Panorama Image Stitching based on 'SIFT' Feature Points

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***Abstract*—In this paper we address the panorama image stitching method, which appropriately applicable in any images. Proposed stitching method use scale invariant feature detection algorithm to generate a proper stitching image regardless of any input images. Proposed method has a three main parts: image matching procedure, removing outlier and image blending. Among the panorama images, we extract the feature points by using a SIFT method. Because the SIFT feature extraction method has a benefit in scale variant image and variant illumination condition image. Between two image pairs, it has a chance that feature points are incorrectly matched. To find out the correctly matched feature points, we propose the robust RANSAC algorithm. Finally to complete the panorama image we use the weighed alpha blending method. From the experiment result, we confirm that the proposed stitching method efficiently work in any input images.**

Keywords—Panorama image; Stitching; SIFT; Alpha blending;

I. INTRODUCTION

Among the cell phone user, about 70% of people use smartphone. Almost of smartphone has a panorama image capturing system. As well as smartphone, many digital cameras and camcoders can make a panorama images [1]. The panorama images will have a worth, when the images are consecutive. Even in vehicle the AVM (around view monitoring) system use a panorama image, which take a picture around the vehicle by using a 4 cameras. To display the vehicle around images, it also need a stitching algorithm.

Image stitching is focusing on the relationship of consecutive image or image pairs. Image blending can eliminate the image noise and various illumination effects that caused by multiple images. Because of the geometrical error and color inconsistence, that kind of error can effect on the stitched image result.

In this paper, we use the SIFT (scale invariant feature transform) method to find out the feature points among the multiple images. SIFT feature detection method literally has an advantage in scale variant or illumination change condition. From the feature points of multi images, we can derive the homography matrix which defined the geometrical relationship between images.

While finding out the homography matrix, incorrectly matched feature points pairs affect to the image relationship. Incorrectly matched feature points are called outlier. The outlier feature points removed by RANSC (random sample consensus) method. RANSAC can be able to solve the motion relation between the feature points of image pairs efficiently and correctly.

Based on the above procedure results, the image pairs can has an obvious seam line in geometrical relation. Even though the incorrect feature matching points are removed, between the two images the boundary region still ambiguous. The exact boundary area of the images does not derived from the homography matrix. To solve those problem, in this paper use the alpha blending method. The alpha blending can properly mix the two image pairs depending on the weight of right or left side image.

To prove the efficiency of proposed stitching method, we use the captured image which in our campus. For each stitching procedure we use five consecutive images. The stitched image which using a proposed method has quite acceptable performance even we use multiple images. Because of the SIFT feature detection can correctly find out the feature point in any illumination condition that the homography matrix also correctly derived.

II. IMAGE STITCHING

A. Feature extraction

To stitch the panorama images, firstly find the feature points between the image pairs. In this paper we use the SIFT feature point detection method. The SIFT feature detection method is the supplement of Harris corner detection method. Because the Harris corner detection method has a problem with the image scaling. To solve that kind of problem, SIFT use the DoG (difference of gaussian).

To generate the Dog, perform the down sampling about the input images. And piled up that images then finally get the image pyramid. For each image size the corner points are detected and if that points are overlapped then that point can be a SIFT feature points.

The Fig. 1 represent the input images for stitching and Fig. 2 show the SIFT feature detection results. In Fig. 2-(a) even that picture captured in lightless circumstance, the feature points are correctly extracted from the images

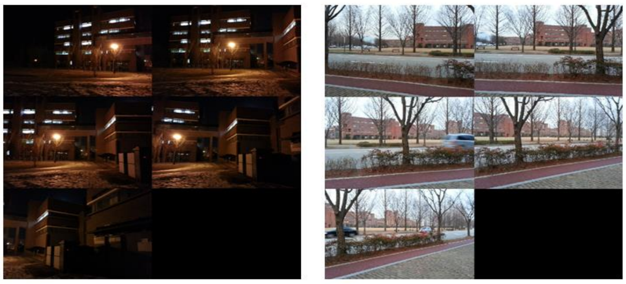

Fig. 1. Input images for feature detection

We also apply the SIFT feature points detection method to another image set to find out the geometrical relationship among the image pairs.

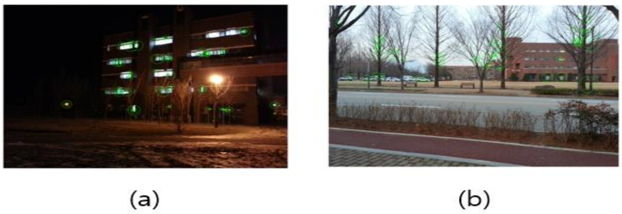

Fig. 2. Feature detection results

B. *Robust RANSAC method*

We propose the robust RANSAC method to supply the conventional RANSAC[2] method. Usually to test the correctness of feature points, randomly extract 3 points. But our algorithm use 5 random points to generate the optimal inlier feature points matching result.

Firstly connect randomly selected 5 feature points and find out the closest feature points on connected line. If that points satisfy the criterion, then iteratively perform the previous step. And then calculate the transformational matrix for geometrical relationship. Testing that matrix for all possible feature points, and if that matrix satisfy all of the feature points then repeating the upper steps for N times. Then finally we can get the correctly matched feature points.

C. *Alpha blending*

Usually used blending method [3] neglect the image illumination condition. So even it has different influence for each images it does not reflected to previous method. So in this paper we use alpha blending for image stitching. Alpha blending method represented in (1).

In (1) the alpha has different value depending on the weight of left and right images. And also the boundary region has a RGB value to compute about all pixel values. So by calculating the (1) we can automatically blend the image pairs.

$$I_L \cdot (R,G,B) \cdot (1-\alpha) + I_R \cdot (R,G,B)\, \alpha = 1 \qquad (1)$$

III. STITCHING RESULTS

To prove our method we use five consecutive images which capture at night and daylight conditions. We can check that the proposed method is effective in consecutive images captured in any situations as represented in Fig. 3. The outliers could be efficiently removed because of the use of robust RANSAC algorithm compare to conventional RANSAC algorithm.

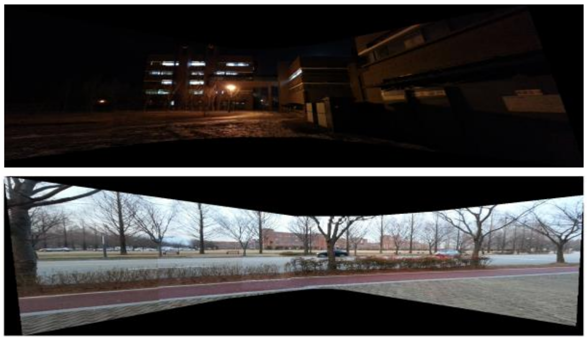

Fig. 3. Panorama image stitching results

IV. CONCLUSION

In this paper we propose panorama image stitching method using SIFT feature detection. Also to improve the RANSAC performance, we propose the robust RANSAC method. As a result of that we can correctly find out the homography matrix and applying the alpha blending method as a final step. From the experiment result we can confirm that our proposed stitching method properly working well in any input images.

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