TELKOMNIKA, Vol.10, No.4, December 2012, pp. 795~800
ISSN: 1693-6930
accredited by DGHE (DIKTI), Decree No: 51/Dikti/Kep/2010

View Synthesizing for a Large-Scale Object in a Scene

Thin Lai Lai Thein[1], Myint Myint Sein[2]
[1]Information System Department, University of Computer Studies, Yangon, Myanmar
[2]Research and Development Department, University of computer Studies, Yangon, Myanmar
e-mail: tllt55@gmail.com, myintucsy@gmail.com

Abstrak

Sebuah metode kokoh untuk rekonstruksi pemandangan panorama disajikan pada makalah ini. Citra diperoleh dengan menggerakkan kamera ke beberapa sudut pandang. Metode kokoh untuk sintesis panorama ini berbasiskan pendekatan pemosaikan citra. Deteksi tepi dan ekstraksi titik-titik ciri dilakukan untuk setiap citra. Titik-titik fitur diestimasi terhadap dua citra yang berturut-turut dan kemudian dihitung jarak keduanya. Kedua citra ini diintegrasikan berbasiskan pada nilai batas minimum diantara keduanya. Setelah itu, pandangan penuh direkonstruksi dengan menggabungkan citra-citra yang terintegrasi secara beruntun dengan pendekatan pemosaikan citra. Penelitian ini menjelaskan bagaimana membangun keterkaitan fitur diantara citra secara akurat dan efektif. Teknik registrasi citra memberikan estimasi awal untuk membangun keterkaitan cirri-ciri titik. Solusi linier dengan keterkaitan yang handal membuat perhitungan transformasi geometris antara dua citra.

Kata kunci: *pemosaikan citra, gerakan linier, registrasicitra, sintesis pandangan, transformasi geometrik*

Abstract

A robust method for panorama view reconstruction of a scene is presented. The images of a scene are acquired by moving a camera to multiple viewpoints. We present a robust method of panorama synthesizing based on image mosaicing approach. The edge detection and feature points extraction are performed for each image. The corresponding feature points between two successive images are estimated and the between these images is computed. These two images are integrated based on the different of minimum threshold values between them. After that, the full-view of a scene is reconstructed by merging the successive integrated images by developed image mosaicing approach. This research describes how to establish feature correspondences between images accurately and effectively. Image registration technique provides an initial estimation for establishing feature correspondences of point features. The linear solution with the reliable correspondences makes the computation of the geometric transformation between two images.

Keywords: *geometric transformation, image mosaicking, image registration, linear motion, view synthesizing*

1. Introduction

It has long been recognized that the large-scale object and scene reconstruction are the important enabling technology for realistic, large-scale visualization of the world. Realism in simulation is enhanced by accurate modeling of the environment being simulated. A robust method for synthesizing the arbitrary view from multiple images of the large-scale object in a scene is presented. The images are acquired from multiple viewpoints. Feature extraction algorithm is developed for extracting the feature points from each image. Histogram equalization and lighting adjusting are performed to improve the accuracy of feature extraction. The corresponding feature points are extracted among images and find the matching automatically. The major contributions of this system are a large scale object can be generated by integrating the multiple images of an object [1-3].

The large-scale object which can't take the whole view at once and it is impossible to take at remove. It can be solved insufficient distance between camera and object. It can be generated impossible to take the whole scene from obstacle object. In our system, we propose a method for synthesizing the arbitrary view. This approach can be applied to generate the

Received July 24, 2012; Revised September 16, 2012; Accepted September 29, 2012

intermediate view, the full view of large-scale object, 3D virtual views and so on [1]. It is also possible to create the new scene by merging the synthesized views of multiple objects. Then it will be provided to reduce the cost and number of camera in security system by using the synthesizing the arbitrary view of images. After that, the proposed system finds feature point of the image which difficult to detect the corresponding pair points and integrate the very small feature points of the large scale object. The advantage of this process is useful for showing irremovable objects from one place to another at museum.

Some reports have already been presented concerning the research work of the synthesizing the arbitrary view for large-scale virtual environment. S.E Chan and Williams [2] proposed the view interpolation method for image synthesizing by using image morphing technique. Sein *et al.,* [4] presents an approach for reconstructing the arbitrary view of a large-scale object. This presents a new approach for synthesizing the arbitrary view based on the image morphing technique. Takahashi *et al.,* [5] proposed a method for rendering views for large-scale scenes. Thein *et al.,* [6] presented a method for reconstruction the entire view of multiple objects. This method is not only different from arbitrary synthesize view of multiple object but also it can be seen entire view of each object individuality.

2. Image Mosaicing Method

Many problems require finding the coordinate transformation between two images of the same scene. Image mosaicing is important to have a precise description of the coordinate transformation between a pair of images. Feeling strongly interested in the field of immersive environments, we present the image mosaicing method, which creates larger images by collections of overlapping images from many related images. Once the homography between two images is obtained, we can construct a large-scale image by transferring one image to the other image with the homographic matrix.

