Research Article *ISSN: 2319-507X*
Harshal Patil, IJPRET, 2013; Volume 1(8): 576-585 *IJPRET*

INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

A PATH FOR HORIZING YOUR INNOVATIVE WORK

IMAGE MOSAICING APPROACH AND EVALUATION METHODOLOGY

HARSHAL PATIL, PROF. R.V.SHAHABADE

1. Student of ME-IT, Terna Engg. College, Nerul.
2. Assistant Professor, Terna Engg. College, Nerul.

Accepted Date:

27/02/2013

Publish Date:

01/04/2013

Keywords

Mosaicing,

Image registration,

Image

Corresponding Author

Mr. Harshal Patil

Abstract

Image Mosaicing is the act of combining two or more images of same scene .It aims to combine images such that no obstructive boundary exists around overlapped regions. The output of image mosaic is the integration of multiple images of same view into one continuous image. An image mosaicing operation consists of steps such as Image registration, Image Warping and composition. Several image mosaicing algorithms claiming to advance the state of the art have been proposed so far based on direct method and feature based method. A quantitative evaluation methodology including standard data sets and performance matrices is provided for these algorithms.

I. Introduction

Image Mosaicing is a process of assembling images of same scene into large image. The output of image mosaic is the integration of multiple images of same view into one continuous image. The mosaic of images is an important topic in Image Base Rending (IBR) area as well as a major technique in rebuilding the Virtual Environment (VE). The problems it is to solve are how to mosaic pictures in small visual area in to a bigger one, to satisfy people's need to observe and browse scene in broad area. The mosaic of scene image is started in accompany with the rapid development of Virtual Reality (VR) technique and the need to real-time draw in Virtual Environment. The image mosaic is the key connection in the process of building virtual scene. However, with rapidly changing and complicated modelling requirements in objective world, the contradiction between the sense of reality and computing scale is always a tough problem. An image mosaic is a synthetic composition generated from a sequence of images and it can be obtained by understanding geometric relationship between images. By using appropriate transformations via warping operation and combining the overlapping regions of warped images it is possible to construct single image indistinguishable from a single large image of the same object, covering entire visible area of the same scene. Image mosaicing methods-direct method and feature based method. The direct method estimate the transformation parameters based on the intensity difference in area of overlap. The advantage of direct method is that very accurate registration is achieved but they are not very robust against illumination variance. Instead of using all available data, feature based method is robust against illumination variance, imaging noise, image rotation, image scaling and perspective distortions .Feature based methods mosaic the images by first automatically detecting and matching the features in the source images, and then warping these images together.

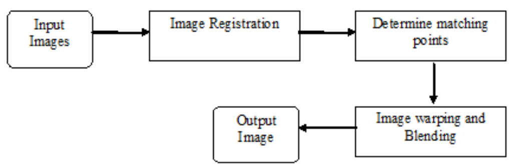

Figure 1: Steps involved in Image Mosaic

An image mosaicing operation consists of steps such as Image registration, Image Warping and composition. In Image Registration, the correspondence between features common to Set of images is defined in order to compute an image-to-image transformation that maps one image into the other (geometric alignment of set of images)..The set consists of two or more digital images taken of a single scene at different time, from different sensors or, from different viewpoints. The objective of registration is to establish geometric correspondence between the images so that images can be transformed, compared and analysed in common reference plane. The next step, Image stitching is the process of combining multiple images with overlapping fields of view to produce segmented wide angle image view. Image Blending is the technique, which modifies the image grey levels in the vicinity of boundary to obtain smooth transition between images by removing these seams and creating a blended image by determining how pixels in an overlapping area should be presented. So for data exploitation or further processing of the image data a projected mosaic is typically desired over multiple, unaligned images containing overlapping pixel data of the same scene. Nowadays mosaicing algorithms are employed not only to generate visually pleasant pictures but also serve as key building blocks of many computer vision applications, such as aerial and satellite photographing, motion detection and tracking, resolution enhancement, augmented reality, mosaic based localization. Each image reflects partial information of certain objective or scene in space and time. Image mosaic technique will provide an effective and complete scene expression method to make people know things and understand real world more objectively and. Therefore, image mosaic technique is important research content of subjects such computer graphics, and image processing and computer vision. And it is widely used in application areas are as follows

1. mosaic of large airspace and satellite remote sensing image;
2. Meteorological and environmental monitoring;

3. Sea-bottom survey and geological survey;
4. The 3D rebuilding of objects;
5. The building of virtual scene and virtual walkthrough;
6. Video compression, video search browse, and video edit.
7. The digitized saving of file;
8. Military reconnaissance and taking evidence.

