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Grid based Multiple Features Image Mosaicing

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ABSTRACT

In this paper, image mosaicing methods based on multiple features is developed and a comparison is shown with scale invariant method. After the comparison made in terms of peak signal to noise ratio and mean square values present work is more satisfactory. Various screenshots are provided in this paper which explains the practical implementation of the present work and it's execution. The graphs provided explains that the output produced is better in comparison to previous developed algorithms .

Keywords: Image mosaicing, image stitching, SIFT model, GBMF mosaicing, Image enhancement.

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INTRODUCTION

Image mosaicing is one of the important research area in image processing. Image mosaicing is done in case one single panaromic image has to be aggregated from various snapshots taken from different views of the same image by different apparatus. This concept is used in various scientific research areas. Particularly in medical apparatus where microscopic images cannot be captured as a whole at a time, then concept of image mosaicing can be used. It has been found from the literature that a lot of work is done in this area. Previous algorithms used suffers from various drawbacks like accuracy, bad quality, problem of misregistration, percentage of mismatches, differences in pixel intensities peak signal to noise ratio etc. The main concept of present work is the development of a new image mosaicing approach which divides whole image into grid and multiple features are extracted and a new step of verification is also introduced in this approach to reduce problem of misregistration. This grid based mosaicing approach is of great help as it tried to enhance the performance metrics like accuracy, difference in pixel intensities etc. of the images.

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Here, the complete work has been carried out in seven phases. Initially, source and target images are applied afterwards, image is divided into frames or grids. In the next step, all features are extracted and calculation of global intensity difference. All features taken of the data set are matched by correlation and common matching points are found in the subsequent phase. Thereafter, image is redrawn and then, various common points derived from above phases are stitched and verified by transformations and normalization is done. Finally, in the last phase, mosaiced image is formed. A new matcher algorithm is derived for it. The initial matching points between any two images are determined by finding the nearest neighbor of a key point in the first image from a database of key points for the second image. This nearest neighbor is defined as the key point with the minimum Euclidean distance for a dimension vector.

Here, for matching all four corners from top and bottom are taken. Best common points are derived and transformations are performed on images like translation, rotation and scaling. For the verification purpose, normalization is performed. Then, at last final mosaiced image is performed. Image verification is a new step introduced in image mosaicing. It reduces problem of misregistration. For this purpose, a Verifier algorithm is developed. This method verifies common points. B.B.F (Best Bins First) is used in stitching.

Review of Related Work

Various methods of image mosaicing are proposed. Feature extraction is the major preprocessing step of image processing [1]. More better features are extracted much better image mosaicing is done. Feature Based image mosaicing plays the key role in image processing. Initial approach was considered only for few features and not good in real time application as it was only for simple images [2]. An advanced image mosaicing method based on minimum cost spanning tree for microscopic images. This was developed for removing the drawbacks of previous algorithm [3]. A homography based image mosaicing approach for automatically removing partial foreground objects. For microscopic images, the main requirement is that of large scale microscope image mosaicing with high quality requirements [4]. A warped document image mosaicing method in which document images are mosaiced. In this approach, image processing is done for inflection point detection by grizzling. The morphological dilation which expend the characters, blurring of details and filling of uneven cracks and hollow on edge of that characters. Optical character recognition result comparison is done tells that recognition rate of original images is much lower than the recognition rate of mosaiced image [5]. A quantitative evaluation method of image mosaicing where a lot of performance metrics like accuracy, difference in pixel intensities, mutual information to measure the quality of mosaicing algorithm is used. video mosaicng for real time field of view enhancement, just like image mosaicing is done. Similarly, video and audio image mosaicing is proposed [6]. S.I.F.T (Scale Invariant Feature Transform) extraction which takes an image and transforms it into collection of local features. Extrema Detection, orientation assignment, key point localization, 3D picture can be rendered using S.I.F.T model to a small amount of parts is efficient for matching faces [7-11]. Feature extraction an important step in image preprocessing includes different features.

The geometrical feature extraction is proposed on the basis of size, shape, height, width, length etc. are extracted and the methods are used [12]. Various evaluation methodologies to detect importance of various image mosaicing and detection of performance metrics like accuracy, peak signal to noise ratio [13]. Global intensity correction in dynamic scenes gives idea about difference in pixel intensities, grayscale conversion and image gradient determination M.S.E(Mean Square Error) [14-18].