In our system, it is expected to get mosaic images and finally get one picture of panorama**.** Our method has many advantages such as high speediness, efficiency, quality and low costs. First, we extract features in the overlapped area in one image and then extract the corresponding features in the other image. After that, we integrate common parts of two images. In our implementation, image mosaicing is decomposed into 2 stages: we first find the perspective transformation between two overlapping images, and then compute the absolute coordinate transform for each image. And then find the best maps between two images.

3. Corresponding Relations Among the Images

Let $P(X,Y,Z)$ be a point in a 3D scene $P'(X',Y',Z')$ and $P''(X'',Y'',Z'')$ are observed from two different camera positions. P' and P'' are the projected image points relations to the different camera positions. Then the relation between the two camera systems can be expressed by the rotation and translation as

$$P'' = (R/T)P' \tag{1}$$

where R be the 4×3 rotation matrix and T be the 4×1 translation vector, respectively. This above equation (2.1) can be expressed in term of the image point P' and P'' as follow:

$$Iq'' = S(R/T)q' \tag{2}$$

where I= $(Z''/f''), S = (Z'/f')$.

The transformations accompanied with the above correspondences are applied to each view and all the views are registered in the coordinate basis of a reference view. After all the views are registered, correspondences are established between all sets of overlapping views on the basis of nearest neighbor that are within a distance. Views that have correspondences less than a threshold are considered as non overlapping views and their correspondences are rejected. The estimation of the feature points by matching two images at different resolutions.

3.1 Image Synthesizing

The basic concept of using the planar projective transform is that it assumes scenes to be planar. By dividing a non-planar scene into multiple triangular patches, the planar projective transform can be applied for non-planar scene. A 3D scenes point P projects onto the 2D points *p*, *p*', *p*'', *p*''' in four views (see Figure 1). The relationship between the 3D and 2D spaces is represented by the camera projection matrices as follows:

$$p = [\mathrm{I},0]P,$$
$$p' = [A, v']P,$$
$$p'' = [B, v'']P, \qquad A = [a_i^j], B = [b_i^j]$$
$$C = [c_i^j]$$

where **I** is the identity matrix andare homography matrix.
The vector *v*, *v*'', v''', are known as epipoles.

The point, *p*''in 3rd image can be obtained from the correspondence pair ***p*** and ***p'*** as, where

$$p_l'' = p_k(p_i' T_{kjl} - p' T_{kil}), \quad T_{ijk} = v_j' b_i^k - v_k'' a_i^j, (i, j, k = 1,2,3) \tag{3}$$

We can virtually extend for multiple images by repeating this process.

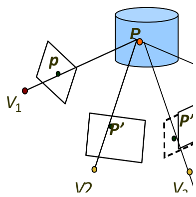

Figure 1. Multiple positions of a camera

3.2 Image Registration and Image Projection

Image registration is one of the fundamental tasks in image processing. It is the process of matching two images which are reference image and operated image. The large-scale image is created for the operated image and the coordinate system of the reference image is known. We find the coordinate transformations between all pairs of an image sequences. After that we cut off the image which is not overlapping region from operated image and then merged it to the reference image. After image registration, the feature points in each image can be transformed the coordinate frame. We computed the transformation parameters by using mean square distance between two images. The set of all images and transformation parameters comprises the mosaic representation of the scene. The correspondences are not easy to find due to incorrect feature detection and non-robust feature matching.

4. Design Implementation

The automatic construction of large and high resolution image mosaics is an active area of research in the fields of photogrammetry, computer vision, image processing, real rendering, robot -vision and computer graphics. Mosaicing is a common and popular method of effectively increasing the field of view of a camera, by allowing several views of a scene to be combined into single view.The most difficult part in image mosaicing is to estimate the geometric transformation between images.The traditional approach, which uses correlation intensity based image registration, suffers from computation inefficiency and is sensitive to variations in image intensity [6]. A feature-based approach is used to improve the efficiency of image mosaics. Two planar views are grabbed by an affine transformation of the camera. One of the images is used as the reference image, and the second image is aligned with the reference image. To find the coordinate transformation between the two images, the feature points in each image are detected firstly. Next, a matching process is performed to estimate the corresponding feature points between these images. SSD (Sum of Squared Difference) method is used for feature points matching. System flowchart is shown in Figure 2.

