IMAGE MOSAIC USING GEOMETRICAL TRANSFORMATION: A REVIEW

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Abstract: **In this project, image mosaicing is widely used in creating 3D and medical imaging, computer vision, data from satellites, and in military for automatic target recognition. Image mosaicing is the act of stiching two or more images in single image. It is widely used in daily life by combining pictures into panoramas or a large picture which can display the whole scenes vividly. This project used to join images such that no obstructive boundaries exist around overlapped regions and to create a mosaic image that exhibits as little distortion as possible from the original images. In this project Harris and FAST method used to detect corner**.

Index Terms: **Mosaic, geometric transform, wraping, Blending, Harris corner detection. FAST.**

I. INTRODUCTION

All time, it may not be possible to capture complete image of large document in single form with definite size. In such case need to split images. So mosaicing is required to merge the split images which have some sort of overlapping region. Image mosaicing is method of combining two or more image such that no obstructive boundaries exist around overlapped regions [1]. In day to day life and work sometimes there is a need for wide angle and high resolution panoramic images, which the ordinary camera equipment cannot reach. However, it is not feasible as far as the issues like whole scene, professional photographic equipment, high price of maintenance convenient for operation, lack of technical personnel and unsuitability of general uses are concerned, and hence the use of image mosaicing techniques has been put forward. Currently the image mosaicing technique has become the popular computer graphics research. Also image mosaic has been efficiently and precisely applied to areas such as industry, military, and health care. Technique of image mosaic for restoring images with larger visual angle and more reality plays an essential role in detecting more information from the image. In fact, to the limit of objective conditions, i.e. equipment or weather, images are usually unable to reflect the full scene, which makes it more difficult for the further processing of those images. The general task of image mosaic is to build the images in way of their aligning series which overlaps in space. Compared with single images, scene images built in this way are usually of higher resolution and larger vision [2]

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II. SYSTEM DEVELOPMENT

The Proposed system consists of five main stages such as Feature detection and Extraction, Feature Matching, Estimation of geometric Transform, Warping and Blending. Block diagram of system development is shown in Figure 3.1. Explanation of each block is below.

Feature detection:
In this step the extraction of salient features/structures and distinctive objects from both reference and sensed images (like significant regions edges, corners, points, or lines etc.) are carried out. These features are represented by control points which are centre of gravity, line endings, distinctive points, object contours, coastal lines, roads, line intersections, and road crossings which are invariant with respect to rotation, scaling, translation, and skewing.

Feature matching:
In this section the major focus is on the feature detected in reference and sensed images. This approach is mainly divided onto two methods area based and feature based. Area based approach deals with the matching approach as on the predefined size or even entire image rather than on the salient features. While in case of the feature based approach the control points are estimated for a perfect match between a reference and sensed image. The whole focus is on the spatial relations or various descriptors of features.

2.1 Mapping function :
After the feature detection and feature matching approach the corresponding mapping function is designed. The reference and sensed images are matched together using the mapping function design with the corresponding control points. The control points

$$M = \sum_{x,y} w(x,y) \begin{bmatrix} {I_x}^2 & I_x I_y \\ I_x I_y & {I_y}^2 \end{bmatrix} \qquad (1.4)$$

If λ1, λ2 are the Eigen values of matrix M, then corner, edge and flat area of the image can be computed from the Eigen value as follows Flat area: both λ1, λ2 are very small.
mapping must be as possible as much to make a significant influence in the resulting registration.

