A Survey On Image Mosaicing Using Feature Based Approach

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***Abstract*— Image mosaicing is consider as an active research area in computer vision and computer graphics. Image stitching techniques can be categorized into two approaches: Direct technique and Feature based techniques. Direct techniques compare all the pixel intensities of the images with each other, and Feature based techniques used to determine a relationship between images through distinct features extracted from the processed images.**

***IndexTerms*— Image Mosaicing, Feature based approach, Feature detection and description, RANSAC,Blending**

I. INTRODUCTION

Image processing is a method to convert an image into digital form and perform some operation on it. In order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Image processing system includes treating images as two dimensional signals while applying already set signal processing methods to them.[13] Image Mosaicing is a method of constructing multiple images of the same scene into a larger image. The output of the image mosaic will be the union of two input images. Image-mosaicing algorithms are used to get mosaiced image. Image Mosaicing processed is basically divided in to 5 phases. Which includes; Feature point extraction, Image registration, Homography computation, Warping and Blending if Image. [2]

Image Mosaicing technology is becoming more and more popular in the fields of image processing, computer graphics, computer vision and multimedia. It is widely used in daily life by stitching pictures into panoramas or a large picture which can display the whole scenes vividly. For example, it can be used in virtual travel on the internet, building virtual environments in games and processing personal pictures.[2]

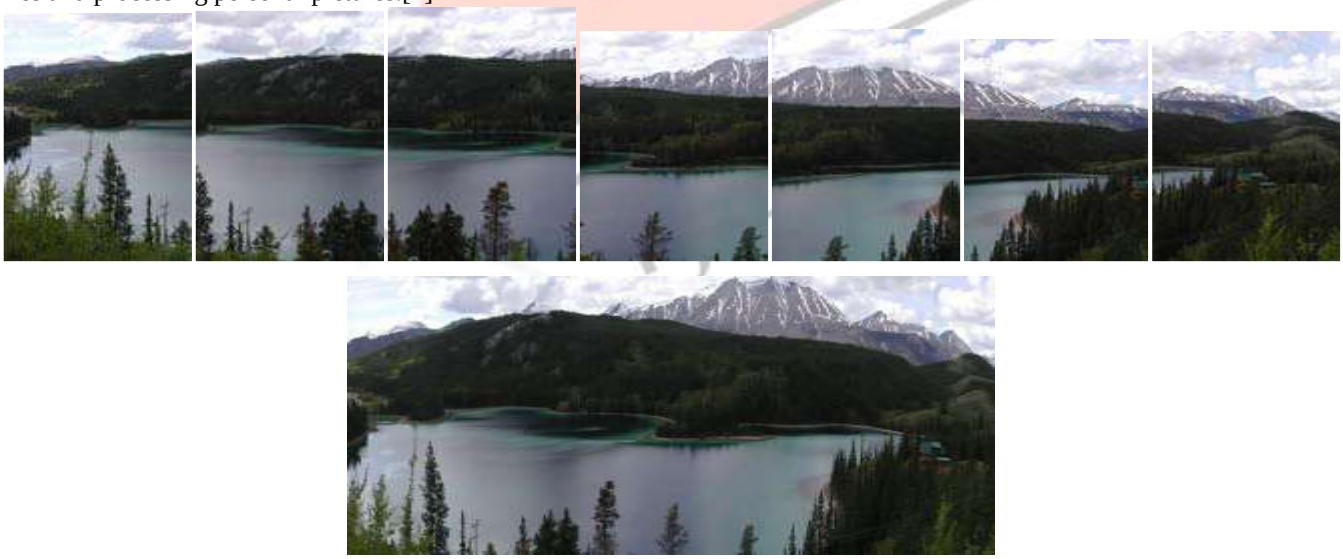

Figure 1: image stitching

In image mosaicing two input images are taken and this images are fused to form a single large image. This merged single image is the output mosaiced image. The first step in Image Mosaicing is feature extraction. In feature extraction, features are detected in both input images.[2] Image registration refers to the geometric alignment of a set of images. The different sets of data may consist of two or more digital images taken of a single scene from different sensors at different time or from different viewpoints. In image registration the geometric correspondence between the images is established so that they may be transformed, compared and analyzed in a common reference frame.

This is of practical importance in many fields, including remote sensing, computer vision, medical imaging. Registration methods can be loosely divided into the following classes: algorithms that use image pixel values directly, e.g., correlation

methods; algorithms that use the frequency domain, e.g., Fast Fourier transform based (FFT-based) methods; algorithms that use low level features such as edges and corners, e.g., Feature based methods; and algorithms that use high-level features such as identified parts of image objects, relations between image features, for e.g., Graph-theoretic methods.[2]

The next step, following registration, 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. The quality of the mosaiced image and the time efficiency of the algorithm used are given most importance in image mosaicing.[2] 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. Blend modes are used to blend two layers into each other.[4]

