Mosaicing of Images using Unsharp Masking Algorithm for Interest Point Detection

Shishir Maheshwari, M. Tech. Scholar
Dept. of Electronics and Communication Engineering
National Institute Of Technology
Rourkela – 769008, INDIA
E-mail: shishirweb@gmail.com

Umesh C. Pati, Associate Professor
Dept. of Electronics and Communication Engineering
National Institute Of Technology
Rourkela – 769008, INDIA
E-mail: ucpati@nitrkl.ac.in

***Abstract* — Image Mosaicing is a method of assembling multiple overlapping images of the same scene into a larger image. The output of the image mosaic will be the union of two input images. In this paper, the detection of interest point is based on unsharp masking technique. This interest point detection algorithm produces an efficient and informative output mosaiced image as compared to other existing interest point detection algorithms. Importance of Image mosaicing can be seen in the field of medical imaging, computer vision, and data from satellites, military automatic target recognition.**

Keywords: Image mosaicing, registration, Warping, homograph, unsharp masking.

I. INTRODUCTION

Image Mosaicing is a technique of combining two or more overlapping images in order to get large Field Of View (FOV). Generally, the Field Of View of a normal camera is restricted to 40^0x50^0 approximately. But a normal human eye can view a field of 160^0 x 175^0. So in order to get the large field of view, we use image mosaicing.

The first step in Image Mosaicing is feature extraction [1]. In feature extraction, features are detected in both input images. 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 analysed 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 [2]; 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 [3].

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.

Image Blending is the last step, in this the image is modified so as to obtain a smooth transition between images by removing these intensity seams and creating a blended image.

In this paper, unsharp masking is used for detection of interest point. Unlike other existing methods such as Harris corner detection [4] which is corner detector method, SIFT [5] which is scale invariant feature based method, SURF [6] is advance and fast version of its predecessor SIFT. The unsharp masking algorithm detects sharp details from the images which is useful in image mosaicing. Comparing sharp features between the images which are common, the common details are then used for the homography and RANSAC [7] process followed by image warping [8].

This paper is organised as follows: section II is about feature detection and extraction which also includes the proposed work. Section III is about results and discussions. Section IV concludes the paper.

II. FEATURE DETECTION AND EXTRACTION

Features in the image can be either corners, or edges, or even can be the small regions of the images referred as image patches. Here we will limit our scope to interest point detection. The features are detected from images as interest point. Registration methods can be divided into the following classes: algorithms that use image pixel values directly, or algorithms that use the frequency domain, or algorithms that uses features such as edges, corners or even an image patch as our interest point of detection.

A. Proposed Algorithm:

The detection of interest point is based on Unsharp Masking. The unsharp masking technique is used to increase the details of the image by adding the mask to an original image. The resultant image obtained is crispier and the details can be noticed easily. The mask is obtained by blurring the original image and then subtracting the original and the blurred image.

$$mask = blurred\ image - original\ image \quad (1)$$

This mask contains those image details which are sharp and can't be removed by high pass or low pass filtering. So now we will make use of this mask to extract interest point and then feature descriptor is formed around the interest point. Algorithm is as follows:

a.) Take an image and Gaussian blur it.
b.) Create the mask according to Eq. 1.
c.) Apply non maximal suppression on the mask.
d.) Form an interest point descriptor around the interest points.
e.) Compare interest point descriptors of both the images and keep only those points whose descriptor gives the best match.
f.) Select top N points based on their strength.

After the mask has been created, and interest points are detected. The rest of the process is similar to the steps involved in the conventional image mosaicing. The interest point feature descriptor is a window of SxS pixel around the interest point where S can be any arbitrary integer value.

B. Homography and RANSAC:

The next step involved in the image mosaicing is homography estimation. In homography, one image is geometrically aligned with respect to the reference image. RANSAC and homography together is used to perform homography estimation. 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 iterations are allowed. The algorithm was first published by Fischler and Bolles. RANSAC algorithm is used for fitting of models in presence of many available data outliners in a robust manner.

The Homography Detection Algorithm using RANSAC scheme is as follows:

1.) First interest points are detected from both the images.
2.) Best match of the feature descriptors of images are kept and others are neglected.
3.) Four points are selected from the set of candidate matches, and a homography is computed.
4.) Pairs agreeing with the homography are selected. A pair (p, q), is considered to agree with a homography H, if for some threshold:

$$\mathrm{Dist}\,(\mathrm{Hp}, \mathrm{q}) < \varepsilon \quad (2)$$

5.) Steps 3 and 4 are repeated until a sufficient number of pairs are consistent with the computed homography.
6.) And at the end, only that homography matrix is used for warping of image which agree with the least value of Eq. (2).

C. Image Warping And Blending

Image Warping: 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.

Image Blending: The final step is to blend the pixels colours in the overlapped region to avoid the seams. Whenever we mosaic two or more images, there are methods of image blending such as feathering, alpha blending, Poisson blending, Pyramid blending, and the most newly introduced is graph cut.

III. RESULTS AND DISCUSSIONS

The set of two input images as shown in Fig. 1 has been taken for image mosaicing. The unsharp masking has been applied on the images for the evaluation of interest point detection. Only those interest points are kept which gives the best match of their interest point descriptors. The homography estimation processes with RANSAC has been applied to the interest point descriptors. The combined homography and RANSAC process eliminates the inliers and the estimation process results in the homography matrix. This matrix is used to geometrically align one image with respect to the reference image. The image warping procedure has been applied and the images are warped on the common mosaiced frame as shown in Fig. 2.

The resultant mosaiced image as seen in Fig. 2 can be comparable with other existing mosaicing methods. Here the result is shown with three set of images. The images can be extended further up to the more set of images.

(a) (b) (c)

Figure 1. Set of three input images.