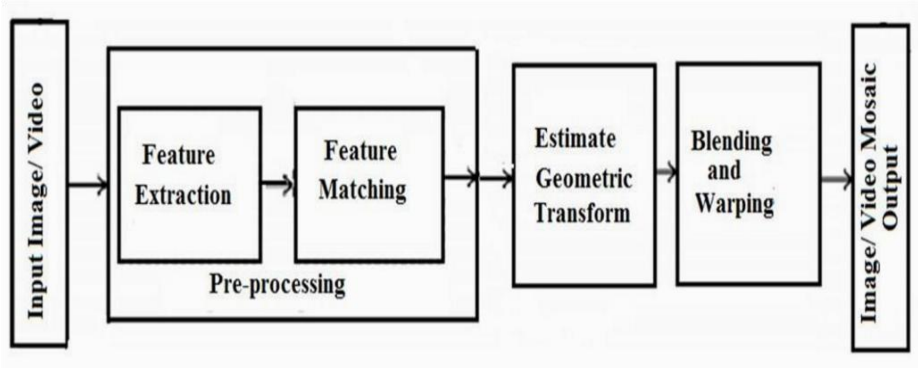

Fig.1.Block Diagram of Proposed Work

2.2 Geometric Transformation and Resampling :-

The sensed image is transformed and reconstructed with the mapping function the images are registered. The transformation can be realized in a forward or backward manner. Forward manner in which using mapping function the pixels from the sensed image is directly transformed. While in case of backward approach the pixels from the target image is determined and the inverse mapping function is established.

2.3 Image Warping and Blending:-

Image Warping is the process of digitally manipulating an image such that any shapes portrayed in the image have been significantly distorted. Warping may be used for correcting image distortion as well as for creative purposes. The final step is to blend the pixels colours in the overlapped region to avoid the seams [3].

A. Mosaicing based on Harris corner detector.

Harris corner detector detects corner points as robust low-level features from source images. Initially a local detection window in an image is chosen. Subsequently the variation in intensity that results by shifting the window by a small amount in different direction is determined as below:

Considering the gray intensity of pixel (u, v) be I (x, y), the variation of gray pixel (x, y) with a shift of (u, v) $c$an be denoted as

$$E\ (u, v) = \sum_{x,\,y} w\ (x, y)\ [I\ (x + u, y + v) - (x, y)]^2 \qquad (1.1)$$

With the application of Taylor series expansion

$$(u, v) = \sum_{x,} w(x, y)[I_x u + I_y v + O(u^2, v^2)]^2 \qquad (1.2)$$

For a small shift of (u, v) we have the following approximation,

$$E(u, v) \cong [u, v] M \begin{bmatrix} u \\ v \end{bmatrix} \qquad (1.3)$$

Where M is a matrix of 2x2 which has been calculated from the image derivatives:

- Edge: one of λ1, λ2 is smaller and the other is bigger
- Corner: both λ1, λ2 are bigger and are nearly equal

Harris corner detector almost always finds closely crowded features. However, this can be overcome by counting the number of features in the neighborhood and then accordingly exclude some of the points, as has been done in [23]. One major problem with the Harris corner detector-based mosaicing methods is that large changes in rotation often generates ghosting in the mosaic output. [30] dealt with this by utilizing a luminance center-weighting algorithm which is used following a slope clustering algorithm for Harris corner point matching. Where the authors used region segmentation and matching in order to limit the search window to potential homologous points.

Harris Corner Detection Algorithm

1. Compute x and y derivative of an image.
2. Compute products of derivative at every pixel.
3. Compute the sums of the product of derivatives at each pixel.
4. Define at each pixel (x, y) the matrix.

5. Compute the response of the detector at each pixel

6. Threshold on value of R. compute nonmax suppression.

B. Mosaicing based on FAST corner detector.

The FAST corner detector was originally developed by Edward Rosten and Tom Drummond and was published in 2006. The important advantage of the FAST corner detector is its computational efficiency. When machine learning techniques are applied, superior performance in terms of computation time and resources can be realized. The FAST corner detector is very suitable for real-time video processing application because of this high-speed performance.

