International Journal of Engineering Research & Management Technology ISSN: 2348-4039
November-2016 Volume 3, Issue-6
Email: editor@ijermt.org www.ijermt.org

A FAST FEATURE – BASED TECHNIQUES FOR IMAGE MOSAICING

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ABSTRACT: In last few decades, real time applications in image mosaicing have been a challenging field for image processing experts. In this research work, feature based image mosaicing technique has been proposed. We have introduced a novel method and variants for image mosaicking. The main aim of proposed method compared with other method is its time its complexity. The method is designed in a way that it's yield a mosaicied image in linear amount of time as compared to other methods. Another advantage is that proposed method yields the best mosaicied image in both color and gray scale as compared to other algorithms. Here we are comparing our proposed method with SIFT, RANSAC.

KEYWORDS: Image stitching, panorama, image mosaicing, features matching, feature detection.

1. INTRODUCTION

Nowadays, image mosaicing is gaining a lot of interest in the research community. It can be regarded as a special case of scene reconstruction. Image stitching is the process of combining multiple images with overlapping fields using different techniques to produce a high resolution of images. The word panorama is derived from Greek words "pan" and "horma" where word "pan" means everything and the word "horma" means to view. Images can be created in a various way from the first round painting in the 18th and 19th centuries. The main aim of image stitching is to increase the image resolution and the field of view(FOV). People used image stitching technology in topographic map is a type of map that characterized by large scale detail and quantitative representation of relief [8].

A panorama is a wide-angle representation of a physical space, whether in painting, drawing, photography, film, seismic images or a three-dimensional model. The word was originally coined in the 18th century by the English painter known as "Robert Barker" to describe his panoramic paintings of Edinburgh and London. The motion-picture term panning is derived from panorama.

Mosaicing is a process that stitches multiple, overlapping snapshot images of a document together in order to produce one large, high resolution composite. The document is slid under a stationary, over-the-desk camera by hand until all parts of the document are snapshotted by the camera's field of view.

Mosaicing is one of the techniques of image processing which is useful for tiling digital images. Mosaicing is blending together of several arbitrarily shaped images to form one large radiometrically balanced image so that the boundaries between the original images are not seen. Mosaicing is a special case of geometric correction where registration takes place in the existing image.

Image mosaic synthesis has recently received substantial attention in both the research literature as well as in the form of commercial application [3]. There are many algorithms today available which are capable of taking overlapping images of the same scene and stitching them together to create a high resolution of images. These algorithms have numbers of requirements like (i) limited camera translation, (ii) lighting variation, (iii) similar setting between images and (iv) limited motion of objects in the scene. The different types of image mosaicing techniques are SIFT SURF, RANSAC, and HARRIS CORNER and ORB techniques.

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. SIFT techniques is one of the most widely used and robust. It is based on the local features, it is a features detection and description techniques. It produces a key point description which describes the images features [6].

SURF is a fast and robust algorithm developed by BAY [6]. It is used for local or similarity in variant representation and comparison. It can be divided into three main steps: (i) key point is selected, (ii) neighborhood of key-point is represented and, (iii) the descriptor vector is match. ORB technique is a very fast binary descriptor based on Binary Robust Independent Elementary Features (BRIEF), key-point descriptor.

RANSAC is a method to calculate the parameters of a mathematical model from a set of observed data. Input of RANSAC algorithm is a set of observed data, a parameterized model which can explain or fit to the observations, along with some confidence parameters [9]. It is a non-deterministic. The algorithm was first published by Fischler and Bolles at SRI International in 1981. A basic assumption is that the data consists of "inliers", i.e., data whose distribution can be explained by some set of model parameters, though may be subject to noise, and "outliers" which are data that do not fit the model.

Harris corner techniques is for matching the point correspondence in subsequent images frames and also keep track of both corners and edges between frames. This operator was developed by Chris Harris and Mike Stephens in 1988 as a low-level processing step to aid researchers trying to build interpretations of a robot's environment based on image sequences. Harris and Stephens were interested in using motion analysis techniques to interpret the environment based on images from a single mobile camera [10].

The main techniques underlying the proposed methodology are the fast- feature matching of images and mosaicing them all together. The appropriate transformation has been applied, images are warped and the overlapping area are of warped images are merged into a common surface which gives single indistinguishable image which is a tantamount version of a single large image of a same scene. The resultant images are the motivation for image mosaicing.

2. PROPOSED WORK

A proposed method, "Fast-Feature Match", an algorithm specially designed to match large images efficiently without compromising matching accuracy. It derives its speed from only computing features in those parts of the image that can be confidently matched. Fast-Match is an order of magnitude faster than the other proposed algorithm.

