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Improved Image Mosaicing method based on Multiple Feature

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Abstract: Image Mosaicing is the process of combining several overlapped images to create a single continuous image. The aim of this paper is to take multiple correlated input images to generate a large wide-angle image of a scene i.e. panoramic image. The input images are having some of the overlapped regions with one another. Image Mosaicing has become an active area of research in the fields of photogrammetric, computer vision, image processing, and computer graphics. Various Image Mosaicing algorithms have been developed to solve problems like misregistration of the image. A Large number of research has been done around the feature extraction and feature matching algorithms to improve processing of algorithm execution in terms of speed and space. In this paper, an improved Image Mosaicing method based on multiple features is implemented which not only includes more features but also improves accuracy over previous methods. Previously, Image Mosaicing algorithms developed includes fewer features hence, not able to produce a better quality of images. Multiple features based methods have shown many advantages over direct mosaicing methods in both time and space complexity.

Keywords: Image stitching/Mosaicing, panoramic image, SIFT, image blending, Feature Extraction, Image Registration, Matcher, RANSAC algorithm, VERIFIER.

I. Introduction

An Image mosaics are useful for a variety of tasks in vision and computer graphics. Several image mosaicing algorithms have been proposed over the last decade. Some novelties include feature-based image mosaicing proposed by Hu which was the first method which tells about feature extraction. Secondly ,expectation maximization algorithm for removing inconsistent overlaid regions in mosaicing proposed by Liyoshi[6] or the distortion calibration and the registration algorithm proposed by Tong[11]. Image Mosaic is a synthetic composition generated from a sequence of images and it can be obtained by understanding geometric relationships between images. The geometric relations are coordinate transformations that relate the different image coordinate systems. By applying the appropriate transformations via a warping operation and merging the overlapping regions of warped images, it is possible to construct a single image indistinguishable from a single large image of the same object, covering the entire visible area of the scene. This paper proposes Improved Image Mosaicing method based on Multiple features which are a combination of various methods includes an image mosaicing algorithm SIFT. Various steps in mosaicing are Image framing, Feature Extraction, applying SIFT algorithm, Matching, Registration, Homography using RANSAC, Image warping, Redrawing, and Stitching.

For image mosaicing t h e system, the work starts with pre-processing phase, which consists of two important steps. First, framing formation on the basis of calculation of global intensity difference. Second, feature extraction after image intensity is calculated. The mathematical formulas and calculation required in global intensity difference consist of intensity difference, image gradient, and grayscale conversion is used for image registration. Many filters are used like Gaussian and average filters which results in less distortion of the image. After the framing phase, here five basic features are considered for mosaicing as geometrical, object oriented, homographic, S.I.F.T (Scale Invariant Feature Transform) and Texture-Based methods of feature extraction is done. 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 a small part of the region of the image.

Image registration refers to the geometric alignment of a set 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 a geometric correspondence between the images so that they may be transformed, compared, and analyzed in a common reference frame. Homography is mapping between two spaces which are often used to represent the correspondence between two images of the same scene. In homography, undesired

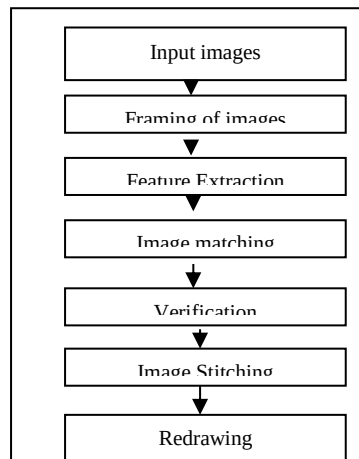
corners which do not belong to the overlapping area are removed. RANSAC algorithm is used to perform homography.

Image stitching process can be divided into three main steps- image registration, image calibration, blending. Stitching of the two images is the most important task in the image mosaic and the both the images may differ in texture, color depending upon the position of the 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. The next step is image warping which includes correcting distorted images and it can also be used for creative purposes. The images are placed appropriately on the bigger canvas using registration transformations to get the output mosaiced image. Image Blending is the technique which modifies the image gray levels in the vicinity of a boundary to obtain a smooth transition between images by removing these seams and creating a blended image.

