Chapter 7
Experimental Results

7.1 Introduction

In the previous chapters, several techniques for the image stitching process are introduced to combine images together successfully. In this chapter, the applications of the image stitching process will be shown with experimental results.

7.2 Scenery Resolution Enhancement

One of the image stitching process applications is scenery resolution enhancement. Because the spatial limitation of digital cameras, it can't contain too much scenery details by capturing a single image. Therefore, the image stitching process can breakthrough the limitation by separating scenery into several parts and capturing them respectively. Subsequently, the proposed image stitching process is employed to combine these images one by one such that the scenery can be obtained with more details by higher resolution.

As shown in Figure 7.1 and Figure 7.3, two scenes are taken as the examples for the proposed image stitching process in this thesis. Each scene is separated into nine blocks and captured by the camera. Further, the proposed image stitching process is applied to each example in different stitching directions. Figure 7.2 and Figure 7.4 respectively show the image stitching results of each example after applying the proposed image stitching process. It is obvious that each input image as source image can change its shape to match up the previous combined image, target image, and the proposed image stitching process can successfully combine two images together. The final stitching result can be obtained from the last combined image.

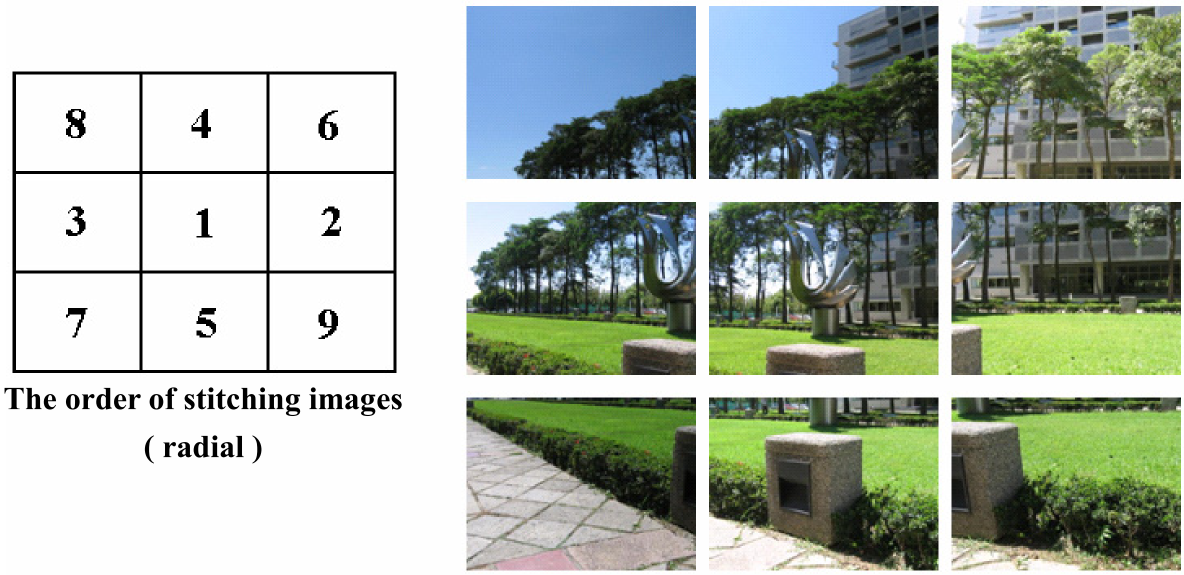
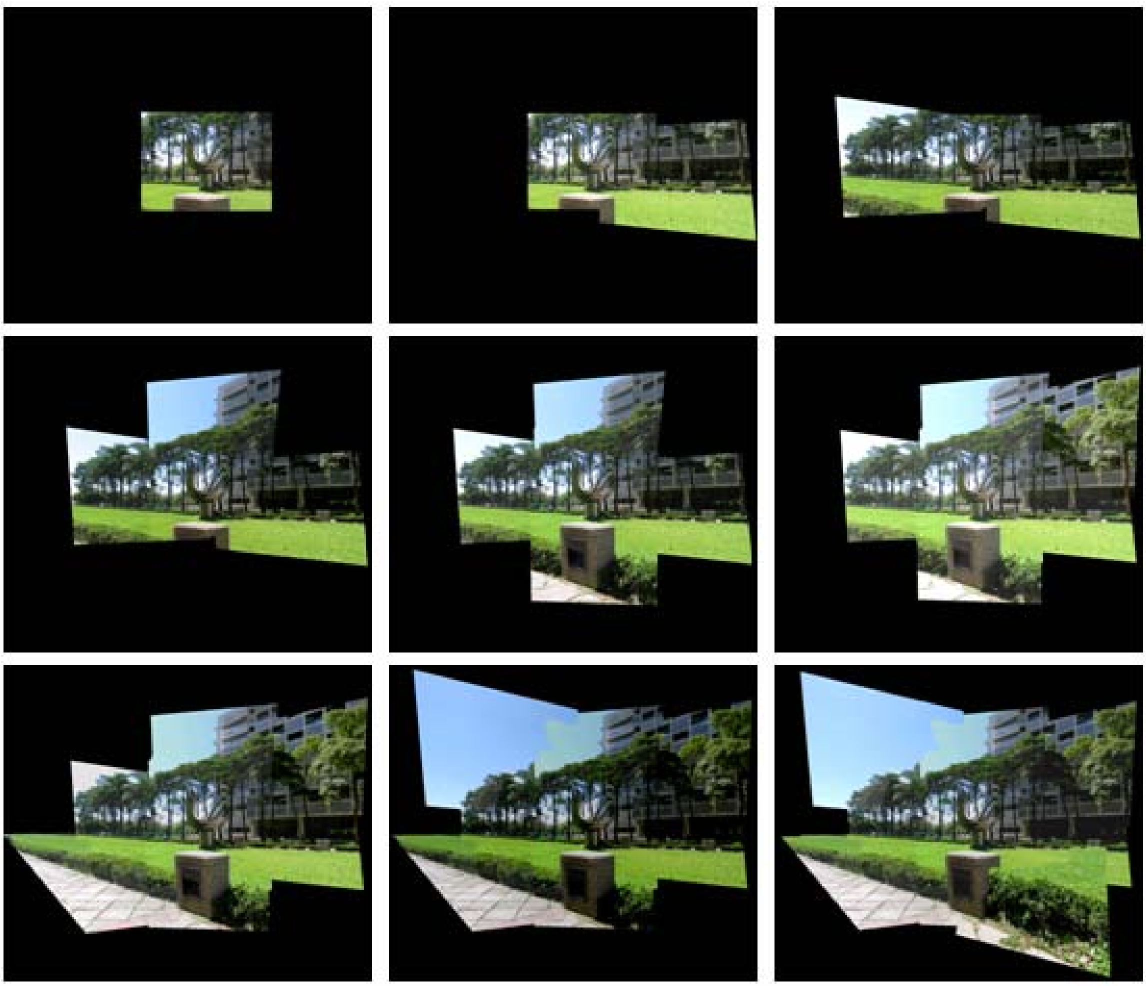


Fig 7.1 The input images stitching in radial direction for the proposed image stitching process



1	2	3
4	5	6
7	8	9

Fig 7.2 The results of applying the proposed image stitching process

9	8	7
2	1	6
3	4	5

The order of stitching images (counterclockwise)

