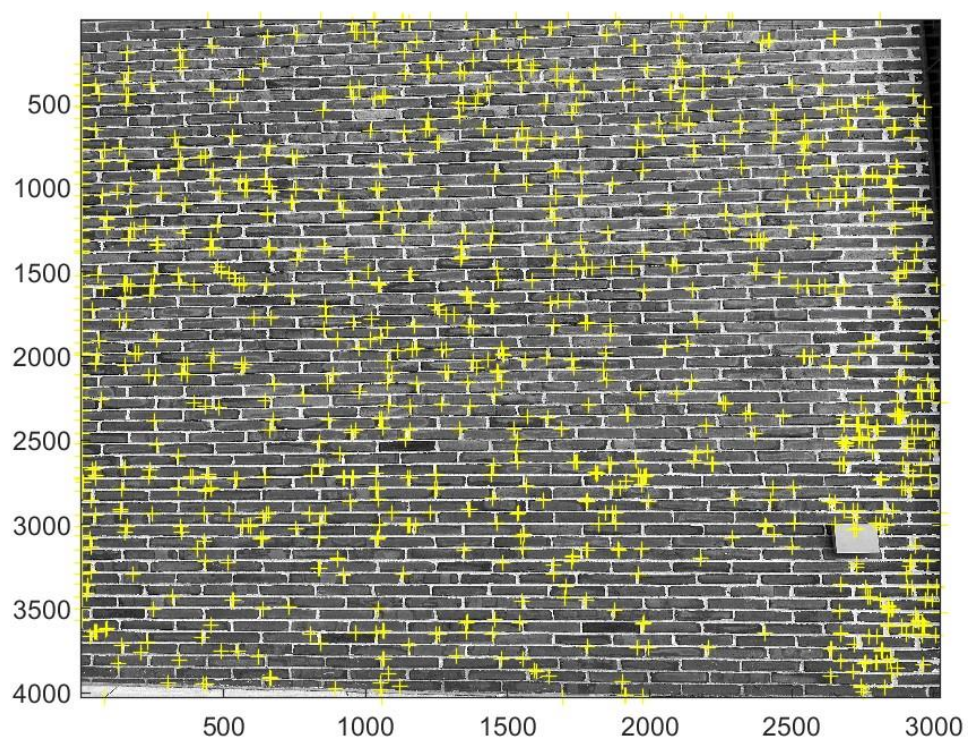


Figure 7. Brick wall ready to stitch
After that, the Harris corner detection algorithm gives.



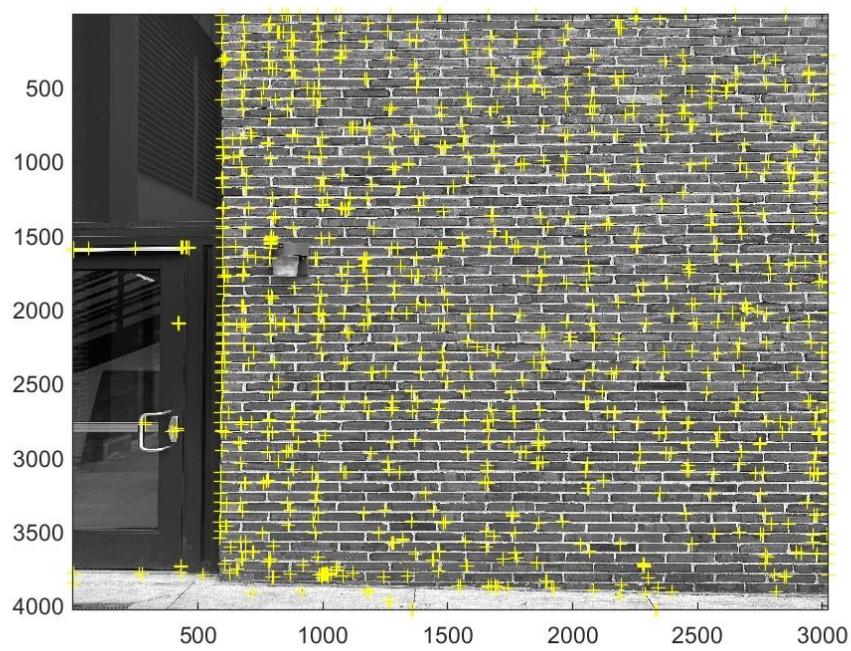
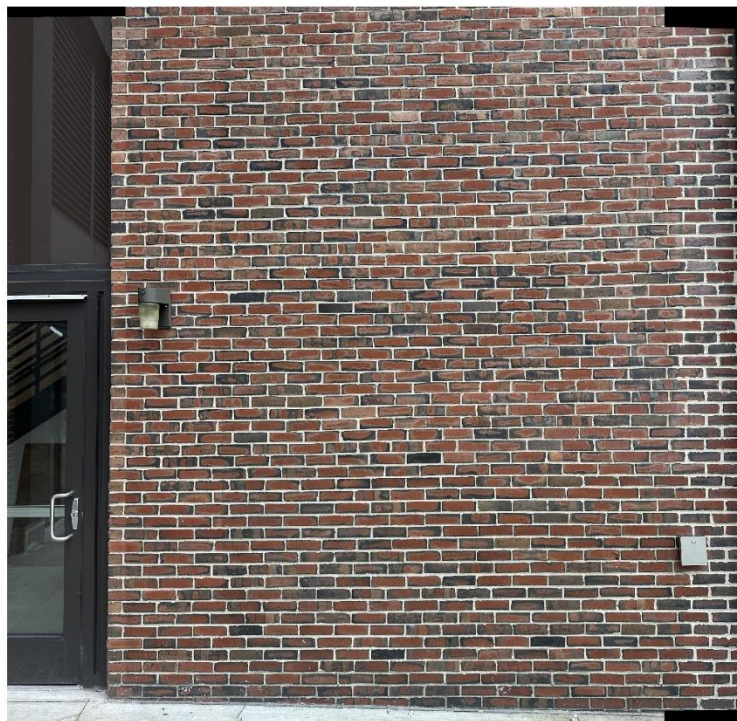


