Design & Development of Image Mosaicking System with Corresponding Points Detection Technique

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Abstract

A Corresponding Points Detection or featureless Method for mosaicking of multiple images is described. Registration is achieved using control points and projective transformation, paying special attention to factors that contribute to precision registration of the images. Among the corresponding control points found in overlapping images, those that best satisfy the projective constraint are used to register the images. Experimental results show that a small number of correspondences that satisfy the projective constraint produce a more accurate registration than a large number of correspondences in least-squares fashion. To achieve seamless mosaics, intensities of all images captured by the cameras are transformed to the intensities of one of the images to minimize the intensity difference between the registered images. Mosaicking results on two image sets acquired by a two camera system are presented and discussed. The experimental results demonstrate the effectiveness of proposed technique.

Keywords: *Image Mosaicking, Image Registration, Points detection.*

INTRODUCTION

Computer graphics is an emerging technique and can be applied to various fields. Among these fields, the special effects industry is one of the important applications. A technique like image mosaics would evoke uses such as better texture maps (i.e. higher resolution texture maps by stitching together several images) and image backgrounds. The image backgrounds can be used for environments maps or some blue/green screen techniques. A number of methods have been proposed to build the image mosaicing system. Szeliski [1] proposed the Levenburg-Marquadt nonlinear minimization algorithm to refine the estimate to achieve the best transformation. Peleg [2] used manifold projection method to create the panoramic mosaics under very general conditions. Both of the methods achieve good mosaic results, but the computation is complex. In this paper, the image mosaicing system utilizes a combination of manual user input for registration between two images and a homography method to attempt to get the relationship among several images. In this particular implementation, there is an underlying assumption that the pair images are related through some sort of planar transformation (i.e. one that is either projective or at least affine). The relationship between two images can be obtained through a homography, H. More specifically, if x is the homogeneous coordinates of a point in the source image, and u is the homogeneous coordinates of the corresponding point in the destination image, then $u = Hx$

The steps to build an image mosaicing system can be described as follows:

(1) Read the multiple images.

(2) By manual user input, Establish point correspondences between different images (Homography).

(3) Produce the mosaic image

Image Registration techniques [3] can be mainly divided into two categories: feature-based methods, and featureless methods. Feature-based methods assume that feature correspondences between image pairs are available, and utilize these correspondences to find transforms which register the image pairs. A major difficulty of these methods is the acquisition and tracking of image features. Good features are often hand-selected, and reliability of feature tracking is often a problem due to image noise and occlusion. On the other hand, featureless methods discover transforms for image registration by minimizing a sum of squared difference (SSD) function that involves some parameters. Since featureless methods do not rely on explicit feature correspondences, they bear no problems associated with feature acquisition and tracking. However, methods in this category typically require that the change (translation, rotation, etc) from one image to another be small, and that good guesses for the parameters of the transform be given as initial values to the program. Moreover, since there is no guarantee that the parameter estimate process will definitely lead to the optimal solution even when the above requirements are met, special efforts must be made to prevent the parameter estimate process from falling into local minima. Fig. 1 shows the flow scheme of image mosaic system.