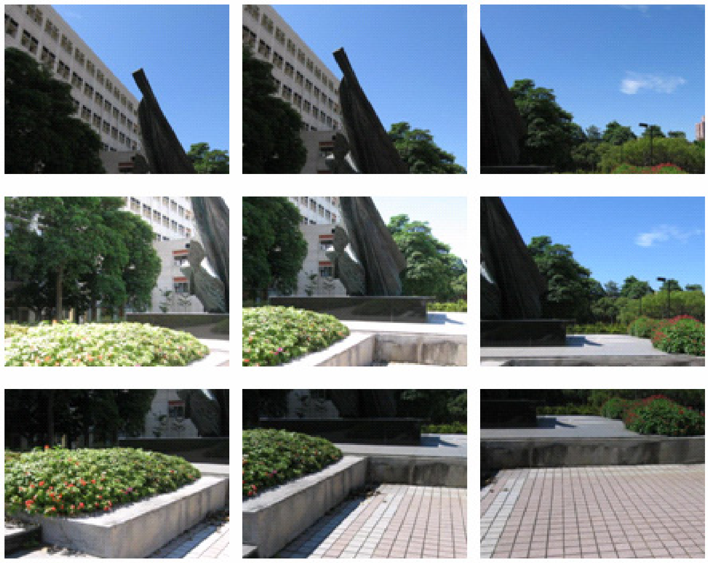
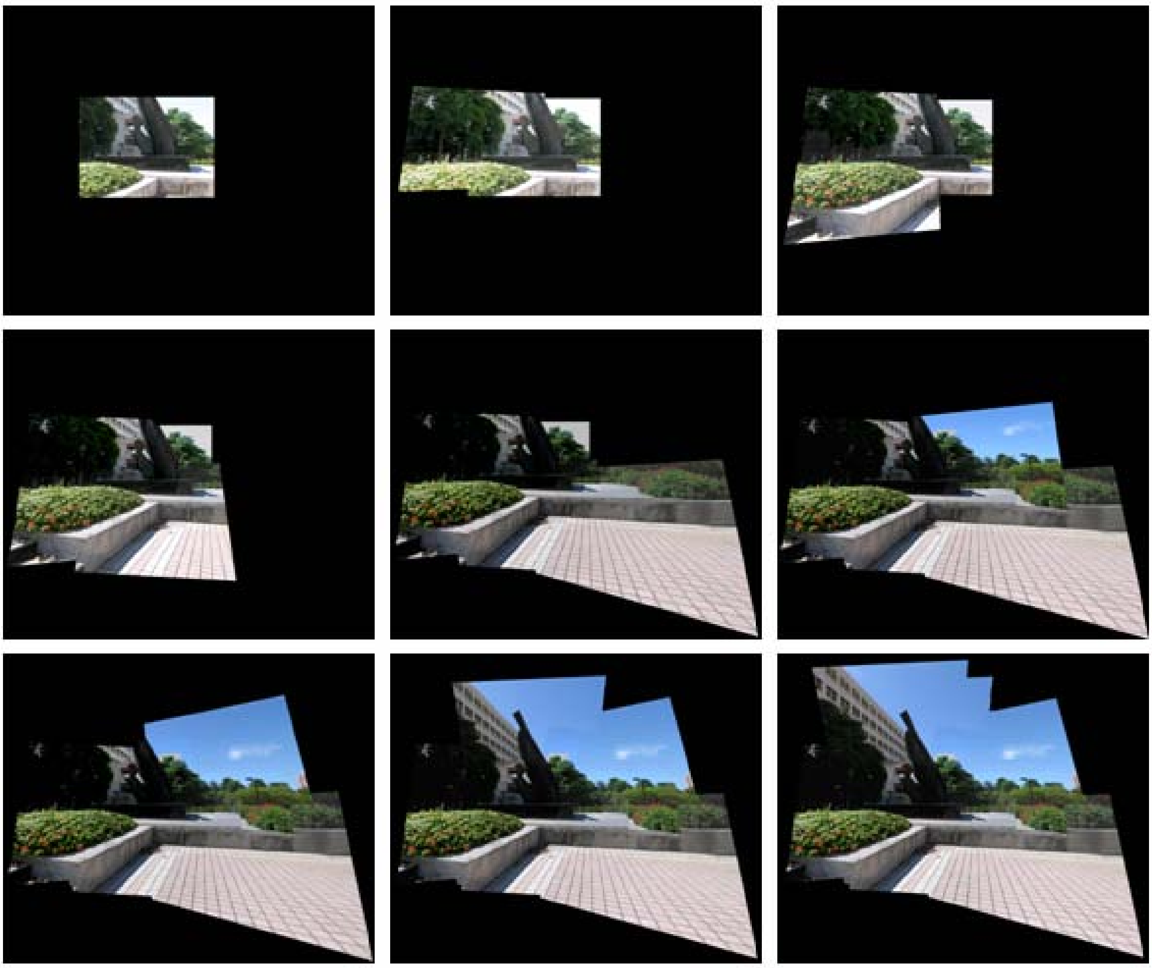


