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Implementation of Grid-Block Based Image Mosaicing Approach and Comparative Analysis with SIFT Approach.

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***Abstract*— Image Mosaicing is one of the key areas of image processing. It is used for different kinds of images like panaromic ,homographic ,satellite and microscopic images .In this paper, we proposed and implemented a Grid based approach for image mosaicing which not only includes more features but also improves accuracy over previous methods .Previously, image mosaicing algorithms developed includes less features hence, not able to produce better quality of images. Geometry, object, homograph and texture based features are extracted which is termed as Feature Extraction. In this method, whole image is divided into frames or grids and later matching of various points is done by Matcher Algorithm based on multiple common features. This is a key process of image matching. Later a VERIFIER algorithm is used for verification. RANSAC method is used at last for image stitching. Hence ,this paper shows the implementation and results which tells hoe this algorithm developed is better that previous image mosaicing methodologies and comparative analysis is done with SIFT image mosaicing approach. It can be further used in medical apparatus devices for capturing microscopic images and also high dimension images such as satellite images.**

***Index Terms*— Feature Extraction, Homographic images, Image Mosaicing, Image Stitching, Matcher, Panoramic, RANSAC algorithm, SIFT Feature Extraction, VERIFIER algorithm**

I. INTRODUCTION

Image Mosaicing is the stitching of multiple correlated images to generate a large wide-angle image of a scene .Mosaicing could be regarded as a special case of scene reconstruction where the images are related by planar homography only. Such images can be very small in size or can be very large in size.

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Generally, image mosaicing is applied on consecutive images which are continuous and then image mosaicing is done. Such kind of image processing helps to ensure more accuracy and also effect various performance metrics like peak-to-signal- ratio ,gray-scale difference, parallax effect of camera which cannot take three dimensions or multidimensional images problem of misregistration ,negligence of some important features of images ,complexeity of images etc.

Applications of image mosaicing in computer vision largely depends on evaluating the quality of the stitching results.In most of the cases the assessment of a mosaicing algorithm is human based perception.Therefore best stitching algorithm RANSAC(RANdom SAmple Consensus) proposed by Konstantinos G. Derpanis [12] which is used in this approach. However, as algorithms have become more accurate in recent years it is not sufficient to rely on visual inspection or subjective evaluation alone .Scientific evaluation requires mosaic quality to be measured quantitatively rather than qualitatively. obtained by different algorithms.

Several image mosaicing algorithms have been proposed over the last decade.Some novelties include feature based image mosaicing proposed by Hu[1] which was the first method which tells about feature extraction. Secondly ,expectation maximization algorithm for removing inconsistent overlaid regions in mosaicing proposed by Liyoshi[5] or the distortion callibrationand the registration algorithm proposed by Tong[10].

Moreover, a new stage of image verification is introduced by VERIFIER Algorithm which is known as Image verification .A new matcher Algorithm is also introduced which considers more common point on the basis of features.Various features are included like Geometrical proposed by Christopher J.C. Burges[2] ,Object Oriented features, Texture based features proposed by R.Singh[9].. and Homographic feature based extraction

The organization of this paper is as follows: Section 2 describes problem statement. Section

3,4,5,6 explains the implementation techniques Section 3 describes adopted methodology of grid based image mosaicing .Section 4 describes Image framing and feature extraction.Section 5 explains Image matching and verification algorithm.Section 6 describes image redrawing and image stitching. Section 7 tells the comparative analysis of this grid based approach with SIFT approach. And implements the techniques discussed in above sections.Section 8 describes conclusion and future work..

II. PROBLEM STATEMENT.

Previously, developed image mosaicing algorithms were not accurate. Less features are extracted from them. Moreover, they suffer from serious drawbacks based on four performance metrics like accuracy, peak signal to noise ratio, percentage of mismatches, difference in pixel intensities, and problem of misregistration. Problem of misregistration occurs due to mismatching of various portions of an image. Also, images were not verified from all aspects hence,,inaccurate stitching can be done. .Misregistration occurs when we take images from various point of views and images are wrongly stitched.

III. ADOPTED METHODOLOGY

The methodology adopted is as follows :First,the image is divided into frames. Secondly , frames are then used in feature selection and feature extraction. Multiple Feature extraction is done . After, this images are matched, verified and redrawn. After ,that images are stitched. The various stages in this approach are explained in below sections.

Problem formulation:

We assume a source image F(X,Y) is a geometric transformed versions of a reference image g(X,Y) under a projective transform described by a Homography Matrix Hi.

