Image Mosaicing Technique – A Brief Review

Saloni Suman
SAGE University, Indore

Abstract- *The confinement of digital PC has presented to the civilization a machine that is much more prevailing than human beings in mathematical calculation. The admissible question leading towards the human capability of processing non-numerical information received from the environment as-well-as society of reasoning and decision making based on non-numerical data could be amalgamated in the machine with identical or more efficiency. The motivation behind the concept carries the problem to automatically estimate correspondences of feature points between two images while avoiding mismatches is a fundamental problem in computer vision and has been lengthily considered for a duo of periods. The process of Image Mosaicing is divided into four simple stages (viz. feature detection, feature matching, transformation, and image fusion), and all these stages can be executed using various algorithms. In this work, the process of feature detection is achieved using Harris Corner Detection algorithm, which is our method of choice because of its advantages like consistency of detection, localization, stability, and low convolution.*

Keywords- Edge Detection, Corner Detection, Eigen Value, Feature Extraction, Image Mosaicing, Image Fusion

I. INTRODUCTION

The Art domain is one of alteration and consideration, pointed for novel methods of expression, and new mediums in which to create. For the artist, the computer is yet another tool or another brush with which to explore human expression. Artists spanning a wide variety of disciplines have embraced the computer. Writers, painters, illustrators, graphic designers, animators, sketch artists, and filmmakers now have the computer at their removal as a creative tool. Mosaicing of pictures have been in exercise since long earlier the age of digital computers. Soon after the photographic process was established in 1841, the use of photos was demonstrated on topographical planning. Images attained from hilltops or balloons were physically pieced together. This was originally done by physically mosaicing pictures which were attained by adjusted equipment, and the necessity for mosaicing sustained to growth later in past as satellites started sending photographs back to earth. Enhancements in computer technology converted a natural enthusiasm to develop computational methods and to solve linked complications.

Image mosaicing is the process of merging split images that are obtained by scanning different parts of a single large document image with some sort of overlapping region to produce a single and complete image of the document. It is connecting two or more images and making a new and wide area image. In any case a part of the needed scene can be taken at once for restriction of the resolution of a camera, a photography angle, etc., by taking the scene many times so that a part of image should be overlapped, and mosaicing the images, the scene can be obtained. Thereby, even a 360-degree panorama picture can be created. At this time, in mosaicing, the biggest is problem how the position relation between two or more images is drawn [1].

Various steps in mosaicing are feature extraction and registration, stitching and blending. The first step in Image Mosaicing is feature extraction. In feature extraction, features are detected in both input images. 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 geometric correspondence between the images so that they may be transformed, compared, and analyzed in a common reference frame. This is of practical importance in many fields, including Aerial Imaging, medical imaging, and computer vision [2]. Registration methods can be loosely divided into the following classes: algorithms that use image pixel values directly, e.g., correlation methods [3]; algorithms that use the frequency domain, e.g., fast Fourier transform based (FFT-based) methods [4]; algorithms that use low-level features such as edges and corners, e.g., feature based methods [3]; and algorithms that use high-level features such as identified (parts of) objects, or relations between features, 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. 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 by determining how pixels in an overlapping area should be presented. Blend modes are used to blend two layers into each other. The term image spline refers to digital techniques for making these adjustments. A good image spline makes the seam perfectly smooth, yet preserves as much as the original information as possible.

II. LITERATURE REVIEW

Raman Maini *et al.* [3] discussed edges characterize boundaries and also a problem of fundamental importance in image processing. Image edge detection suggestively decreases the quantity of data and filters out unusable information, while preserving the important structural properties in an image. Meanwhile edge detection is at the vanguard of image processing for object recognition, it is critical to have a good empathetic of edge detection algorithms. This work presents a comparative analysis of various image edge detection techniques. It has been shown that the Canny's edge detection algorithm performs better than all these operators under most scenarios. Assessment of the pictures shows that underneath noisy situations Canny, LoG (Laplacian of Gaussian), Robert, Prewitt, Sobel exhibit improved performance, respectively. It has been pragmatic that Canny's edge detection procedure is computationally more affluent equated to LoG (Laplacian of Gaussian), Sobel, Prewitt and Robert's operator.

Chao Sui *et al.* [4] proposed an image mosaic construction method which focuses towards feature matching and image fusion. The virtue of this method is that it can effectively reduce the rate of feature mismatches. The corners in two overlapping images are taken as features. These features are detected and matched in order to derive a transformation matrix. The matrix is used to align the images that are further combined. In order to guarantee a reduced rate of mismatching, the cross-correlation algorithm is employed. Furthermore, a smooth mosaic is obtained by the use of a fusion process.