Fig 7.3 The input images stitching in counterclockwise direction for the proposed image stitching process



1	2	3
4	5	6
7	8	9

Fig 7.4 The results of applying the proposed image stitching process

7.3 Panoramic Construction

Different from the scenery resolution enhancement, panoramic construction is one of other applications by image stitching process to achieve the wide sight or all sight panoramic construction without reducing the resolution.

7.3.1 Wide Sight Panoramic Construction

Wide sight panoramic construction uses a video containing a series of image frames as input for the proposed image stitching process to obtain a wide sight panoramic image. The middle image frame is taken as the start frame and combined with its neighbor image frames one by one. Finally, the last result of combined image will be obtained as the wide sight panoramic image. As shown in Figure 7.5, the image frames from video with three frame-shift are obtained as the input images for the proposed image stitching process.

Fig 7.5 The input images frame from video for the proposed image stitching process

As shown in Figure 7.6 and Figure 7.7, the twelfth image in Figure 7.5 is taken as the start image frame and the results of the combined images are obtained. The last enlarged image in Figure 7.7 is the final result of constructing the wide sight panoramic view in a single image.

Fig 7.6 The stitching results after combining the first twelve image frames

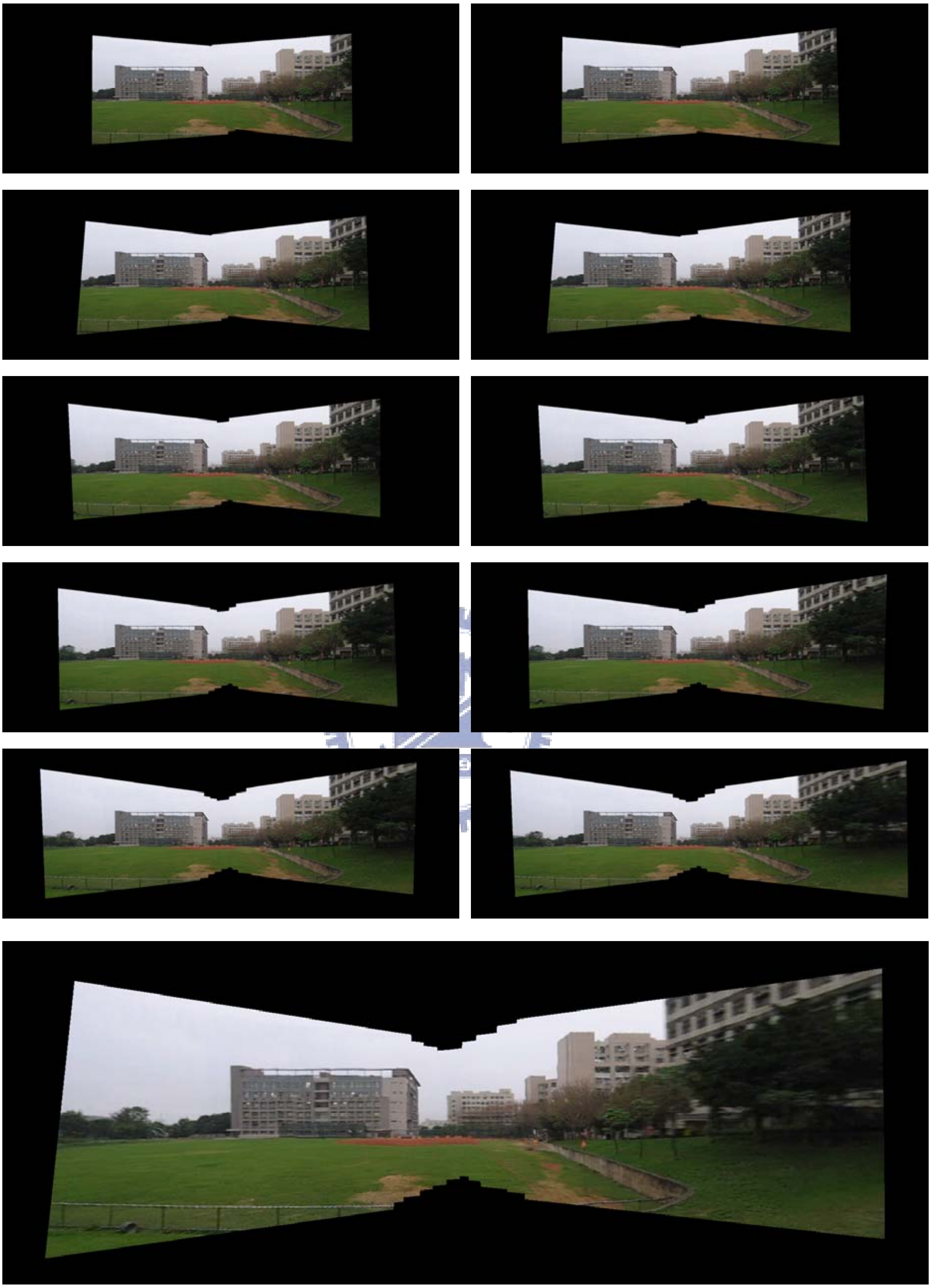


Fig 7.7 The stitching results after combining the thirteenth to the last image frame

7.3.2 Surrounding Panoramic Construction

Surrounding panoramic construction gathers several images as a group for image stitching process to obtain a part of panoramic view in 360 degrees each time. The advantage of using this method is that it generates a part of panoramic image each time by stitching parts of all the images to avoid great changes of the image shape such as Figure 7.7. Figure 7.8 shows the seventeen images captured in 360 degrees and then take every three serial images as a group for the proposed image stitching process to obtain the shifting frame panoramic images in Figure 7.9 that each combined image contains a part of whole panoramic sight.