We match local image features we are facing with a choice between performance and accuracy. On one hand SIFT features shown again and again to compare favorably to other local image descriptors. On the other, SIFT key points and descriptors are slow to compute, the main reason for the introduction of "Fast Feature Matching Algorithm".

Feature selection, as a very first step to machine learning, is effective in reducing dimensionality, removing irrelevant data, increasing learning accuracy, and improving result comprehensibility. However, the recent increase of dimensionality of data poses a severe challenge to many existing feature selection methods with respect to efficiency and effectiveness.

Feature selection has been a fertile field of research and development since 1970's and proven to be effective in removing irrelevant and redundant features, increasing efficiency in learning tasks, improve learning performance like predictive accuracy, and enhancing comprehensibility of learned results[4]. Block matching and feature-point matching are the two basic ways to identify the matching region from the input images. Block matching algorithms calculate the correlation between regular-sized blocks generated in sequential images [7].

Feature detection is a low-level image processing operation. That is, it is usually performed as the first operation on any image, and examines every pixel to see if there is a feature present at that pixel. If this is part of a larger algorithm, then the algorithm will typically only examine the image in the region of the features. Feature detection and matching aims to detect features and then match them. Local and global registration starts from these feature matches, locally registers the neighboring images and then globally adjusts accumulated registration error so that multiple images can be finely registered. Image composition blends all images together into a final mosaic [5].The processing involved with feature based mosaicing systems can generally be broken down into five distinct stages. At each stage different algorithms can be implored to compute results and then be used by the next stage of the inter-camera projection process. This structure is demonstrated in Figure 2.1.

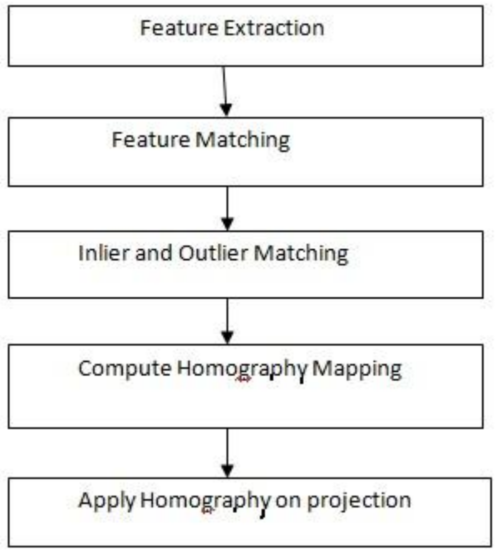


Fig: 2.1*:* Five sequential stages to feature based mosaicing.

These stages are chained together, each relying on the previous stage's output to compute an output result of its own. This places key importance on the type of feature detector chosen for the First stage and as such makes the feature extraction stage a critical step for any mosaicing system. Features are extracted from each image set to be combined in the mosaic, putative feature matches are computed. The feature matching stage produces these putative matches which should have as high of a correct matching rate as possible, yet undoubtedly will produce some false matches. These false matches are then presumably identified in stage three by an estimation process.

During this process the false matches are considered outliers to some sort of likelihood model and the correct matches or inliers are passed on to stage four. The fourth stage takes these estimated true matches and computes the geometric transformation which best maps the corresponding scene points from one image to the same scene points in the other.

In this proposed method we take two input images. The threshold value is calculated for the respectively images. Depending upon the dimension of the images or the corner value of both the images, two input images is being stitched. We are matching the features between the two input images according to their threshold value and the input images are being stitched.

A. Feature Extraction

Features are computed in this stage for each image contributing to the formation of the mosaic. Various types of features can be extracted from an image. The feature vectors themselves are used in stage II matching, and detected image locations of the features is used in the computation of a holography in stage IV with respect to Figure 2.1

B. Feature Matching

In the second stage of processing, features are matched between each pair of overlapping images. For this reason, this processing stage produces putative feature correspondences. In the next stage of processing false matches will be determined from these putative correspondences via a modeling and estimation algorithm. This means that putative feature matching techniques employed should strive to be fairly consistent and as strong as possible in providing a set of putative matches for the next stage. Both cross correlation methods and nearest neighbor matching schemes are described here as stage II algorithms.

C. Inliers and Outlier Matching Estimation

In the third stage of mosaicing for feature based systems, false matches are detected through an estimation process. This estimation process firsts feature matches to a probabilistic model. The parameters of the model which best accommodate the feature set are then selected which in the case of mosaicing are the elements of a tomography matrix.