Image mosaicing is a process of piercing together overlapping images of a scene into a larger image smoothly. This is required to increase the area of coverage of an image without degrading its resolution. Therefore, overlapping images are acquired and combined into larger image through image mosaicing. An image mosaic is created from a set of overlapping images by registering and re-sampling all images into the coordinate system of a reference image.

Planar mosaic is used when it is known that the image sequences are related to be homographic (planar), all the images can be warped onto a plane and the mosaic can be constructed. In cylindrical mosaicing, the translational gesture across images is appraised in terms of cylindrical coordinates. In other words, the input images are warped onto a cylinder. In Spherical mosaicing, the images are mapped to a sphere as opposed to a cylinder. Other types of mosaicing include manifold mosaicing and stereo mosaicing. Constraints on the wave of camera used for mosaicing can be uninvolved using manifold mosaicing and Stereo mosaicing is a firmer method of mosaicing wherein one panorama is generated for the left eye, and another landscape is produced for the right eye.

K Sai Venu Prathap *et al.* [6] describes image Mosaicing is a method of combining two or more images into a single set of large image. Mosaic image is produced from a fractional view to attain great view of a section and it has several presentations. Classically five phases are involved in an Image Mosaicing. They are: Feature Extraction, Image Registration, Homography Computation, Image Warping and Blending. The Feature Extraction can be done by using multiple corner detector algorithms. Many feature Descriptors are discussed with necessary equations. Homography can be estimated by different methods, like RANSAC Random Sample Consensus, LMS-Least median of squares and Hough Transform.

Image Warping used for original resolutions and modifies the twist images. Image Blending is the method to diminish artifacts of the mosaic image by varying the image gray levels to seem rich vicinity of an output image

Chris Harris *et al.* [7] describe consistency of image edge filtering. The filtering of image edge is of prime prominence for 3D clarification of image sequences using feature tracking algorithms. To provide for image areas holding texture and isolated structures, a combined corner and edge detector based on the native auto-correlation occupation is exploited, and it is shown to achieve with good steadiness on natural imagery.

Yanli Wan *et al.* [8] used SUSAN corner detector to extract feature point. The phase correlation method is used to unevenly guesstimate translational factors of two images. The wrong matched points are deleted with least square algorithm after the initial matching. At the same time, fundamental matrix and homographic matrix are estimated based on the epipolar and homographic constraints. The linear weighted transition method is employed in the process of image fusion.

The image mosaic algorithm proposed in this work has the following steps:

a) Translational parameter estimation of two images roughly
b) Corner point extraction
c) The initial matching
d) Wrong matched point deletion

e) Image stitching
f) Seam elimination

There are some classical algorithms about the corner detection like Harris and SUSAN [9]. They have characteristics such as good rotation invariant and are not sensitive to the illumination changing. The precision of matching increases to some extent by the correlation operation to get the matching points and to estimate translational parameters of two images. So that the range of searching and the computing load decrease greatly in the initial matching. At the same time, fundamental matrix and homography matrix are estimated in a robust sense.

III. FEATURE EXTRACTION

In an image, a Feature is used to denote a piece of information which is relevant for solving the computational task related to a certain application. The types of features are edges, corner/interest point, blobs and ridges. Edges are points where there is a boundary (or an edge) between two image regions. In general, an edge can be of almost arbitrary shape, and may include junctions. Edges are the one dimensional structure while corners have a local two dimensional structure. They referred as point-like features in an image. There are various edge detection techniques, which uses Roberts operator, Sobel operator, Laplace operator and the Prewitt operator [5].

They are several features which we mentioned above, that may be used for detection and matching, and certain criteria are used to justify the type of feature chosen. These criteria are that the features should be unique, able to be detected without difficulty, and have a good spatial distribution over the images. It has been found that corners form their own class of feature as the property of being a corner is hard to define mathematically. Therefore we introduce Harris Corner detector in our mosaic framework.

The Harris Corner Detector was given in 1988. Harris and Stephens improved upon Moravec's corner detector by considering the differential of the corner score with respect to direction directly, instead of using shifted patches. The Harris corner detector is a popular interest point detector due to its strong invariance to: rotation, scale, illumination variation and image noise. The Harris Corner Detection Technique works on Eigen Values Concept and the use of auto correlation function is also seen. The Harris corner detector is based on the local auto-correlation function of a signal; where the local auto-correlation function measures the local changes of the signal with patches shifted by a small amount in different directions. The Harris corner detector gives a mathematical approach for determining whether the region is flat, edge or corner. Harris corner technique detects more features.