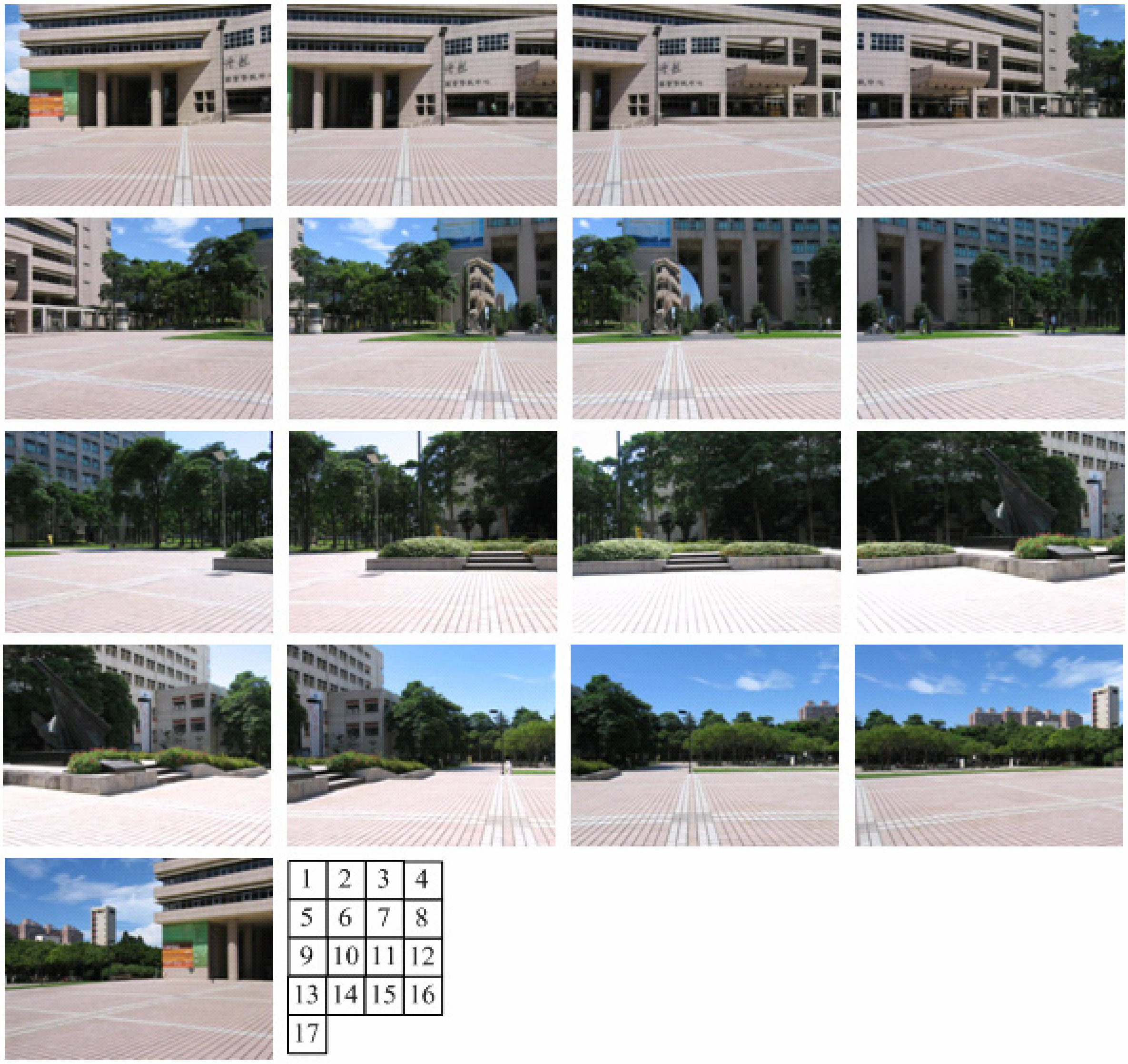


Fig 7.8 The input images captured in 360 degrees for the proposed image stitching process

Because each image group contains the different three images with different overlap region, the results of the combined images are obtained with different shapes. After acquiring all the combined images, cut them into the rectangular form to obviously realize the shift frame all sight panoramic construction as shown in Figure 7.9.