Figure 8. Harris corner detection algorithm for brick wall
As the Harris corner detection results shows. Most points of interest are on the brick wall corner/edge. This will make the image stitch easier. The stitched result is showed below.



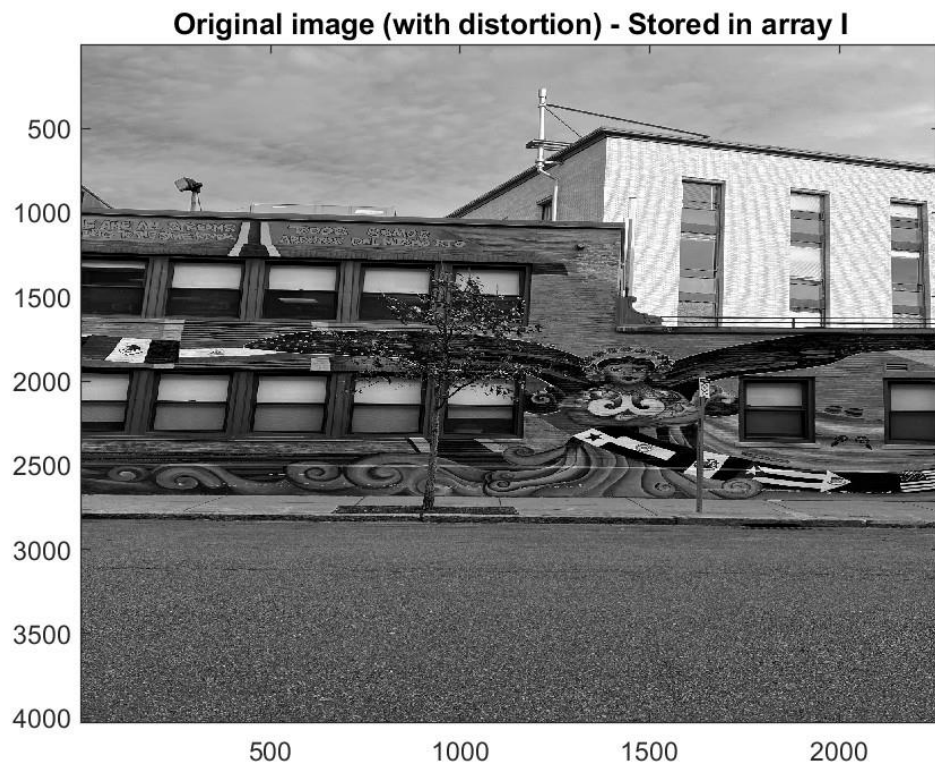


Figure 9. Stitched brick wall

Comparing to LCS panorama, the brick wall panorama looks better. It has less noise and it has no conflicts points. The reason for that, maybe due to the Harris detection. In the LCS process, most Harris points of interest are on the ground, there are only few points on the mural. In the brick wall process. Almost all points are on the brick wall contour. That makes the stitching process easier.

With 15% overlap. The panorama outcome will become uneven. In the result showed below, it is easy to see that the building is twisted. The building edges are not align to each other. Therefore, the result is not ideal.



Figure 10. Harris 15% overlap panorama

With 50% overlap. Referring to the brick wall panorama (figure 9). Most of these are overlapped. And most points of interest have repeated each other. The conclusion is that, if less overlapped Harris corner. The panorama stitched will not be ideal and the result will become uneven. However, with 50% or more overlap, the image will easily revert to the original.