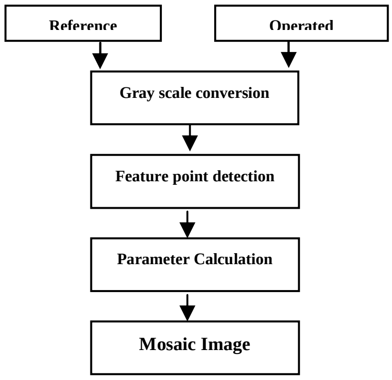

Figure 2. Flowchart of mosaic creationsystem

5. Result and Analysis

In this section, the experimental results and analyzing of proposed technique are presented for synthesizing the multiple images. The registered image is obtained from operated image by using image registration. It is used to match two or more images of the same scene taken at different times from arbitrary view. It is the process of matching which are reference image and operated image. The corresponding feature points on the two input images are detected and the distance in the overlapping region is calculated.In system, the reference image could be the first frame of the image sequences. The accuracy rate percentage is the ratio of the number of corresponding pairs and number of all feature points pairs in images. The following equation is used for calculating the accuracy rates.

$$\text{Accuracy rate} = \frac{\text{Number of corresponding pairs x 100\%}}{\text{Number of all feature points pairs}}$$

5.1 Synthesizing for Two Images

The non overlapping region of the operated image is cut off and then merged it to the referenced image. Before extraction the feature points from both images, edge detection is used for estimating the translational displacement between the images. Figure 4 shows the overlapping region of two images. Figure 5 shows the edge extraction from two input images. By synthesizing these images, the whole view of a scene is obtained (see Figure 6).

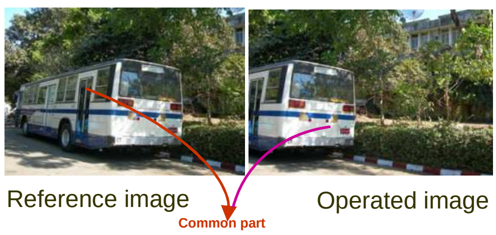

Figure 4. Two input images and overlappedregion

Reference image Operated image

Figure 5. Edge detection

Figure 6. Synthesized two images

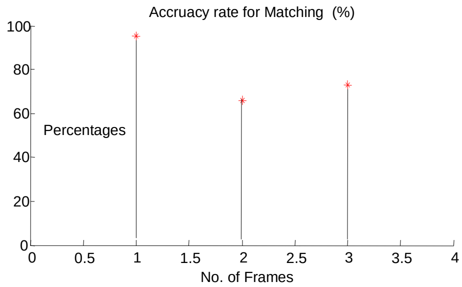

Figure 7. Accuracy rates of matching

5.2 Synthesizing for Four Images

Figure 8 shows four input images in outside scene using digital camera for minimum time interval. The sub-mosaic images of Figure 8(a) and 8(b) areillustrated in Figure 9. Then this sub-mosaic and next input image (c) have been combined.

(a) (b) (c) (d)

Figure 8. Four input images

Figure 9. Sub-mosaic image of (a) and (b)

Figure 10. Sub-mosaic image of Figure 9 and (c)

Figure 11. The result image using four input images

The result sub-mosaic image is shown in Figure 10. By repeating this process, the whole view of outdoor scene created (see Figure 11).

The correct matching points is (95.3630%) for first image and second image.And it took (65.7330%) for a correct matching points between submosaic and the third image. Then the correct match between submosaic and the fourth image is (72.9466%). Final result will get after sub-mosaic and the fourth image are synthesized.

6. Conclusion

The proposed system makes the full-view of large-scale object with multiple images at any position as real scene. We compute the absolute coordinate transform for each image by an error minimization technique. Image mosaics are collection of overlapping images together with coordinate transformations that relate the different image coordinate systems. The transformation parameters between each successive image are calculated and then used in blending operation. For each image pair, we could get very good results but when we use these parameter in blending, it could cause some artifacts. The perfect and good image has been received when blending the two, three, four images into one.

References

[1] CDoraiet.al. Registration and Integration of Multiple Object Views for 3D Model Construction. *IEEE Tran. On pattern analysis and machine Intelligence.* 1998; 20(1).

[2] SEChan, Williams. *View Interpolation for Image Synthesis.* Proc.SIGGARPH 93. 1993; 279-299.

[3] M Irani, P Anandan, S Hsu. *Mosaic based representations of video sequences and their applications.* Fifth International Conference on Computer Vision (ICCV'95). Cambridge, Massachusetts. 1995; 605-611.

[4] MM Seinet.al. *Reconstruction the Arbitrary View of an Object Using the Multiple Camera System.*IEEE International Symposiun on Micromechatronic and Human Science(MHS 2003). Nagoya, Japan. 2003; 83-88.

[5] T Takahashi et al. *Arbitrary View Position and Direction Rendering for Large-Scale Scenes.* IEEE International Conference on Computer Vision and Pattern Recognition. 2000; 2:1063-6919.

[6] TLL Thein, MM Sein. *An efficient Method for Reconstruction the Entire view of the Multiple Object by Pair-wise Registration Technique.*SICE-ICASE International Joint Conference.Bexco, Busan, Korea. 2006.