D. Solving for the Holography

In this stage, the final mapping is computed which will relate coordinates of two overlapping images captured of a common scene. The input to this stage is estimated feature match inliers between two images. A holography is the name of a matrix capable of protectively mapping points in one image to those in another. The concept of a tomography comes from the branch of mathematics called projective geometry [1] and is a type of perspective transformation containing eight degrees of freedom.

E. Perspective Image Transformation

To complete the process of mosaicing computed hymnographies are used to transform the set of individual images captured of a common scene, projecting them as one, final complete image. This single image containing all of the imaged portions of a single scene is called the mosaic, and this stage of processing is called perspective projection. This step is the final part of the formation of the mosaic and a variety of interpolation techniques exist to accomplish this task with one of the most common being bilinear interpolation.

3. CONNECTED COMPONENT DESDRIPTORS

Another investigated feature type is a connected component descriptor used in an application for the mosaicing of camera captured document images [2]. These features are based on the image segmentation technique called connected component labeling. This connected component labeling technique first involves setting an intensity threshold to an image. Using this threshold a binary image is created from the original image and then similar regions of pixels are identified by a two-pass connected component labeling algorithm on the binary image. Either black or white pixels in the binary image are first considered to be background elements. It is also standard practice to apply the algorithm twice and alternating white and black as background elements.

Next, the two-pass algorithm is performed by raster scanning the image two times. On the first pass, connected groups of pixels by neighborhood that are not elements of the background are labeled with the smallest integer label not in use. On this pass the integer label index is incremented each time a new connected region of pixels is established, and a note is made for equivalent labels. After the second pass through the image equivalent labels are then replaced by the smallest integer label of the connected region. The result of the two-pass algorithm is a connected component labeled image. Following the labeling process with the two-pass algorithm the connected component descriptors are obtained via the angular radial transform (ART) taken on each component. In standard form the equation for the angular radial transforms.

4. FAST CORNER DETECTOR

Another possible feature extraction algorithm is the FAST corner detector. These features are computed efficiently based on a machine learning technique. This corner detection technique has recently found utilization in the image mosaicing field for a real-time aerial image mosaicing application. The FAST corner detection scheme finds potential corner points on a local neighborhood in the shape of a circular. The key principle is that a corner exists at the center of this circle when the minimum value is high for the difference of a disk pixel a positive radius away and the center pixel squared plus the difference of a disk pixel a negative radius away and the center pixel squared. If the minimum value for a given orientation angle, µ, exceeds a threshold the point, xc, is considered to be a corner. This concept in itself is not entirely new. However, to make this computation over a discretized disk efficiently is the proposed FAST method. This method involves using a training set of images and making the computation of corners for a circle of specified perimeter pixels on the disk. Entropies are computed accordingly across all training images to find the points, x, which yields maximum information and a decision tree is then formed for a speedy computation.

5. PROPOSED ALGORITHM FOR FAST-FEATURE MATCHING

1. In first step we have two images let us consider it “A” and “B”.
2. In second step we search for the point which lies on both images “A” and “B” and named them as, “hy” and “gt” followed by extension with cropping.
3. In the third step, we have to consider the region in which stitching takes place followed by calculating the difference between the input images and taking the maximum of the differences in the three color channels.
4. In the fourth, let us call difference as diff, now we have to consider inverse of the difference.
5. In fifth step, is to create a seed image. Create a seed image.
6. In sixth step, we apply the global alignment.
7. In last step, image is blend and its composition. Blend the input image and warp it to give output.
8. Finally we received a Mosaicing image using Fast Feature Matching Technique.

6. RESULT AND COMPARISION

A. *Result*

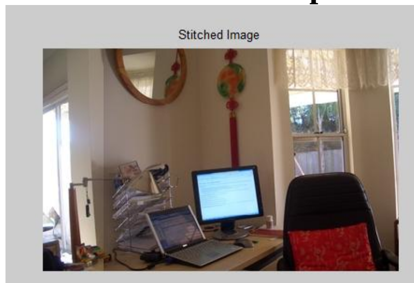
The result is divided in five parts of input images where:

1. 1st part consists of two colored input images and resultant is single mosaicing image and it is compared with already described methods on the basics of mosaicied image output and its time complexity that is the time taken by image to be mosaicied.
2. 2nd part consists of two input images and resultant is single gray mosaicing image and it is compared with already described methods on the basics of mosaicied image output and its time complexity that is the time taken by image to be mosaicied.
3. 3rd part consists of three input colored images and resultant is single mosaicing image and it is compared with already described methods on the basics of mosaicied image output and its time complexity that is the time taken by image to be mosaicied.
4. 4th part consists of three input images and resultant is single gray mosaicing image and it is compared with already described methods on the basics of mosaicied image output and its time complexity that is the time taken by image to be mosaicied.
5. 5th part that is last part consists of comparison algorithm result where, three input images is taken and resultant is single mosaicied image with its time complexity. The result is compared on the basic of time complexity is yield. Below are the result of mosaicing and the table of time complexity which is based on average time complexity.