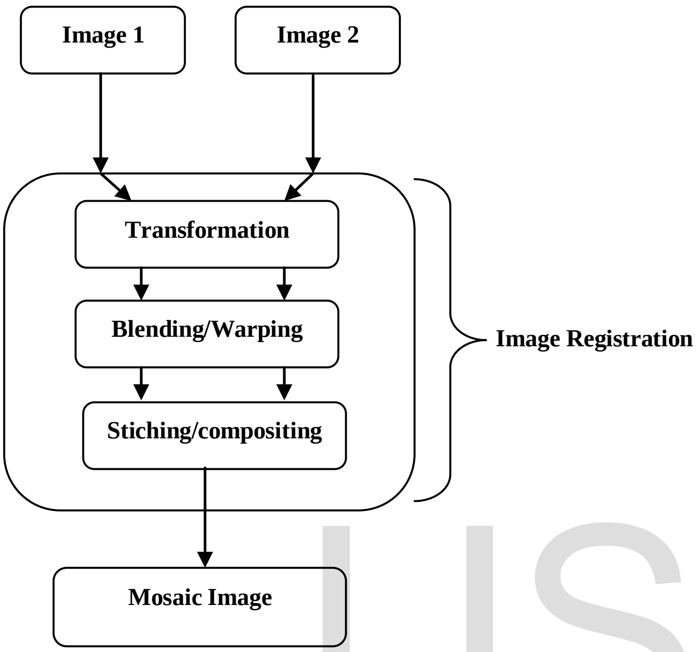

Fig.1 Flow chart of image mosaic system

IMAGE TRANSFORMATION

Image Transformation refers to the geometric alignment of images. The set may consist of two or more digital images taken of a single scene at different times, from different sensors, or from different viewpoints .The goal of registration is to establish geometric correspondence between the images reference frame. Image registration is the task of matching two or more images. It has been a central issue for a variety of problems in image processing such as object recognition, monitoring satellite images, matching stereo images for reconstructing depth, matching biomedical images for diagnosis etc. Registration is also the central task of image mosaicing procedures. Carefully calibrated and prerecorded camera parameters may be used to eliminate the need for an automatic registration. User interaction also is a reliable source for manually registering images (e.g. by choosing corresponding points and employing necessary transformations on screen with visual feedback).

Homogeneous Coordinates Points

Before proceeding, we need to consider the geometric transformations that relate the images to the mosaic. To do this, homogeneous coordinates is used to represent points, that is, 2D points in the image plane can be represented as (x, y, w). The corresponding Cartesian coordinates are (x/w, y/w). In homogeneous coordinates, all geometric transformations can be written as Matrix Multiplication:

$$u = H\,x$$

$$\begin{bmatrix} u' \\ v' \\ w' \end{bmatrix} = H \begin{bmatrix} x \\ y \\ 1 \end{bmatrix} \quad (1)$$

$$u = u'/w',\ v = v'/w',\ w' \neq 0 \quad (2)$$

Where

(3)

The simplest transformations in this general class are pure translations, followed by translations and rotations (rigid transformations), plus scaling (similarity transformations), affine transformations, and full projective transformations. Figure2 sh… …fine, and projective … …nd affine transformati… …legrees of freedom, re… …ions have a general **H**

$$H_{rigid-2D} = \begin{bmatrix} \cos\theta & -\sin\theta & t_x \\ \sin\theta & \cos\theta & t_y \\ 0 & 0 & 1 \end{bmatrix}$$

$$H_{affine-2D} = \begin{bmatrix} a & b & c \\ d & e & f \\ 0 & 0 & 1 \end{bmatrix} \quad (4)$$

(5)

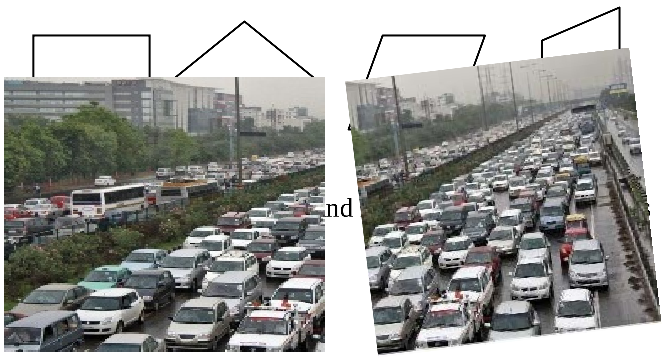

Fig.3 Transformations on set of images

IMAGE BLENDING

Since the two images that are used will probably not have perfectly matching pixels at all regions where they overlap, the image blending calculations are designed to average and more properly meld the two images together. In addition, this calculation is aimed at elim … from o … ation p … all of th … o one m … tially th … saic, th … saic