II. IMAGE STITCHING APPROACHES

Direct technique : Depends on comparing all the pixel intensities of the images with each other. It minimizes the sum of absolute differences between overlapping pixels or use any other available cost functions. In direct technique, each pixel intensities of image are compared with each other.[12] The main advantage of direct technique is that it minimizes the sum of absolute differences between overlapping pixels. In this technique, each pixels are compared with each other so it's a very complex technique. The main disadvantage of direct techniques is that they have a limited range of convergence.[8]

Feature based techniques **:** Feature based methods have become increasingly popular and widespread in mosiacing. This is particularly because of the strength of new algorithms and types of invariant features which have been demonstrated in the recent years. In feature-based technique, all main feature points in an image pair is compare with all features in the other image by using one of the local descriptors.[8] Feature- based methods are used by establishing correspondences between points, lines, edges, corners or any other shapes. The main characteristics of robust detectors includes invariance to image noise, scale invariance, translation invariance, and rotation transformations. There are many feature detector techniques exist some of which are, Harris, Scale-Invariant Feature Transform (SIFT), Speeded Up Robust Features (SURF), Features from Accelerated Segment Test (FAST), and ORB techniques.[12]

Different methods of feature based technique[12]: In image stitching systems that are based on the features approach, the features of the input images are extracted and then matched with each other based on correspondence similarity of their descriptors. This stage can be classified into three main steps: detection, description, and matching. There are two main types of features descriptors: vector descriptor and the binary descriptor. SIFT, and SURF are considered as vector descriptors while ORB and BRIEF are binary descriptors. In traditional methods, first edges are detected to find corners which have quick variation in all directions. Corners are two dimensional structures.[2]

Binary Descriptors brought are major advantage in both memory footprint and running time since traditional descriptors expensive gradient operations and memory. Binary descriptors has pixel to pixel comparison and results in a binary strings and holds a properties below

1. Binary Descriptors result in a fraction of time because pixel to pixel comparison executes negligible time than the gradient operation.
2. Hamming distance is used to match binary representations which is faster than Euclidean distance.
3. A binary descriptor is 4 times faster than gradient descriptors because it uses 512 bits for a single binary descriptor where as a single gradient descriptors need 64 or 128 floating points to store.

SIFT: SIFT proposed by David Lowe and then improved in 2004. It is the most common known vector descriptor. It consists of four essential stages: scale-space extreme detection, key points localization, orientation assignment, and generating key point descriptor. In the first stage, the key points are extracted based on their strength that are invariant to orientation and scale using Difference of Gaussian. In the second stage, the wrong points are removed. Then in the following stage, one or more orientations are assigned to each key point. In the final stage, a vector descriptor is made for each key point.[8]

SURF: The SURF algorithm was proposed by Bay et al. It is built upon the SIFT, but it works by a different way for extracting features. SURF is based on multi-scale space theory and speeds up its computations by fast approximation of Hessian matrix and descriptor using "integral images". Haar wavelets are used during the description stage.[5]

FAST: FAST is a high-speed feature detector that is much suitable for real-time applications. The algorithm considers a circle of 16 pixels around the candidate corner p. A feature is specified when a set of n contiguous pixels in the circle are all darker or brighter than the candidate pixel p plus a threshold t.[12]

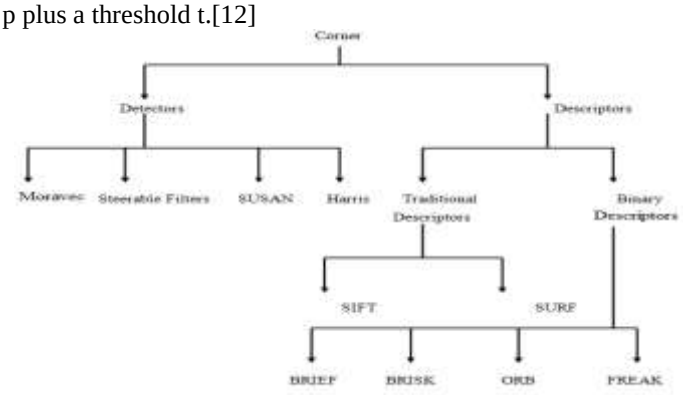

Figure 2: Classification of popular Corner Detectors and Descriptors[2]

Harris: Harris is a corner detector based on Moravec algorithm, which is proposed by Harris and Stephens in 1988. A detecting window in the image is designed. The average variation in intensity is determined by shifting the window by a small amount in a different direction. The center point of the window is extracted as a corner point.[3]
Good Features to Track Detector: It expands the Harris detector to make its corners more uniformly distributed across the image. Shi and Tomasi showed how to monitor the quality of image features during tracking. They investigated a measure of feature dissimilarity that quantifies how much the appearance of a feature changes between the first and the current frame.[9]
ORB: ORB technique developed by Rublee et al. It is a combination of features from FAST key point detection and Binary Robust Independent Elementary Features (BRIEF) descriptor. It describes the features of the input image in a binary string instead of the vector.[10]
MSER: MSER stands for Maximally Stable Extremal Regions Detector. It was generated by Matas et al. to find matching between image elements from two input images from different viewpoints. The maximally stable in MSER describes the property optimized in the threshold selection process. The word extremal refers to the property that all pixels inside the MSER may be either higher or lower intensity than all the pixels on its outer environment.[8]
BRISK: BRISK stands for "Binary Robust Invariant Scalable Key points". BRISK is feature detector and descriptor introduced in 2011. It is a binary descriptor with 512 bits that computes weighted Gaussian with very low cost. It averages near key point over a scale pattern of points. In art algorithms high quality performance is achieved with BRISK. It is faster than SURF due to its high speed and limited power computations it has many real-time applications.[8]

III. IMAGE MOSAICING MODEL USINF FEATURE BASED APPROCH

In the proposed image stitching system, apply the following steps:

1) Here extract features from the overlapping input images using one of the different extraction techniques and then generating the descriptor of those features.