1ST PART:

Two Input Image:

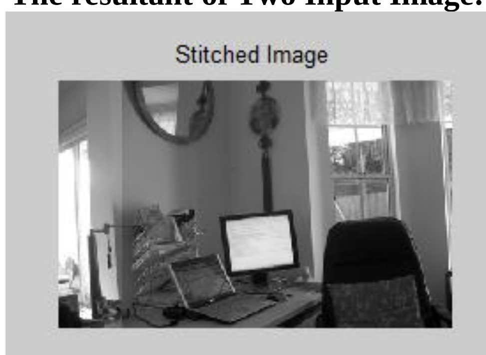
The resultant of the two input image is:



2ND PART:

Two input images:

The resultant of Two Input Image:



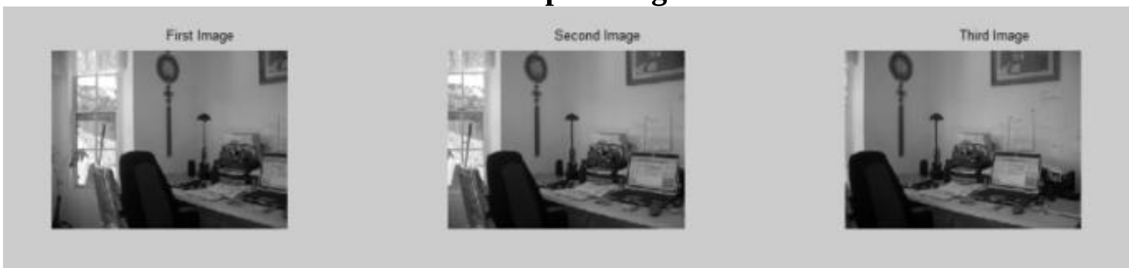
3RD PART:

Three input images:

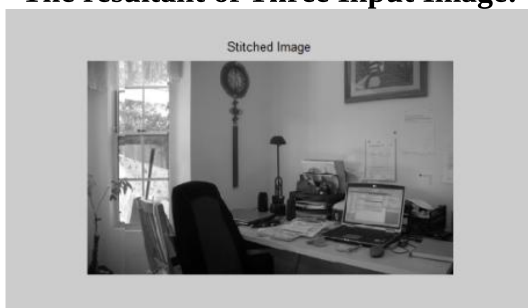
The resultant of Three Input Image:

4^{TH} PART:

Three input images:



The resultant of Three Input Image:



5^{TH} PART:

Three input images:

The resultant of Three Input Image:

Hence, our proposed method is best as its result is best in comparison with its time complexity and output of mosaicied image.

TECHNIQUES	AVERAGE TIME COMPLEXITY	
SIFT	72.84 sec	
RANSAC	4.58 sec	
PROPOSED METHOD	TWO IMAGES(RGB & GRAY)	THREE IMAGES(RGB &GRAY)
	2.5 sec & 1.68 sec	1.08 sec & 1.76 sec

Table1: Comparative Result

B. Comparison

Now at this we are comparison our proposed method with SIFT, RANSAC, Harris corner, SURF techniques. Comparison is done on the basics of mosaicied image output and its time complexity that is the time taken by image to be mosaicied. It is a average time complexity calculated on the basics of set of 10 input images.

7. CONCLUSION AND FUTURE WORK

A. Conclusion

Image mosaicing is the method of assembling the images with overlapping area into a single image. Image mosaicing is the method of assembling the images with overlapping area into a single image. We have introduced Fast-Feature Match Techniques and comparing with other techniques like SIFT,RANSAC. At the same time, Fast-Match can be nearly a magnitude faster than Ratio-Match.

The retrieval variant of Fast-Match is particularly effective for matching a single given image to multiple large images.

B. Future Work

The test input images used for the present work were the planar 3-D images, it can be extended for the cylindrical and spherical images as well. Individual algorithms can be further improved at the algorithmic level rather that at the level of implementation to incorporate the added and complimentary features of the other algorithms, and hence the execution time as well the procedural length can be greatly reduced for four and more images and as well as for the video.

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