IV. HOMOGRAPHY

Homography is the third step of Image mosaicing. In homography undesired corners which do not belong to the overlapping area are removed. RANSAC algorithm is used to perform homography. RANSAC is an abbreviation for “RANdom Sample Consensus.” It is an iterative method to estimate parameters of a mathematical model from a set of observed data which contains outliers. It is a non-deterministic algorithm in the sense that it produces a reasonable result only with a certain probability, with this probability increasing as more iteration are allowed. RANSAC algorithm is used for fitting models in the presence of many available data outlined in a robust manner. Given a fitting problem with parameters, it estimates the parameters considering the following assumptions:

1. Parameters can be estimated from N data items.
2. Available data items are totally M.
3. The probability of a randomly selected data item being part of a good model is Pg.
4. The probability that the algorithm will exit without finding a good fit if one exists is Pfail.

V. IMAGE WRAPPING

The last step is to warp and blend all the input images to an output composite mosaic. 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 (e.g., morphing).While an image can be transformed in various ways, pure warping means that points are mapped to points without changing the colors. Basically we can simply warp all the input images to a plane defined by one of them known as reference images. The output in this case is known as composite panorama.

1. First we need to make out the output mosaic size by computing the range of warped image coordinates for each input image, as described earlier we can easily do this by mapping four corners of each source image forward and computing the minimum x, minimum y, maximum x and maximum y coordinates to determine the size of the output image.
2. The next step is to use the inverse warping as described above for mapping the pixels from each input image to the plane defined by the reference image, is there to

perform the forward and inverse warping of points, respectively.

The final step is to blend the pixels colors in the overlapped region to avoid the seams. Simplest available form is to use feathering, which uses weighted averaging color values to blend the overlapping pixels. We generally use alpha factor often called alpha channel having the value 1 at the center pixel and becomes 0 after decreasing linearly to the border pixels. Where at least two images overlap occurs in an output mosaic.

VI. CONCLUSION

After studying various feature detecting techniques, Harris Corner Detector was chosen as our tool for feature detection as it is invariant to rotation, scale, illumination variance and image noise. Mathematical analysis was done in detail of the Harris Corner Detector. Auto-correlation and Eigen value concept were the primary tools used in Harris Corner Detection and was studied in detail to extract features from an image. After feature detection, feature matching was studied thoroughly. We adopted a correlation coefficient measure that gave us satisfied results.

REFERENCES

[1] Emina Hadrović, Dinko Osmanković, Jasmin Velagić, "Aerial Image Mosaicing Approach Based on Feature Matching", International Symposium ELMAR, IEEE 2017

[2] S. Battiato, Di Blasi, G.M. Farinella, G. Gallo, “A Survey of Digital Mosaic Techniques”, Eurographics Italian Chapter Conference, 6 – 95125 Catania (Italy), 2006.

[3] Markus Hörhan and Horst Eidenberger, "An Efficient DCT Template-based Object Detection Method using Phase Correlation" 50th Asilomar Conference on Signals, Systems and Computers, IEEE 2016

[4] K. Sai Venu Prathap, Dr.S. A. K. Jilani, Dr. P. Ramana Reddy, "A Critical Review on Image Mosaicing", International Conference on Computer Communication and Informatics (ICCCI), IEEE2016

[5] Chris Harris & Stephens, “A Combined Corner and Edge Detector”, the Plessey Company PLC. 1988.

[6] Yanli Wan, Zhenjiang Miao, Jing Chen, “A Robust Image Mosaic Algorithm”, Institute of Information Science, Beijing Jiaotong University, Beijing, Vol. 3, pp: 766 - 770, May 2008.

[7] Raman Maini & Dr. Himanshu Aggarwal, “Image Processing Study and Comparison of Various Image Edge Detection Techniques”, International Journal of Image Processing (IJIP), Vol. 3, Issue 1. 2009

[8] Prof. Waheeda Dhokley et. al. "Image Mosaicing using Bidirectional Algorithm", ICIIECS IEEE 2017

[9] André Rocha, Ricardo Ferreira, Aurélio Campilho, “Image Mosaicing using Corner Detection”, Instituto de Engenharia Biomédica – INEB, FEUP, 1988.

[10] Soo-Hyun Cho, Yun-Koo Chung, Jae Yeon Lee, “Automatic Image Mosaic System Using Image Feature Detection and Taylor Series”, VII Digital Image Computing: Techniques and Applications, 10-12 Dec. 2013

[11] Dr. Sukhendu Das, “Concepts in Edge Detection”, Dept. of Computer Science and Engineering, Indian Institute of Technology, Madras, India.