II. PROPOSED METHODOLOGY

The image mosaicing procedure generally includes following steps. Firstly, we input the images. Secondly, using SIFT algorithm which detects features in an image, we can identify the similar objects in other images. By estimating the Homography, which relates pixels in one frame to their corresponding pixels in another frame, followed by wrapping and blending of input frames according to the estimated homography is done so that their overlapping regions align. In this paper, Improved Multiple features algorithms are proposed which not only includes more features of images on the basis of texture, object oriented, homographic based, And SIFT-based thus large data set can be obtained and Homographic approach for image registration including framing reduces problems of previous approaches. The methodology adopted is as follows: First, the image is divided into frames.

Figure 1: Workflow Diagram



Secondly, frames are then used in feature selection and feature extraction. Multiple Feature extraction is done. After these images are matched, verified and redrawn. After, those images are stitched. The various stages in this approach are explained in Figure 1.

III. ALGORITHMS

A. SIFT Algorithm:

Scale-invariant feature transform (or SIFT) is an algorithm in computer vision to detect and describe local features in images. The algorithm was published by David Lowe in 1999^[1]. Applications include object recognition, robotic mapping, and navigation, image stitching, 3D modeling, gesture recognition, video tracking, individual identification of wildlife and match moving. It has some unique features, such as rotation, affine transformation, scale invariance and noise immunity. SIFT is a corner detection algorithm which detects features in an image which can be used to identify similar objects in other images. SIFT produces keypoint descriptors. Key-point descriptors are given as input to the Nearest Neighbor Search (NNS) and produce closely matching keypoint descriptors.

B. Image Framing and Feature Extraction:

Texture-Based Approach for Framing: To overcome the complexity of using texture features on the entire image the proposed method divides the image into four Parts of different size and evaluates the texture features in each part separately. This is called framing. The texture features are derived from co-occurrence Parameters.

Feature extraction Based on Homography: Input Images of a scenery or hall are taken from the various point of view and features are extracted. Homographs estimation is done by calculating energy functions:

Calculation of energy Function is as follows:

$$Enq(L) = \sum DP(lp) + \gamma \sum Vp, q(lp, lq), \{p, q\} \in N$$

Where $Dp(lp)$ denotes the *data term*, and $Vp, q(lp, lq)$ denotes the *smoothness term*. The data term $Dp(lp)$ defines the cost of assigning the label lp to pixel p .

Feature extraction using SIFTS: SIFT FEATURE using homographic approach includes:

- Scale-space construction
- Extrema detection
- Orientation Assignment
- Key point Localization
- Key point descriptors.

Feature Extraction based on geometry: Various geometrical features like shape, size, width, height are considered in this feature extraction. Oriented Algorithm is used for this purpose.

Feature extraction Based on Object Oriented: Object Oriented includes tree, car, buildings, fan etc. are matched and common points are derived. This concept of object oriented is used.

C. Image Registration

For each frame with respect to source image:

Step 1. Compute the common points of target images and source images.

Step 2. Both common points are correlated.

Step 3. Find the homographic using STITCHER Algorithm. Call STITCHER

Step 4. Best matching points are obtained and call. *MATCHER and VERIFIER*

D. Stitcher Algorithm:

- 1: Select randomly the minimum number of points and determine the model parameters and solve parameter.
- 2: Determine how many points from the set of all points fit with a predefined tolerance ϵ .
- 3: If the fraction of the number of inliers over the total number points in the set exceeds a predefined threshold re-estimate the model parameters using all the identified inliers and terminate.
- 4: Otherwise, repeat steps 1 through 4 (N times).

E. Image Matching and Verification:

A. *Matcher algorithm:*

```
Method: w1 (P1, Error1) > w2 (P2, Error2)
If P1 > P2
    Return True
Else
    If P1 < P2
        Return False
    Else
        If  $\delta 1 > \delta 2$ 
            Return False
        Else
```

GMST of G reduction here, image matching is done by taking P1 and P2 which means P1 means the probability of far common points and P2 means the probability of near points $\delta 1$ and $\delta 2$ are function values of different points.