Methodology

As per the theme of the problem and assumptions, the original image suffers from inaccuracy, bad quality, noise, distortions, Intensity differences and problem of misregistration. Hence, to remove these problems, global intensity difference, correlation and variance for image matching and transformation for verification and redrawing are calculated.

For calcuating intensity difference, normalization, gray scale and image gradient are three important concepts. Normalization is also called histogram stretching or contrast stretching. Digital image (grayscale) is performed by using linear normalization for the formula given in equation 1.

$$I_N = (I - \mathrm{Min})\frac{\mathrm{newMax} - \mathrm{newMin}}{\mathrm{Max} - \mathrm{Min}} + \mathrm{newMin} \quad (1)$$

Grayscale is used to converted whole image into white or black pixel. For the SRGB color space, the gamma expansion is defined as:

$$C_{linear} = \begin{cases} \dfrac{C_{srgb}}{12.92}, & C_{srgb} \le 0.04045 \\ \left(\dfrac{C_{srgb} + 0.055}{1.055}\right)^2, & C_{srgb} > 0.04045 \end{cases} \quad (2)$$

Where, C_{srgb}= three gamma compressed SRGB primaries in the range [0,1]. C_{linear}= corresponding linear intensity value in the range [0,1] as quoted in equation 2.

As per ITU-R BT.709 standard, primaries used in SRGB, the weighting Y = 0.2126 R + 0.7152 G + 0.0722 B gives the CIE 1931 color spaces. In the brightness, source appears to be radiate or reflect the light. Luminance is the lumen intensity per unit area (photometric measure). $Y' = 0.299\ R + 0.587G + 0.114B$. The coefficients represent human perception of colors, humans are more sensitive to green and least sensitive to blue. Computing the luma component as. $Y' = 0.2126R + 0.7152G + 0.0722B$. Figure 1 shows the represents of grayscale image Third component is image gradient which has a minute effect on image.

Correlation and variance for image matching.

Consider, the observations sets (x_1, y_1), (x_2, y_2),,..... (x_n, y_n), the correlation coefficient can be calculated by equation 3.

$$\mathrm{Cor}_{i,j} = \frac{\mathrm{Cov}_{i,j}}{\sqrt{\mathrm{Cov}_{i,i}}\sqrt{\mathrm{Cov}_{j,j}}} \quad (3)$$

Coefficient of variation can be calculated as

$$Var(X) = \sum P_i (x_i \mu)^2$$
$$\text{Where, } \mu = \sum P_i X_i \quad (4)$$

$$\text{For n terms, } Var(X) = \frac{1}{n}\sum (X_i \mu)^2 \quad (5)$$

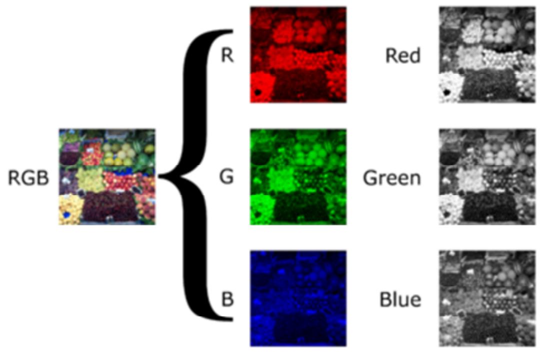

Figure 1: Gray scale images

TRS Transformation

For each fingerprint, translate and rotate all other grids of source image with respect to the target image according to the following formula:

$$\begin{pmatrix} x_{i\_new} \\ y_{i\_new} \\ \theta_{i\_new} \end{pmatrix} = TM * \begin{pmatrix} (x_i - x \\ (y_i - y \\ (\theta_i - \theta) \end{pmatrix} \quad (6)$$

Where, (x,y,θ) = parameters of the reference minutia, and TM is

$$TM = \begin{pmatrix} \mathrm{Cos}\theta & -\mathrm{Sin}\theta & 0 \\ \mathrm{Sin}\theta & \mathrm{Cos}\theta & 0 \\ 0 & 0 & 0 \end{pmatrix} \quad (7)$$

The above equation number 7, describes the rotation of two images in three dimensions (x axis, y axis, z axis)

$$TM = \begin{pmatrix} S_x & 0 & 0 \\ 0 & S_y & 0 \\ 0 & 0 & S_z \end{pmatrix} \quad (8)$$

and equation 8, describes the scaling of images in three dimensions(x axis,y axis,z axis). The figure 2 given below indicates the rotation and scaling of matrix.These transformations are applied on our present approach so that proper mosaiced image is generated.

