Image Mosaicing and Producing a Panoramic Visibility

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Abstract— Aim of this research paper is to take multiple input images, the input images are having some of the overlapped region with one another. Since digital cameras can't take photos of a wider view, for a wider view we need a highly sophisticated camera. It is therefore being attempted to develop enabling methodology which can convert the corresponding images captured form such cameras into a panoramic view. In this paper an algorithm is used and applied some of the advanced function available in matlab to make this work much more efficient.

Keywords ⸺ *Image Mosaicing, Panoramic, Image Blending, Stitching, Image Registration.*

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I. INTRODUCTION

Image mosaics are useful for a variety of tasks in vision and computer graphics. New algorithms for stitching to form continues images is becoming promising area of research .Image mosaic is a composed image generated from a sequence of images. It can be obtained by understanding geometric relationships between images. The geometric relations are affine transformations that relate the coordinate systems of different images .Applying appropriate transformations via warping operation and merging the overlapping regions of warped images which yields a single image depicting the single large image of the same object, covering the entire visible area of the scene. This single image describes the entire panoramic visibility covered by all the images used in process in mosaicing.

The image matching here is mainly divided into two categories:

1. Feature-based approach: In this approach the features from the images are extracted and then the overlapped region is being calculated with the help of the features.

2. Feature-less approach: In this approach the transformation matrix is being calculated from the two images over the overlapped region. That will help to obtain minimum transformation relation between the images. It does not obvious features of the image, but it requires an image to another one of the transformation to small part of region of the image.

Stitching of the two images is the most important task in the image mosaic and the both the images may differ in texture, colour depending upon the position of camera while taking the snaps and view of the camera. After stitching the images another main task where research is being done, that is blending for which the cutting line is to be found.

Some of the applications of image mosaic are following:

1. Panoramic visibility: constructing high resolution images that cover large field using very unexpensive equipment.
2. Creating 3-d view by image mosaic.
3. Video content over-view.
4. Virtual reality technology(VRT)
5. Medical image processing.
6. Computer graphics.

II. RELATED WORK

Image mosaicing is an important technique in the field of computer vision, image processing and creating panoramic images. Image mosaicing is being used in commercial software like Photoshop and algorithms are being improved one over another. One of the algorithms works image mosaicing based on similar curve method [1].This algorithm follows the basic approach on the similar curve of two images. It determines the matched position of two images by finding out feature points of two close images. After finding out the matched portion of the image that part is overlapped by one of the image and the composite image is formed.

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 [7] 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).

Another approach of feature based mosaicing algorithm has done a significant contribution in automatic image mosaicing [2]. This algorithm works by matching the corner points in the two images through Harris corner detection which is used to detect corners in the images. After detecting the corners in the both images now correspondence is solved by modifying the Harris corner detection algorithm.

Matching in this approach was done in two ways:
1. Matching through correlation
2. Matching through relaxation

For image blending in an overlapped region simple approach was writing pixel values as the weighted distance from the image boundary. By using this simple approach the image is blended smoothly and seamless stitching of image is done.

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Another SSD approach used for image blending is used in automatic image mosaicing and refining [3]. When the multiple images are stitched then error is accumulated becomes large. Image pairs which do not lie in consecutive flight thus feature matching algorithm will not be able to find any correspondences and thus they would not match perfectly .If transformation matrix is available with the intensity-based method, the interest point correspondences between images can be found.Once we have chosen a suitable motion model to describe the alignment between a pair of images, we need to devise some method to estimate its parameters. One approach is to shift or warp the images relative to each other and to look at how much the pixels agree. Approaches that use pixel-to-pixel matching are often called *direct methods*,[8] In this approach, we first detect corner points using the SUSAN(Smallest Univalve Segment Assimilating Nucleus) principle in the each two images [9]. The response is processed to output the set of corners. The mask is places at each in the image and, for each point, the brightness of each pixel within the mask is compared with that of the nucleus, i.e. the canter point.

III. ALGORITHM DESCRIPTION

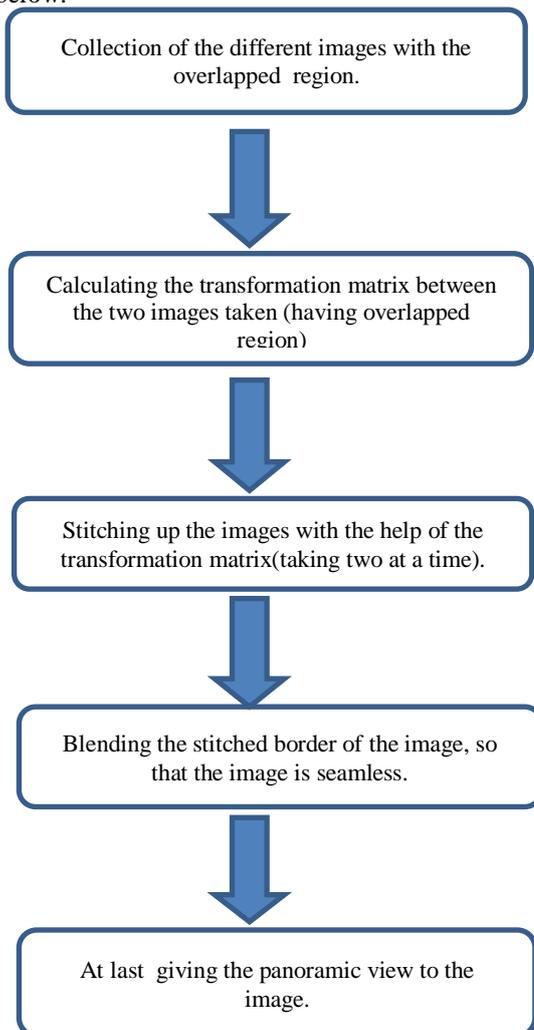Image mosaicing consist of the series of steps which are given below:

Fig 3.1 Steps of image mosaicing.

There are almost four subparts of image mosaicing which are needed to be focused those are as follow:

1. Image registration
2. Image stitching
3. Finding line of cut in new image.
4. Image blending

Now going through each of these steps and explaining how to efficiently apply these steps in order to get a better panoramic view of the stitched image.

1. *Image registration*: It is the process of aligning two or more images according to one referenced image know as base image. The main objective of image registration is to make the input image into alignment with the referenced image by applying a spatial transformation to the input image. Now determining the parameters of the spatial transformation matrix is key part of image alignment without which nothing can be done.
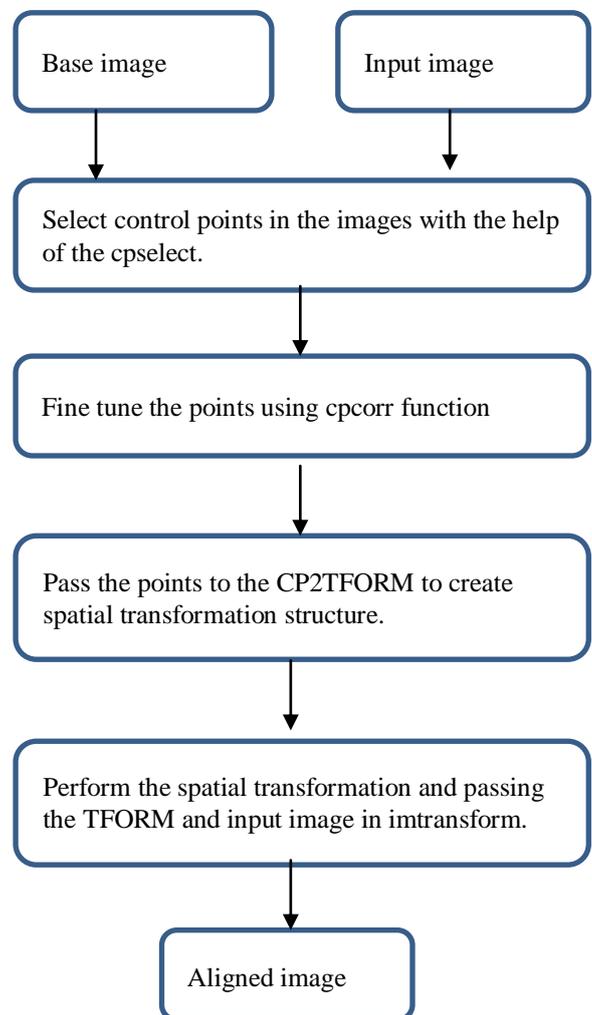

Fig 3.2 Steps of image registration.

In the process of image registration calculation of transformation matrix calculation is most important part. For that when we select the feature points from both the images with the help of control point selection tool. These points are returned by this tool and with the help of these points the

transformation matrix is calculated by solving the equation involved in transformation matrix.

For this project following transformation matrix are taken into consideration:

a. *Translation transformation:* In this the coordinate get shifted by tx and ty parameter along x axis and y axis respectively.

$$\begin{pmatrix} X \\ Y \\ 1 \end{pmatrix} = \begin{pmatrix} X' \\ Y' \\ 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & tx \\ 0 & 1 & ty \\ 0 & 1 & 1 \end{pmatrix}$$

Fig3.3 translation transformation matrix

b. *Rotational transformation:* In this coordinates are set by rotating the image by angle ®.

$$\begin{pmatrix} X \\ Y \end{pmatrix} = \begin{pmatrix} X' \\ Y' \end{pmatrix} \begin{pmatrix} Cos® & Sin® \\ -Sin® & Cos® \end{pmatrix}$$

Fig3.4 rotational transformation matrix

c. *Scaling transformation:* In this the scaling of the matrix is done along x axis by sx and along y axis by sy.

$$\begin{pmatrix} X \\ Y \end{pmatrix} = \begin{pmatrix} X' \\ Y' \end{pmatrix} \begin{pmatrix} Sx & 0 \\ 0 & Sy \end{pmatrix}$$

Fig 3.5 scaling transformation matrix

Solving these transformation matrixes depends upon the number of unknown variables. Minimum number of control points to select from control point selection tool will depend of the transformation matrix and unknown variable in that matrix. So minimum of three control points are necessary for all above transformation matrix.