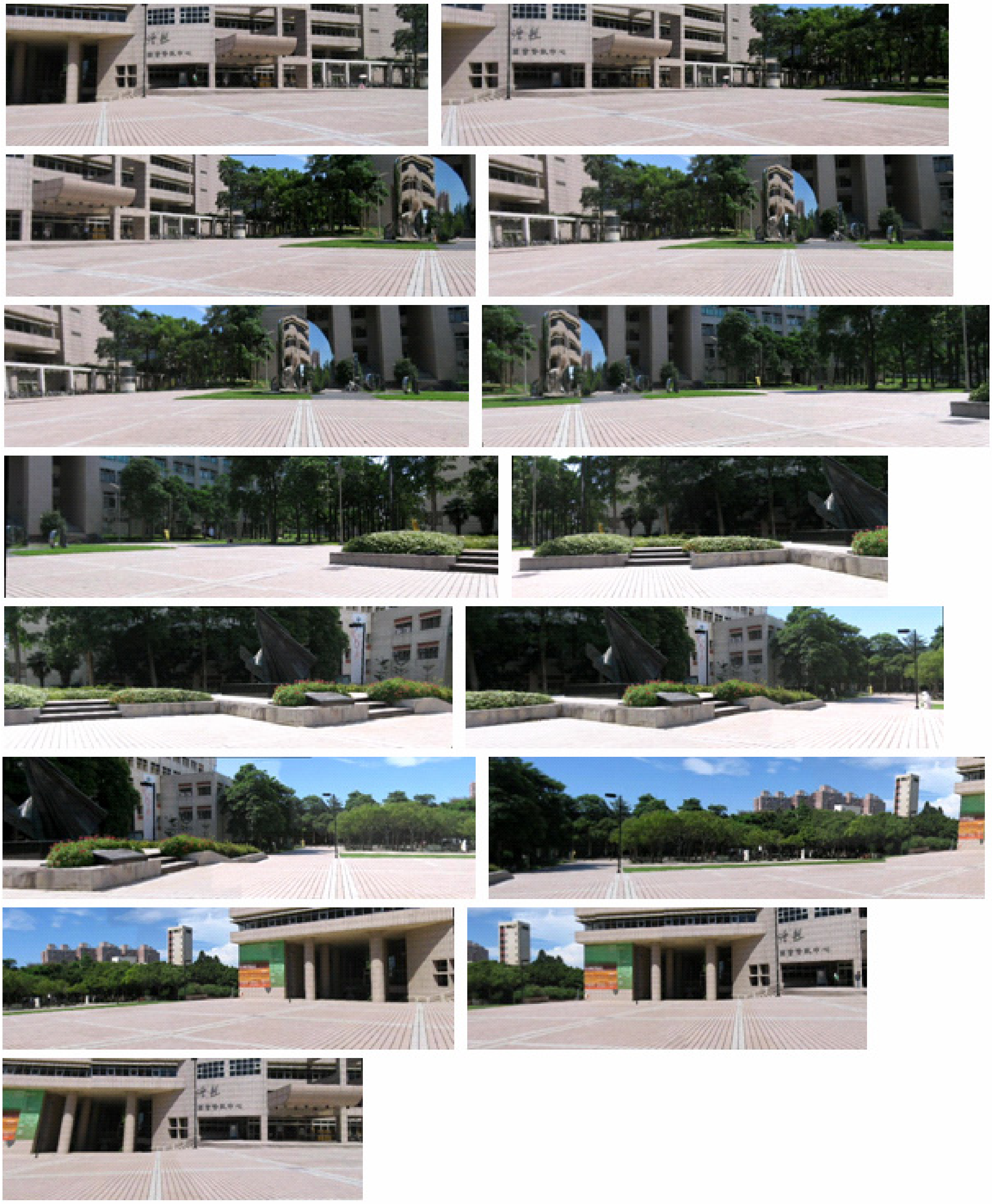


Fig 7.9 The results of combing each image group by the proposed image stitching process

7.4 Unsuitable Stitching Conditions

7.4.1 Color difference

Although the proposed image stitching process can successfully combine several images together to achieve the goals of resolution enhancement and panoramic construction, the sun light reflections would sometimes influence the image stitching performance. The images in Figure 7.10 are the stitching results of Figure 7.2 and Figure 7.9. The color difference along the border can be seen because the images are captured under different sun light reflections which result in obvious color change. Fortunately, such color difference seldom happens because it is often smoothed by the image blending method stated above.

Fig 7.10 The great color difference makes the borders obvious

7.4.2 Position Mismatching

Although the mapping model and derived appropriate mapping parameter vector can change the shape of source image to match target image with the most of correct matching pairs, it is inevitable that a few correct matching pairs are omitted and unfit to the derived mapping parameter vector; sometimes the unfitness causes position mismatching just like the edges circled in the images in Figure 7.11 which are the stitching results of Figure 7.2 and Figure 7.9.

Fig 7.11 The position mismatching cases that generate the discontinuous edges

7.4.3 Failed Stitching

In Section 4, it is known that the choice of the mapping parameter vector is based on the correctness of matching pairs obtained by normalized cross-correlation method. Unfortunately, the decision of matching pairs might be influenced by the brightness or photograph angle. Therefore, too many wrong matching pairs are resulted and make the mapping failed. As shown in Figure 7.12, it can be seen that most of the matching pairs gather in the overlap region of the source image but disperse everywhere in the target image. Hence, the wrong mapping parameter vector would be obtained and lead to the failure of image stitching process. However, the failed stitching condition does not often occurs, so the optimal mapping method stated in Section 4 is still feasible.

(a)

(b)

Fig 7.12 The failed case of the proposed image stitching method (a) the source image, and (b) the target image