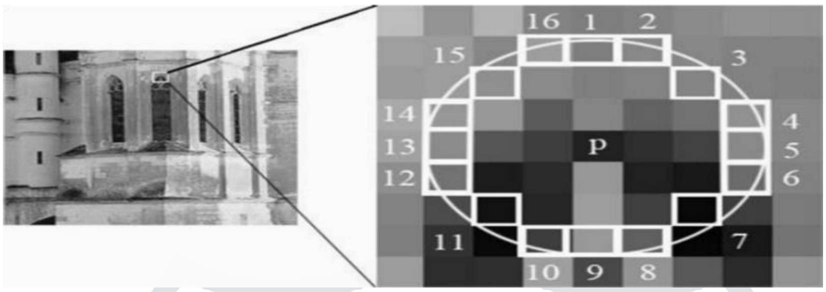

Fig. 2. Candidate feature detection for FAST algorithm

FAST Algorithm:

1. Select a pixel ***p*** in the image which is to be identified as an interest point or not. Let its intensity be ***Ip***.

2. Set a threshold intensity value ***t***, (say 20% percent of the pixel under test).

3. Consider a circle of 16 pixels around the pixel under test. (This is a Bresenham circle of radius 3.)

4. Now the pixel ***p*** is a corner if there exists a set of ***n*** contiguous pixels in the circle (of 16 pixels) which are all brighter than ***Ip* + *t***, or all darker than ***Ip* - *t***. (The authors have used ***n***= 12 in the first version of the algorithm)

   5. To make the algorithm fast, first compare the intensity of pixels 1, 5, 9 and 13 of the circle with ***Ip***. As evident from the figure above,
   at least three of these four pixels should satisfy the threshold criterion so that the interest point will exist.

6. If at least three of the four-pixel values—***I1, I5, I9, I13*** are not above or below (***Ip* + *t***), and (***Ip* - *t***.) then ***p*** is not an interest point (corner). In this case reject the pixel ***p*** as a possible interest point. Else if at least three of the pixels are above or below ***Ip* + *t***, then check for all 16 pixels and check if 12 contiguous pixels fall in the criterion.

$$\text{Spx}= \begin{cases} d & Ipx \le Ip - t \quad (darker) \\ s & Ip - t < Ipx < Ip + t \quad (similar) \\ b & Ip + t \le Ipx \quad (brighter) \end{cases}$$

7. Repeat the procedure for all the pixels in the image

III. EXPERIMENTAL RESULT

Two input images first converted into gray image and then applied a Harris method. Fig.3 shows the corner detection using Harris method Original image is shown in Fig. 4. Original image after converting into gray image is shown in Fig3. in Fig 5 shows Result of corner detected in both image. Fig 6 shows Matching of Corner in both image with inliers and outliers.

Figure 3: First Input and Gray Images

Figure 4: Corner Detection Using Harris Method

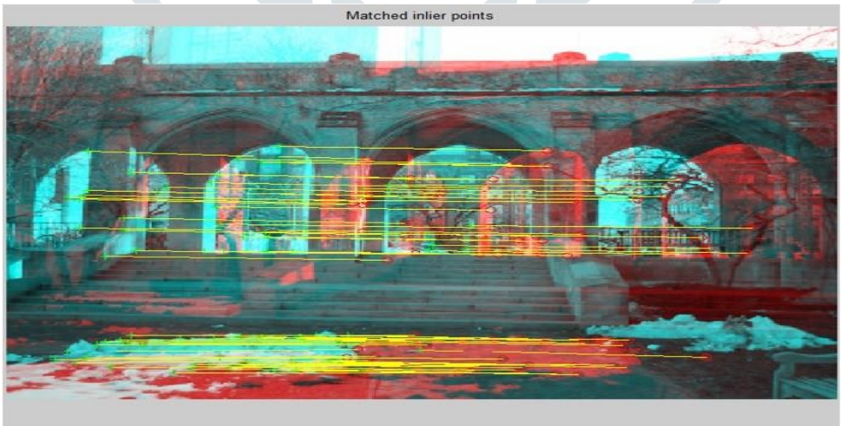

Figure 5: Corner Matched with Inliers (Harris Method)

Figure 6: Mosaic Output 1

A. *Result of FAST Method*

Here we apply FAST algorithm on gray image. Detected corner using FAST are shown in Figure 7. The number of corner detected in both image is 5077, 5158 respectively. Figure 8 shows matching of corner in two images. The count of matching is 53 . Figure 9 shows matching of corner with RANSAC. After applying RANSAC algorithm with projective transform true matched count is 47. The efficient matched ratio is about 88.67%. Figure 10 is output of final mosaic.