II. Literature Survey

2.1 Background

Modern aerial surveillance systems utilizing camera arrays can capture several square miles of ground activity at high resolution from a single aircraft. A camera array uses multiple cameras to capture images synchronously with partial overlap between cameras' fields of view. This allows a wide area to be monitored continuously and without any blind spots. Rather than observing images from each individual camera one large image containing all of the images' views of the scene activity is desirable when one, larger camera to capture this data is not available. This image which combines all of the images captured by the camera array is generally called a mosaic in the field of computer vision and is achieved by performing an inter-camera projection process to stitch the images together. Visually from an image analyst's perspective a mosaic is simpler to study than multiple images at different viewing angles and with redundant scene data. Moreover, for data exploitation or further processing of the image data a projected mosaic is typically desired over multiple, unaligned images containing overlapping pixel data of the same scene. The process of projecting images of the same scene as a mosaic is not new. For many years this has been a field of active research. The success of any solution to an image mosaicing problem is dependent on the type of imagery that is captured and requires stitching. Some techniques in computing mosaics have been developed to work directly for specific information content of observed scenes. One such example is a technique for mosaicing camera captured document imagery to produce a final, single mosaic containing all of the text from the original document. One such example is a technique for mosaicing camera captured document imagery to produce a final, single mosaic containing all of the text from the original document. This mosaicing system is based on matching the sets of imaged letters based on their corresponding connected component descriptors. Yet aside from the image content, even when it comes to the type of cameras alone used in the mosaicing application a myriad of complicating situations can exist such as variations in illumination, difference of scale between imaged objects, extreme rotation between images, lens distortion, focus blur, motion blur, occlusions, different resolution of cameras, and many others. Moreover, image mosaicing problems differ greatly based on the specifications and the requirements of the application. Several key applications for image mosaicing include: creating panoramas from images captured by consumer cameras of any number of different scenes, creating mosaics from video sequences for which only slight rotational changes may occur between frames.

2.2 Image mosaicing methods:

Research in computer vision and related fields has produced a variety of methods for stitching two or more images into mosaics. Essentially, the multitude of individual techniques and systems designed to create these mosaics can be organized into two general approaches. These consist of a direct method comparing all the pixel intensities of the images with each other and a feature based method which aims to determine a relationship between the images through distinct features extracted from the images. Research in solving image mosaicing problems using direct methods has been around for several decades. Research in solving image mosaicing problems using direct methods has been around for several decades. Direct methods attempt to iteratively estimate the camera parameters by minimising an error based on the intensity difference in the area of overlap. Direct methods have the advantage that they use all of the available data and hence can provide very accurate registration. These approaches include Fourier analysis techniques [1] and also coarse to fine optimization of cost or objective functions [2]. From researching these methods of the past it appears a strong foundation has been laid for direct approaches involving pixel intensity operations and comparisons. However, a real-time implementation seems highly limited and in many cases convergence towards the optimal solution appears to be a problem [8].

Feature based methods have become increasingly popular and widespread in mosaicing. This is partially due to the strength of new algorithms and types of invariant features which have been demonstrated in recent years such as the SIFT algorithm [3]. Mosaicing applications using feature based methods include

Real-time aerial surveillance [6], mosaicing of camera captured document images [5] and panorama stitching [7] among others.

Recently, both the direct and feature based approaches have been analysed by researchers and it was observed that feature detection and matching schemes are remarkably robust So recent work in image mosaic focuses on the uses features and has a good success rate at automatically stitching [8] as direct have a limited range of convergence, matching partially overlapping images in photo-based panoramas, they fail too often to be useful [8]. A high level view of relevant research advancements for both direct and feature based methods is shown in Table1. This table demonstrates chronological research advances in the mosaicing field and a recently increasing trend for feature based techniques. The chronological advancements in Table 1 reveals trends in computer vision and image mosaicing applications for a growing potential of feature based methods.

At the top of Table 1 a trend is shown that direct methods began as early as the nineteen-seventies and improved over an earlier time frame. However, with the advent of the scale-invariant feature transform in 2004. Feature based methods have grown to become powerful and dominate over direct methods in recent computer vision research and applications in terms of illumination invariance, noise, scaling and translation.

Table 1: Research advancements for direct and feature based Methods

Direct method advances	Year	Feature method advances
Phase correlation image Alignment	1975	
Iterative image registration in stereo vision	1981	
	1986	Feature based correspondence image Matching
Registration of translated and rotated images with Fourier transforms	1987	
	1988	A Combined Corner and Edge Detection
Hierarchical model-based	1992	
Direct methods for visual scene reconstruction	1995	
	1998	Statistical framework for feature matching in un-calibrated image mosaicking
Image Stitching in Gradient Domain	2003	Recognizing Panoramas
	2004	Distinctive Image Features from Scale-Invariant Key points
	2005	A Performance Evaluation of Local Descriptors
	2007	Automatic Panoramic Image Stitching using Invariant Features
	2008	Connected Component descriptor for Robust Mosaicing of Camera-Captured Document Images
	2010	Real-time aerial image Mosaicking

Table 2: Comparison between Direct method and Feature based method

Direct Method	Feature Based Method
1)It compares all pixel intensities of images with each other	1)It Determines relationship between the images through distinct features extracted from the images
2)It can provide very accurate registration,	2)It reduces computational complexity
3)I is not very robust against illumination invariance	3)It is highly robust against illumination invariance
4)It has limited range of convergence	4)It has high range of convergence
5)Sensitive to noise	5)Sensitivity to noise can be reduced.