H=1+h1 h2 | h5
h3 1+h4| h6

h7 h8 |h9 eq (1)

where $h=\{h1,h2,\ldots\ldots.h8\}^T$ *denotes the Homography parameters.*

$$f(x,y)= g(x,y)$$
$$\{X=((1+h_1)x+h_2y+h_5)/h_7x+h_8y+1)$$
$$Y = h_3x + (1 + h_4)y + h_6/h_7x + h_8y + 1 \}.$$

To estimate the parameters $\boldsymbol{h} = (h1 \ldots h8)$_ of the homography matrix H we define the sum of squared difference function $Err(\boldsymbol{h})$ as follows:

$$Err(h) = f(X, Y) - g(x, y)$$

$$(x,y)\in\Omega \qquad (3)$$

where Ω denotes the overlapping region in a pair of the images f and g. Eq. (3) can be rewritten as follows by denoting the coordinates (x, y) with $(\boldsymbol{x})$ and (X, Y) with $(\boldsymbol{X})$:$Err(\boldsymbol{h})=f(\boldsymbol{X}k) - g(\boldsymbol{x}k)$

where $|\Omega|$ is the number of all pixels in the overlapping region. And estimate the homography parameters $\boldsymbol{h}$ by minimizing this nonlinear function $Err(\boldsymbol{h})$.

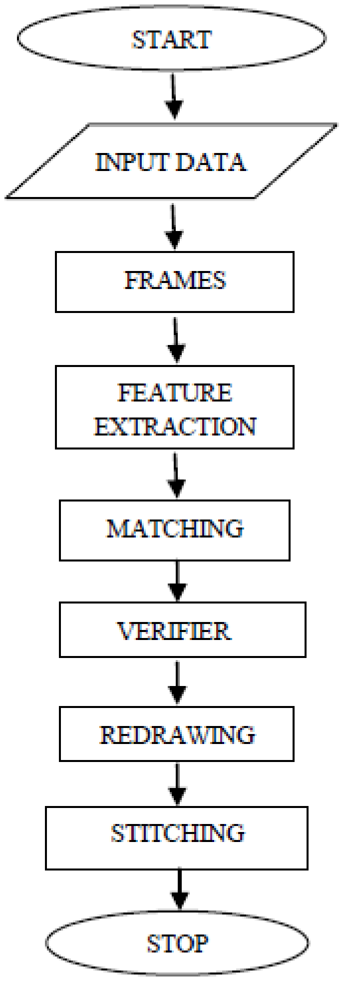

Fig I:Work Flow Diagram of Grid image mosaicing.

IV. IMAGE FRAMING AND FEATURE EXTRACTION

A. Image Framing means dividing of a single image into small grids or blocks or frames. All frames are individually analyzed on the basis of different features. Division of whole image into frames makes it easy for the application of Feature Extraction.

B. Feature Extraction can be viewed as a preprocessing removes distracting variance from a dataset, so that downstream classifiers or regression estimators perform better.

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:

Algorithm: ORIENTED ALGORITHM:
1.Input images are taken from camera. The images are divided into frames. 2 .FERET Database is prepared which consists of 160 individual portion of images. 3. Distance measure is calculated-: A. .Adding Distance Measures. B. Aggregation of distance measures. C. Correlating distance Metrics. 4. Selection of eigen vectors-: A.Removing the last eigenvectors Graphical method is used: $\Theta_a = \sum_{j=1}^{k}{}_j \beta_a / \sum_{j=1}^{k} \beta_b$ $S_a = \beta_{a/} \beta_b$ B.Removing the first eigenvector.

Table I: Oriented Algorithm

Feature extraction Based on Object Oriented.

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

Feature extraction Based on Texture Based

Algorithm:TEXTURE BASED FEATURE EXTRACTION
Input: Full image **Output**: The final image is the output image. ANGULAR SECOND MOMENT (ASM) = $\sum p_{(\acute{\emptyset},\, d)(}$a, b) MAXIMUM PROBABILITY=MAX $P_{(\acute{\emptyset},d)(}$a,b) Entropy (ET) = $\sum_{a,b} p_{(\acute{\emptyset},d})(a,b)\log_2 p_{(\acute{\emptyset},d})(a,b)$ Inverse Difference (ID)= $\sum P_{(\acute{\emptyset},d)(}a,b)/(1+\vert a-b\vert)$ Inverse Difference Moment (IDM) = $\sum p_{(\acute{\emptyset},d)(}a,b)/(1+\vert a-b\vert^2)$ Mean (M) = $\sum a^* p_{(\acute{\emptyset},d)(}a,b)$

Table II:Texture based feature Extraction

Texture Based Approach depends on shape ,color composition etc of an image.

In given table of algorithm $p_{(\acute{\emptyset},d)(a,b)}$ is the frequency of occurrences of two where pixels, with gray-levels a, b appearing in the window separated by distance‘d’ in direction ‘Ǿ’

Feature extraction Based On Homography :

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

Calculation of energy Function is as follows:

$$Eng(L) = \sum D_P(lp) + \gamma \sum V_{p,q}(lp, lq), \{p,q\} \in N$$

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*.

V. IMAGE MATCHING AND VERIFICATION:

MATCHER ALGORITHM:
Method: w1 (P1, Error1) > w2 (P2, Error2) If P1>P2 Return True Else If P1<P2 Return False Else If δ1>δ2 Return False Else return true GMST of G will reduce

Table III: Matcher Algorithm

Here,image matching is done by taking P1 and P2 which means P1 means probability of far common points and P2 means probability of near points. Δ1 and δ2 are function values of different points.