2) After extracting and describing the features, and match these features with each other based on their descriptors.

3) Then, find out the correcting features by using the feature matching techniques, which removes unwanted feature points.

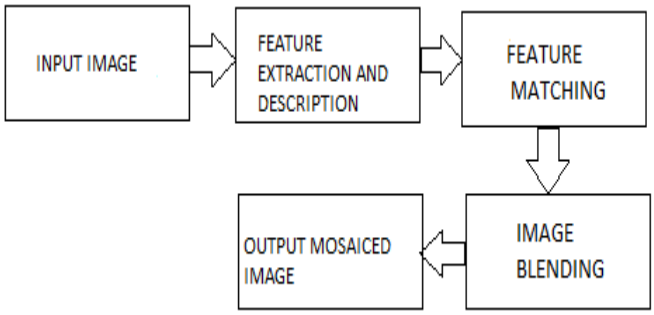

Figure 3: Image mosaicing block diagram

4) Then apply blending process to eliminate the seams between the processed images. With the help of image blending method.

5) In the last step, get the final output panoramic image with a high stitching quality.

IV. LITURATURE SURVEY

K. Sai Venu Prathap, Dr. S. A. K. Jilani, Dr. P. Ramana Reddy.[2] This paper discusses a review on distinct algorithms of feature detectors and descriptors. Typically five phases are included in an Image Mosaicing. They are: Feature Extraction, Image Registration, Homography Computation, Image Warping and Blending. Advantages are ORB is faster, FREAK executes good performance than the BRISK. SURF performance is good. Disadvantages are The FAST is both scale and rotation invariant with optimized execution time used in real time applications but for noisy images, performance is poor. ORB is little bit lesser quality.

Shreyas Mistry, Prof. Arpita Patel,[3] This paper discusses the feature detection step can be executed in a number of methods by selecting various features in the images which are unique and robust. Out of all the feature detected, the corners are most versatile and gives the very good results. The corner detection method used in this paper is Harris corner detection method in which used the Harris-Stephens algorithm to detect the corners the given image. Advantages are Harris corner detector is a popular interest point detector due to its strong invariance to rotation, scale, illumination variation and image noise. And it's disadvantage noisy image data or data with uncertainties.

Ruixing Du and Taskin Padir[4] This paper provides quantitative comparison of these two image stitching techniques to evaluate the performance in acquiring aerial surveillance information from multiple vision. Advantages are the infinite-homography-based method can stitch images with a faster speed and little compromise in the quality of the panorama. The cameras installed on IPASS are low-cost CMOS cameras. Disadvantages are the quality of images taken by these cameras are not good enough and this sometimes leads to failure to extract enough feature points for the feature-based image stitching method.

Ebtsam Adel, Mohammed Elmogy, Hazem Elbakry[10] This paper is to introduce a high-quality image stitching system with least computation time. First compare many different features detectors. Test Harris corner detector, SIFT, SURF, FAST, Good Features To Track, MSER, and ORB techniques to measure the detection rate of the corrected key points and processing time.

Second manipulate the implementation of different common. categories of image blending methods to increase the quality of the stitching process. Advantage is ORB algorithm is the fastest, more accurate, and with higher performance. Disadvantages are several problems while implementing the stitching system.

Ms. Mital S. Patel, Dr. N. M. Patel, Dr. Mehfuza S. Holia[5] This paper presents an efficient method for multi-view image registration based on SURF (speeded up robust feature) to enlarge a field of view. Multi-view image registration is used in the field of video conferencing, 3D image reconstruction, generating large field of view and satellite imaging. It can also be used for mosaicing based localization, shape recovery and motion detection and tracking. Advantages are Detection of the feature using SURF increase the speed and accuracy of the feature detection . SURF gives more accurate result compare to Harris.

Ebtsam Adel, Mohammed Elmogy, Hazem Elbakry[7] In this paper, a real time image stitching system based on ORB feature-based technique. Advantages ORB algorithm is the fastest, the highest performance, and it needs very low memory requirements. Disadvantages are comparative study between all those detectors according to affine transformation problem, scale changes, illumination changes, and noisy images.

V. CONCLUSIONS

This paper proposes Image mosaicing is considered as an active research area in the fields of computer vision. It has large amount of different algorithms for features detection. These algorithm used for improving the image stitching using image blending techniques.

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