III. Evaluation Methodology

Quantitative evaluation has been usually achieved by calculating errors statistics among registered images of the input sequence. However comparison among different algorithms is impossible unless the very same set of control points is used. An algorithm cannot be evaluated based solely on its output, since the registration transformations need to be available to compute error statistics. We can rate and rank algorithms based on direct pixel wise comparison between the generated and ground truth mosaics provided that data are properly normalized

IC and IT respectively the mosaic under evaluation and the ground truth mosaic, use the following performance metrics:

a) Average of the intensity distances:

It amounts to the MSE (Mean square error) over intensities of corresponding pixels

$$\mathrm{MSE} = \frac{1}{M}\sum_{(x,y)} D_{xy} = \frac{1}{M}\sum_{(x,y)} \left(m_C(x,y) - m_T(x,y)\right)^2$$

where mC(x, y),mT (x, y) are corresponding pixels in IC, IT and M is the number of pixel belonging to the region of overlap between the two images. Pixels not shared by both images are neglected.

b) Average of the geometric distances.

It amounts to the MSE of the distances between corresponding control points

$$\epsilon_{est} = \frac{1}{L}\sum_i D_i = \frac{1}{L}\sum_i \left\|(x^i_C, y^i_C) - (x^i_T, y^i_T)\right\|^2$$

where L is number of correspondences.

c) Number of misplaced pixels:

It is the sum of missing and redundant pixels normalized with respect to number of views

d) Time complexity

f) Robustness to rotation, scaling and shearing effect:

IV. Experimental Results

Some of the mosaics created by different approaches are shown below.

ISSN: 2319-507X
IJPRET

a) b)

Figure 2 c) Resulting mosaic of a), b)

a) b)

Figure 3 c) Resulting mosaic of a), b)

V. Conclusion

On the basis of subjective analysis , the direct methods of image mosaic are based on intensity difference in the area of overlap. The advantage of direct method is that very accurate registration is achieved but they are not very robust against illumination variance.

The feature based image mosaic uses features such as edges, corners as they represent local structures in image. Extracting features significantly reduces computations. .Feature based methods are more robust than direct method in terms of noise, scaling and translation, illumination variance.

References

1. James R. Bergen, P. Anandan,Th J. Hanna, and Rajesh Hingorani,‘Hierarchical model-based motion Estimation.’, Pages 237-252. Springer-Verlag, 1992

2. Simon Baker and Iain Matthews. Lucas-kanade, A unifying framework. International of Computer Vision’,pg:221-255, 2004.

3. David G. Lowe, ‘Distinctive image features from scale-invariant keypoints’, International Journal of Computer Vision, November 2004.

4. Tom Botterill, Steven Mills, and Richard Green, ‘Real-time Aerial Image Mosaicing’, In the Proceedings of Image and Vision Computing, New Zealand, pages 1-6, Queenstown, NZ, Nov 2010.

5. T. Kasar and A. G. Ramakrishnan, ‘Connected component descriptor for robust mosaicing of camera-captured document images’, In Koichi Kise and Hiroshi Sako, Document Analysis, Systems, pages 480-486. IEEE Computer Society, 2008.

6. Matthew Brown and David G. Lowe, ‘Automatic panoramic image stitching using invariant features’, International. Journal of Computer Vision, vol 74, pages 59-73, August 2007.

7. Richard Szeliski, ’Image alignment and stitching’, Trends In Computer. Graphics. Volume 2, Jan 2006.

8. X Dai and S khorram, ‘A feature based image registration algorithm using improved chain code-registration combine with invariant moments’, IEEE transactions on geosciences and remote sensing, volume 37, no 5, pp.2351-2362,1999

9. Y Ziquin and W Hao, ‘An image mosaic algorithm of pathological sections based on feature points’, In Proc. International Conference on Information Engineering and Computer sciences’,2009,pp/1-3.

10. Zaho Hui, chen hui and Yu Hong, ‘An improved fully automatic image mosaic algorithm’, Journal of Image and Graphics, 2007 volume 12 pp36-42.

11. Krystian Mikolajczyk and Cordelia Schmid, ’A performance evaluation of local descriptors’, IEEE Transactions on, ’Pattern Analysis and Maching’., vol 27 pp:1615-1630, October 2005.

12. ‘An Evaluation Methodology for Image Mosaicing Algorithms’, by Pietro Azzari, Luigi Di Stefano, and Stefano Mattoccia.