B. *Verifier Algorithm:*

VERIFIER is a new proposed algorithm which discards false matches.

1. Estimates an optimum Homographic matrix based on homographic constraints.
2. Geometric distance error is calculated and maximum no of inliers are derived for constructing the homographic matrix. Then using this matrix image is warped into a common coordinate frame.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

A. Collection of Data Sets:

Figure 2: Data Set of images



B. SIFT feature based image mosaicing:

SIFT Stands for Scale Invariant Feature Transforms. This is already developed module in MATLAB. It uses the invariant features extracted from images is used to perform reliable matching. Scale Invariant method was one

of the most effective methods of feature extraction which was extended to form mosaiced image and the comparison is done.

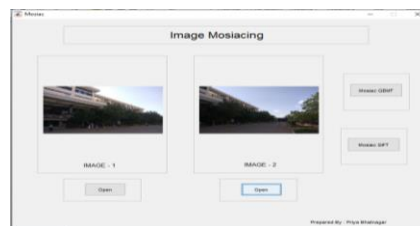
Figure 3: Mosaiced Image of image 1 and 2 using SIFT



C. Improved Image Mosaicing Method :

A new technique is developed by us in that more comparison is done on the basis of multiple features extraction like Homography, SIFT, Object Oriented and Geographic Based. Data Set is taken as input. After that image matching is done and common points are found.

Figure 4: Selection of image 1 and 2 as input image

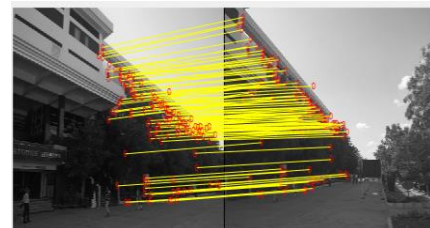


First of all, both images 1 and 2 are combined with each other. After that key points are calculated and matched.

Figure 5: Combined view of image 1 and 2



Figure 6: Matching points between image 1 and 2



Finally, we got the output as a mosaiced image.

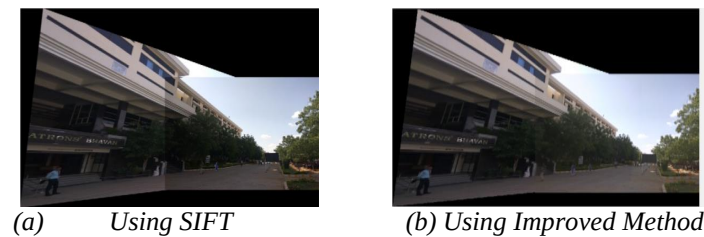
Figure 7: Mosaiced output Image of image 1 and 2



V. COMPARISON

The images shown below give a clear picture that there is a less distortion of images using Improved Image Mosaicing approach. It also produces better quality as compared to SIFT approach. The improved method ensures more accuracy by calculation of correlation and covariance method and normalization.

Figure8: Mosaiced output



VI. CONCLUSION

Image mosaicing is considered as an active research area in the fields of computer vision and computer graphics. Due to the wide range of applications, image mosaicing is one of the important research areas in the field of image processing. Here we have presented some of the very fundamental and basic techniques and improved algorithms used in image mosaicing. This paper presents a complete process for image mosaicing. In this paper, the approach focuses on a frame-based method which includes a lot of features. Features are extracted on the basis of texture, geometrical, object oriented, homographic and SIFT features. Later image mosaicing is performed. This method solves accuracy, PSNR problem, better cost, and computation. Therefore, enhances the performance of previous methods. VERIFIER Algorithm removes the flaws of matching. But, since in this method more features are included, therefore, it has resulted in more execution time. In future, this algorithm can be improved by reducing execution time and applying it to very small and very large images. In medical apparatus and digital cameras this algorithm can be further applied.

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