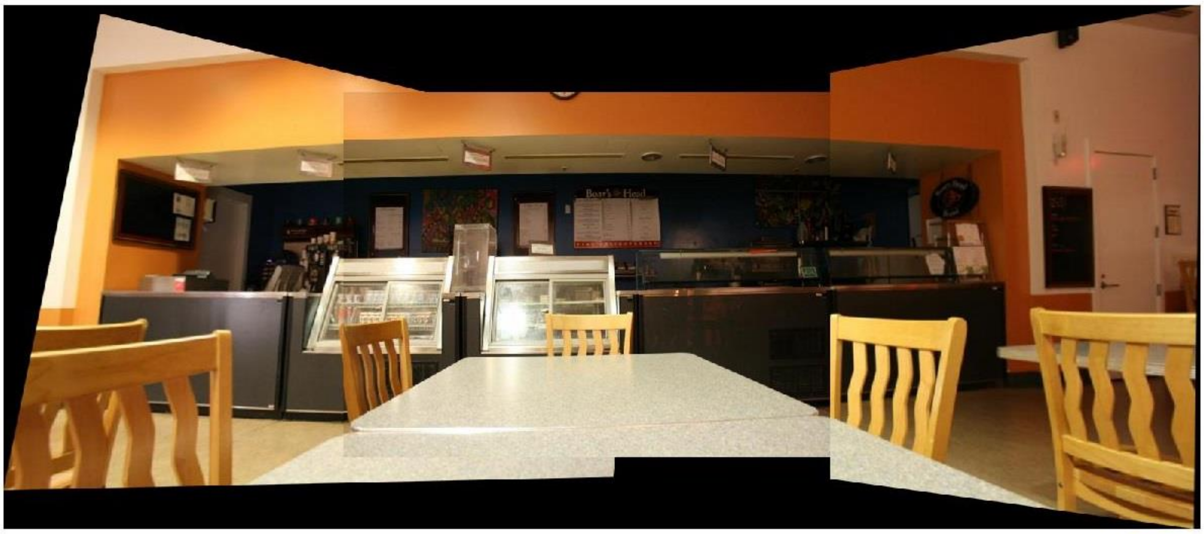

Figure 2. Mosaiced image.

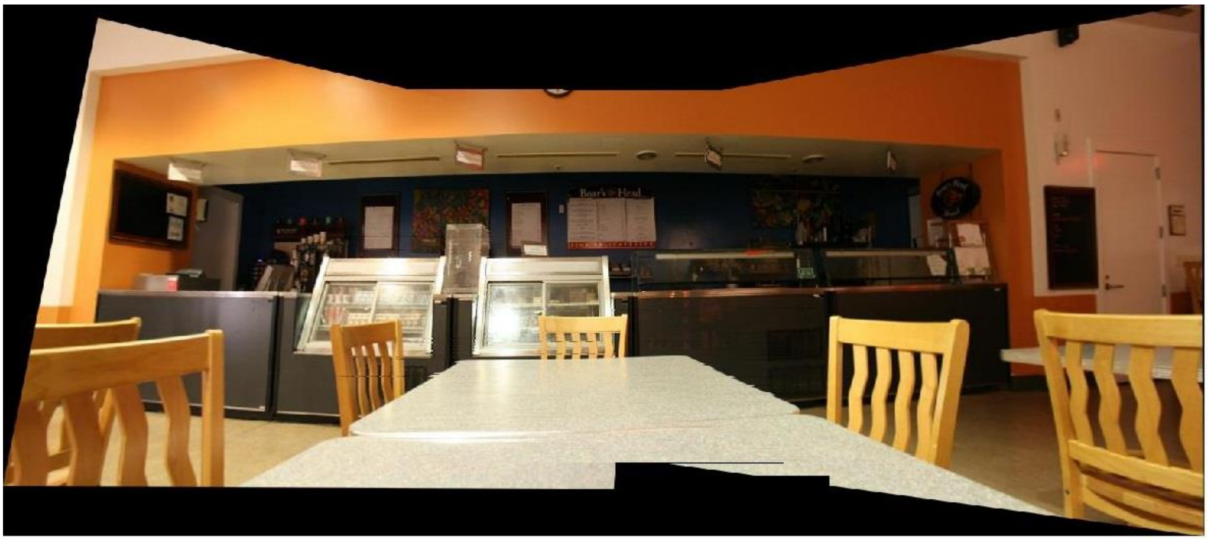

Figure 3. Graph cut blended mosaiced image.

The Fig. 3 is graph cut blended mosaiced image. As image blending is the last step involved in image mosaicing. Here the graph cut method without optimisation has been used for the removal of intensity seam. The minimum cut / maximum flow algorithm is applied for the graph cut.

Also this method requires less calculation for detection of interest points. So it is computationally fast and also consumes less memory as it requires less variables.

Although the work is under developing phase, there is much more to improve. The future work on the algorithm will be supported by scale invariant feature and also the algorithm will we made more robust with respect to images.

IV. CONCLUSION

This paper presents a new technique for interest point detection in image mosaicking. The unsharp masking technique has been used for the detection of interest point for image mosaicing. The mask is created from the difference of smoothed and original image as described in Eq. (1) and then the mask is used for the detection of interest points. The interest point descriptors are formed around the interest points and the best match of the interest point detector between two images is kept. Best match means the closeness to which the two descriptors agree that they are having nearly same pixel intensities in the two images of same scene. Homography and RANSAC has been together used for estimating homography matrix. The images are warped on a common mosaic frame using the homography matrix. As the last step, the image blending is performed to remove the intensity seam from the junction point where images starts overlap each other.

Finally, it can be seen that the results are comparable with existing methods. Also it can be used with more number of images.

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