2. *Image stitching*: Image stitching is next step after the transformation matrix is calculated. Now the pixels are pasted on the image after doing required transformation. Pasting of entire image (overlapped part) is leads to redundancy and degrades the quality of mosaic images.
    For stitching part create a blank image big enough to hold the registered image. Now write the pixel values from the base image to blank image and if there is no pixel available in first image the take it from aligned image. This approach is efficient as it will not be required to rewrite pixel values of one of the image again and again while overlaying the base image over aligned image.

3. *Finding the line of cut in new image* : In this the position of image cutting line is found with the help of simple mathematics like in translation transformation matrix We can know the line of cut following algorithm:
    First of all follow the boundary of the image and apply transformation matrix on those points and get new coordinates these new coordinate will be the line which will differentiate the two images by showing line of cut.

4. *Image blending:* After finding the line of cut now we need to blend the line of cut or the line of the image boundaries. By image blending the image will look seamless without cut and boundaries of the composite images. Interpolation method and Re-sampling is used pixel values are rewritten by weighted pixel values. For this find overlapped region (with the help of line of cuts) and rewrite each pixel value according to the distance from the each images.

IV. RESULT AND ANALYSIS

For this project the images were taken of iiita campus with the help of digital camera by slightly translation it. Since the registration to be done was semi-automatic so percentage of overlapping was not much important but still almost 30-70 % overlapping between the images are taken. The code was being developed in MATLAB and for feature selection matlab tool box was used which is known as cpselect, with the help of this tool selection of control points became a lot easier. This tool was having inbuilt features of zooming, locking etc which were very useful.
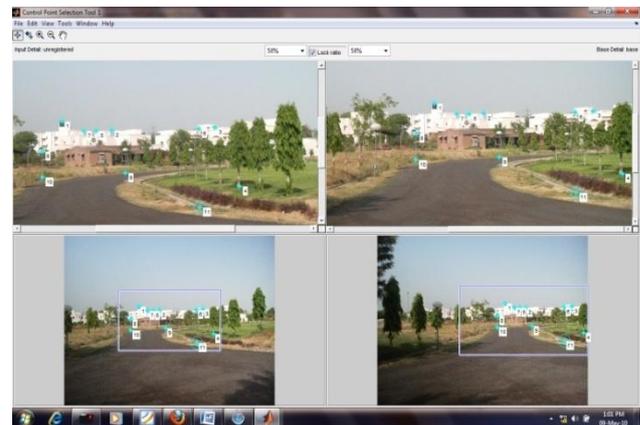

Fig 4.1 control point selection tool(matlab)

With the help of the control point selection corresponding points were selected in both the images and these points were returned from this toolbar after it is being closed. Those point were taken and transformation matrix was calculated which later helped in image registration.

After performing the image registration, stitching and blending mosaic image was shown as in fig4.2.

Fig 4.2 mosaic image

Mosaic image of two images was quite good, after those three images were taken are as follow having overlapped region from 30-70%.
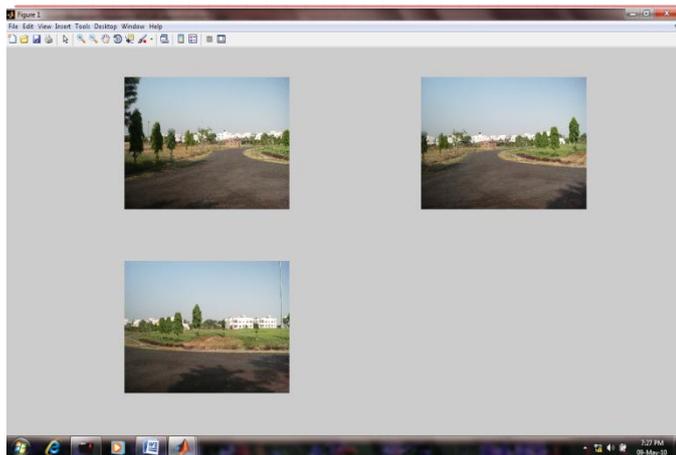
Fig4.3 three input images

On performing image mosaic on these three images output mosaic image was fine as shown below.

Fig. 4.4 mosaic image of three images

V. CONCLUSION AND FUTURE SCOPE

Finally this approach is developed which perform image mosaicing with the help user intervention. Its efficiency and correctness is largely dependent upon the user while selecting the control points. This approach has steps like selecting control points, image writing and blending. It facilitates the user to have a very wide range of image without using any expensive wide angle camera. This feature can be utilized for the better interpretation of the scene in the fields like medial imagery etc where angle of image capturing is constrained by other real life limitation.

A good and efficient methodology is used for image mosaicing and panoramic images but still further improvements can be done in the specialized sub-parts. Some of the sub-parts like image blending, image registration or interpolation can be more optimized and can be made efficient. Further addition can be done to this work by adding fully automatic image mosaicing in which there is no need for user to give the control points, in that case algorithm should be good enough to solve the problem. These all aspects of image mosaicing can be extended.

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