VERIFIER ALGORITHM

VERIFIER is a new proposed algorithm which discards false matches.

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

Table IV: VERIFIER ALGORITHM

VI. IMAGE REDRAWING AND STITCHING

Image redrawing means after the completion of verification of all portions of an image various portions are merged into a single mosaiced image.

Image Stitching is another important step in which the whole image which is redrawn and stitched.

Algorithm :STITCHER ALGORITHM
1: Select randomly the minimum number of points & determine the model parameters and solve parameter. 2: Determine how many points from the set of all points fit with a predefined tolerance €. 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)..

Table V:STITCHER ALGORITHM

VII. EXPERIMENTAL RESULTS AND DISCUSSION

A. Collection of data sets

a b e

c d f

Fig II. : Data set for experiment.

b . SIFT feature based image_mosaicing

SIFT stands for Scale Invariant Feature Transforms. This is already developed module in MATLAB 2012 version. It uses the invariant features extracted from images is used to perform reliable matching.

Scale Invariant method was one of the most effective method of feature extraction which was extended to form mosaiced image and the comparison is done.

Algorithm: SIFT ALGORITHM:
1. Input Image is inserted. 2. Scale space of images is constructed using Gaussian filter 3. Then, the difference of Gaussian scale space is computed and extrema is detected by comparing a pixel to it 4. Keypoint localization is done for removing low contrast and roughly localized key points. 5. Based on local image gradient direction one or more orientation assignment is determined for each key point. 6. After orientation, values are accumulated as histogram's that summarizes all contents

Table VI: SIFT ALGORITHM

In Scale Invariant Feature Transform method first image is applied as input of Figure 2.

Keypoint Localization

It is the second step performed on input images.

Methamatical Formula:

The first stage is to construct a Gaussian "scale space" function from the input image [1]. The difference of Gaussian (DoG), D(x, y, σ), is calculated as the difference between two filtered images, one with k multiplied by scale of the other.

$D(x, y, \sigma) = L(x, y, k\sigma)-L(x, y, \sigma)$ *eq* (1)

$L(x, y, \sigma) = G(x, y, \sigma)*I(x, y)$ *eq*(2)

$G(x, y, \sigma)= 2\pi\sigma* \exp \{- x2*y2/\sigma2\}$ eq (3)

Image matching and verification:

Image Matching is performed by finding Keypoints on the basis of common features indicated by blue lines.Fig 2a) b)c) and d) data output is found by localization.

Fig.III a) Points of building b)Points of hall

Later,verification is performed and following table is generated.

H=	H1	H2	H3
	0.4831	-0.0271	297.01
	-0.2560	0.7707	108.319
	-0.0007	-0.0002	1.000

Table VII: Minimum Function values for SIFT

Total 385 keypoints are found. By Matching Algorithm total 128 matches are found.

Orientation assignment:

In this,images are rotated by application of scaling and rotation on data set.

Fig IV a) Orientation of building 4b) Orientation of hall

Mosaiced image is generated:

Fig V a) and b) Mosaiced images of data set a,b,c and d.

C.Grid based image mosaicing:

A new technique is developed by us in which more comparison is done on th basis of multiple features extraction. The image is divided into grid or frames.

Data Set is taken as input.After that image matching is done and common points are found.

Fig VI Combined images of data set a,b,c and d

First,of all both images are combined with each other. After that keypoints matched are matched and more features are included.

Fig VII a)Common points of data set a and b

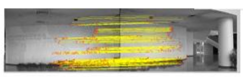

Fig VII b)Common points of data set c and d

H=	H1	H2	H3
	1.182	-0.0331	-298.6866
	0.0899	1.1196	-53.6505
	-0.0003	-0.00000	1.0000

Table VIII:Minimum Function Values for Grid Based Image mosaicing.

Here total 600 keypoints are not found which are represented by yellow dotted lines.Total 300 matches are found.

D. Comparision of sift with grid image mosaicing

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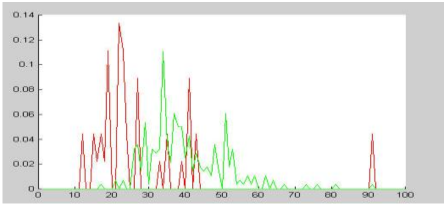

Fig VIII c) Comparision of Sift with Grid Based method

The green dotted lines represents the SIFT Based approach in which less no of features are included. While pink dotted lines include more features and is based on less no of features.Hence Performance of Grid based is better in terms of quality but bad takes more time. The comparison clearly indicate the difference in performance metrics like accuracy,translation.quality of image etc.

VIII. CONCLUSION AND FUTURE WORK

In this paper, the proposed Grid based approach focuses on frame based method of image mosaicing which includes a lot of features (geometrical, object oriented, homographic and texture based features).Hence, due to the inclusion of more features the output produced results in better quality of image, Many performance metrics like gray scale ratio, accuracy and brightness of image has improved.

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 in very small and very large images. In medical apparatus and digital cameras this algorithm can be further applied.

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