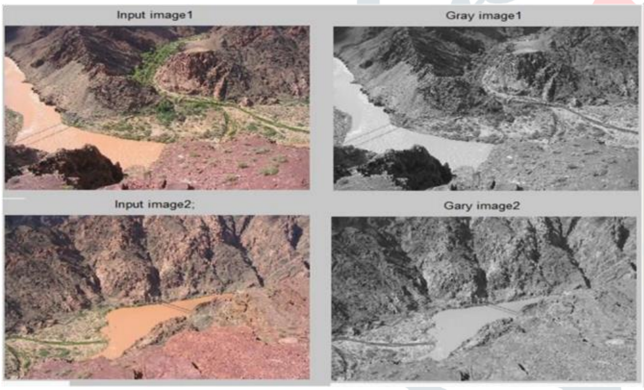

Figure 7: Second Input Set

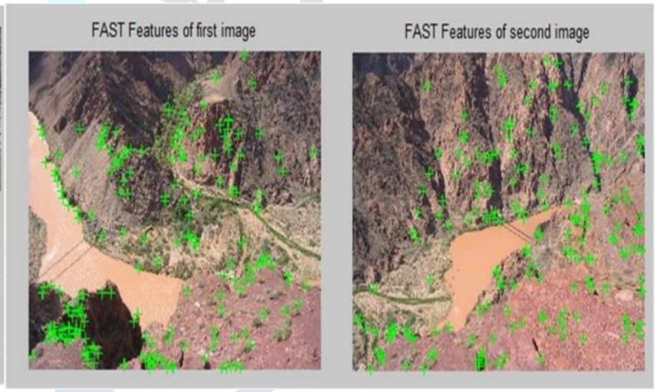

Figure 8: Corner Detection Using FAST Method

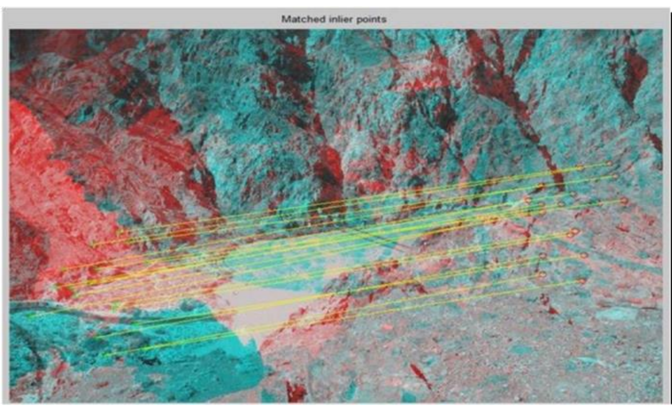

Fig 9: Corner Matched with Inliers (FAST Method)

Fig 10: Mosaic Output 2

IV. CONCLUSION

Image mosaicing is useful for a variety of tasks in computer vision and computer graphics. Image mosaicing is one of the important research area in the field of image processing. In this project, two algorithms are implemented. Harris and FAST corner detecting methods are proposed to detect the corner which need not set the threshold by manual and is in sensitive to isolated point, noise and edge. So it can avoid corner redundant or lost brought by uncertain threshold selection and improve the precision of corner detecting more ever by using the advantage of RANSAC in parameter estimation, which can remove the false matched corner pair effectively and improve the corner matched ratio.

Harris corner detection method is robust, and rotationally invariant. However, it is scale variant. The FAST algorithm is both rotation and scale invariant with improved execution time. FAST algorithm helps in video processing because of its speed. But, its performance is poor in presence of noise. Harris and FAST methods are simple and more accurate than other methods. Experiment shows the proposed algorithms has achieved well result.

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