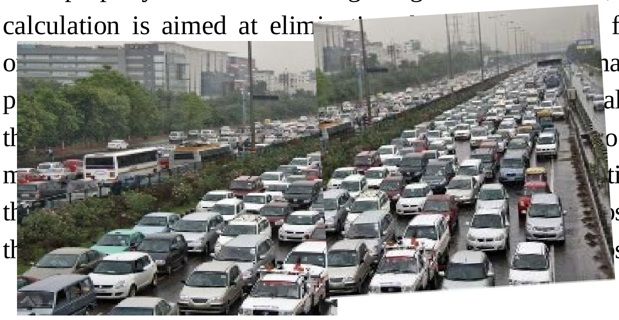

Fig.4 Image blending on set of images

has empty pixel. If any pixel in the second images is mapped to a mosaic pixel which has not been already occupied by previous image pixel, then the value of that pixel (second image) is used the value of mapped pixel in mosaic. Once the source pixels have been mapped onto the final composite surface, we must still decide how to blend them in order to create an attractive looking panorama. Creating clean, pleasing looking panoramas involves both deciding which pixels to use and how to weight or blend them. The distinction between these two stages is a little fluid, since per pixel weighting can be thought of as a combination of selection and blending. In this section, I discuss spatially varying weighting, pixel selection (seam placement) and then more sophisticated blending.

1) Color correction: matching the adjoining areas of the component images for color, contrast and brightness to avoid visibility of the seams.

· Dynamic rang extensions.

· Motion compensation/deghosting/debluring to compensate for moving objects.

2) Pixel averaging method

In this method, each pixel in mosaic takes its value from only one image. This method **g**ives unblured results but it has many artifacts especially corner of the overlapping area because of misalignment. In this paper, instead of superimposing method, we preferred to use pixel averaging method in blending phase.

2.2 Image Blending Calculations:

Since the two images that are used will probably not have perfectly matching pixels at all regions where they overlap, the image blending calculations are designed to average and $c_{uv} = (1-u)(1-v)c_{00} + u(1-v)c_{01} + (1-u)vc_{10} + uvc_{11}$, this … from one image to another. Without loss of generality, let the four pixels immediately surrounding (u,v) have coordinates (0,0); (0,1); (1,0); (1,1). And let (u,v) have values between 0 and 1. Thus (u,v) falls within the square whose corners are the coordinates given above. Let the colors at these corners be c00, c01, c10, a $c_{u0}=c_{00}+u(c_{10}-c_{00})$

$$c_{u1}=c_{01}+u(c_{11}-c_{01})$$

(6)

When working $c_{uv}=c_{u0}+v(c_{u1}-c_{u0})$ need to simply interpolate for each channel (i.e. do it for R, G, B, separately). The above formula can be optimized in terms of following calculations, which uses three multiplies instead of eight:

(7)

(8)

(9)

There are two input images: mosaic1.jpg, mosaic2.jpg, shown in Figure 2. The first step is to establish point correspondences between the images. Because the input images only partially overlap, the correspondences are obtained only between the first and second, between the second and third, and between the third and fourth images. Using Matlab, manually mark and record at least two corresponding points between each pair of images. For the best results, the points should not all lie on a straight line, but should be spread out in the image. Use the zoom feature in Matlab to mark the points more accurately. It is usually easier to mark prominent features in the image, e.g. corners of buildings.

IMAGE STICHING (COMPOSITING)

Image … multiple photo… view to produ… image. Comm… oftware, most … ly exact overla… produce seaml… e

Fig.5 Image Stiching on set of images

Stitching combines a number of images taken at high resolution into a composite image. The composite image must consist of images placed at the right position and the aim is to make the edges between images invisible. The quality of stitching is therefore expressed by measuring both the correspondence between adjacent stitched images that form the composite image and the visibility of the seam between the stitched images. Image stitching can be performed using

- image pixels directly - correlation method
- in frequency domain - fast Fourier transform method[4]
- using low level features such as edges and corners
- using high level features such as parts of objects

APPLICATIONS

There are many applications which require high resolution images. In bright field or epifluorescence microscopy for example, which are used in biological and medical application. It is often necessary to analyze the complete tissue section which has dimensions of several tens of millimeters at high resolution. The most common approach is to acquire several images of parts of the tissue at high magnification and assemble them into a composite single image which preserves the high resolution .The most common mosaicing applications include constructing high resolution images that cover an unlimited field of view using inexpensive equipment, creating immersive environments for effective information exchange through the internet. These applications have been extended towards the creation of completely navigatable “virtualized" environments by creating arbitrary views from a limited number of nodes. The reconstruction of 3D scene structure from multiple nodes has also been another active area of research.

Among the numerous application of image mosaic, one of the major application is the intelligent traffic congestion control scheme[5], in which image mosaic technique is used for measuring the traffic density on road so that timings of RYG light on the road, may vary after measuring traffic density.

ASSUMPTIONS

The following are some of the assumptions we have made to solve the problem.

1. The input images given by the user should have at least 10% overlap for good results.

2. If the user does not get good results in the first time then user needs to try again with new points for better accuracy.

3. The brightness of the images given by the user should not
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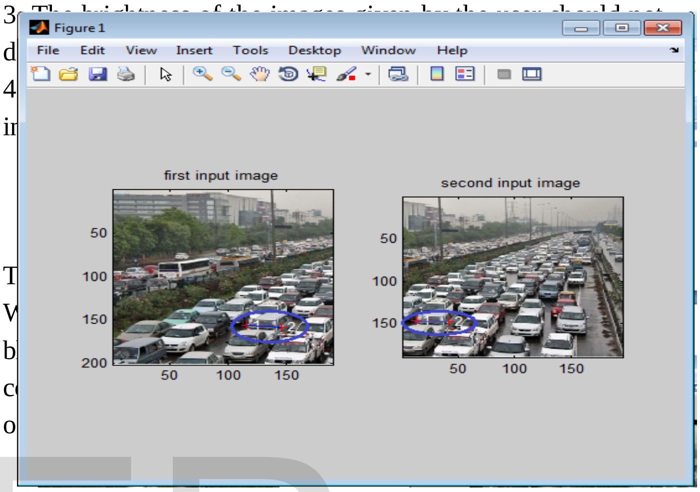

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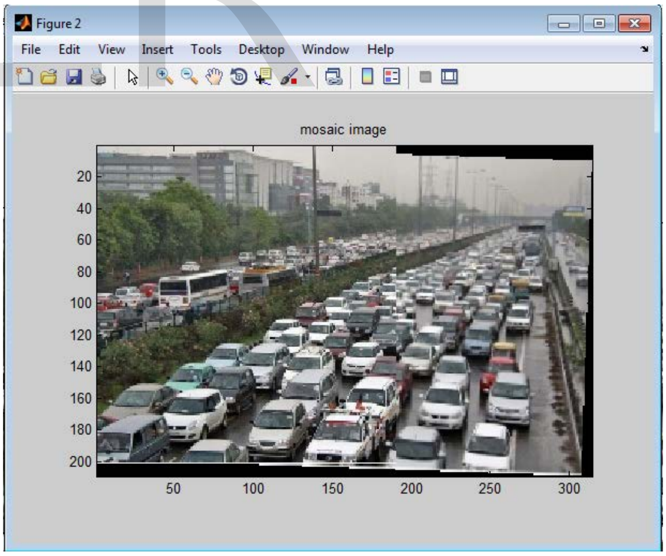

Fig.7 Output Mosaic

It can be seen that detection of better corresponding points in set of images; better the mosaic can be achieved.

CONCLUSION & FUTURE WORK

In this paper, we use corresponding coordinates to represent points. After projecting the points from different images to the reference image, we simply interpolate overlapped points for each RGB channel and get the Mosaics. Still imagery can be used in a variety of ways, including the manipulation and compositing of photographs inside video paint systems, and the texture mapping of still photographs onto 3D graphical models to achieve photorealism. Although laborious, it is also possible to merge 3D computer graphics seamlessly with video imagery to produce dramatic special effects. As computer-based video becomes ubiquitous with the expansion of transmission, storage, and manipulation capabilities, it will offer a rich source of imagery for computer graphics applications. One novel use of image mosaics, or at least a related variant of it, would involve not only stitching images over space in a continuous fashion, but also over time.

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