In this paper four algorithm has been used for Image Framing and Feature Extraction, Image Registration, Image Stitching and Image Matching and Verification

Algorithm 1- Image Framing and Feature Extraction:

Step 1 Read source and target image.

Step 2.Divide the target image into equal grids or blocks called as framing.

Step 3.For each grid with respect to source image,calculate the global intensity difference

Algorithm 2- Image Registration:

For each grid with respect to source image:

Step 1: Compute the common points of grid of target images and source images common points are found.

Step 2: Both common points are corelated.

Step 3: Find the homography using STITCHER Algorithm.Call STITCHER

Step 4: Best matching points are obtained and call MATCHER and VERIFIER.

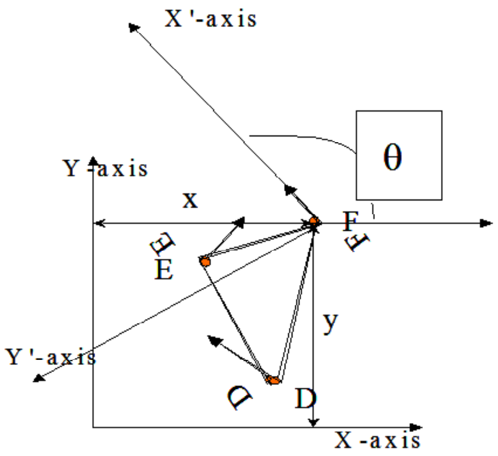

Figure 2: Effect of rotation and scaling

Algorithm 3- Image Stitching STITCHER:

Step 1: For stitching,all four corners top left ,top right,bottom left and bottom right are matched of all grids of the source image with reference to target images.

Step 2: Corelation method is used for this process.

Step 3: Call MATCHER And VERIFIER

Step 4: Return.

Algorithm 4-Image Matching and Verification MATCHER and VERIFIER:

Step 1: After the best common points are detected from grids, Normalize all the common points of the images.

Step 2: All other points are transformed by scaling and rotation. TRS Concept is used. Target image is transformed.

Step 3: Image is redrawn through reprojection of all grids.

Step 4: Final mosaiced image is generated.

Step 5: End.

Experimental Results and Discussions

This section deals with experimental setup of the work that has been carried over a collection of data set of images. The developed algorithm called G.B.M.F(Grid Based Multiple Features) image mosaicing algorithm has been tested with necessary test data and performance parameters like accuracy, noise ratio, mismatches are checked. Problem of misregistration is solved. After collection of data set, different phases and algorithm are implemented. Also, a comparative analysis is done with scale invariant feature transforms (S.I.F.T) method. Moreover, graphs are plotted to show difference in common points matching and extraction of S.I.F.T image mosaicing approach and G.B.M.F image mosaicing. Figure 3 and figure 4 show the steps involved in opening and insertion of source image respectively.

A large amount of data set are collected to conduct this experiment. More data set will result in better performance of image mosaicing approach. The experimental setup involves image feature extraction, matching, transformation and mosaiced final image generated by G.B.M.F based on image mosaicing and S.I.F.T method.

Screenshots of experiment performed for G.B.M.F image mosaicing:

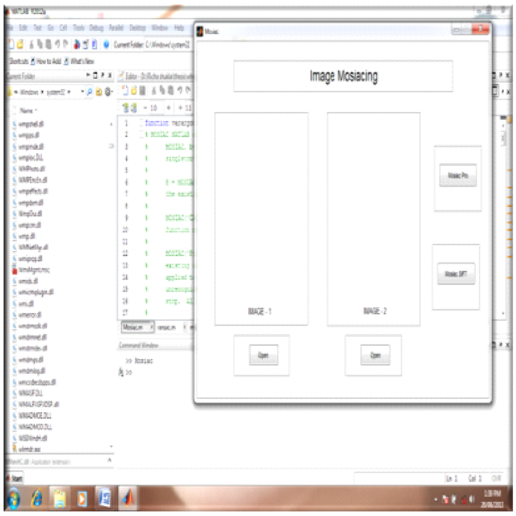

Figure 3: Opening of G.U.I for performing experiment

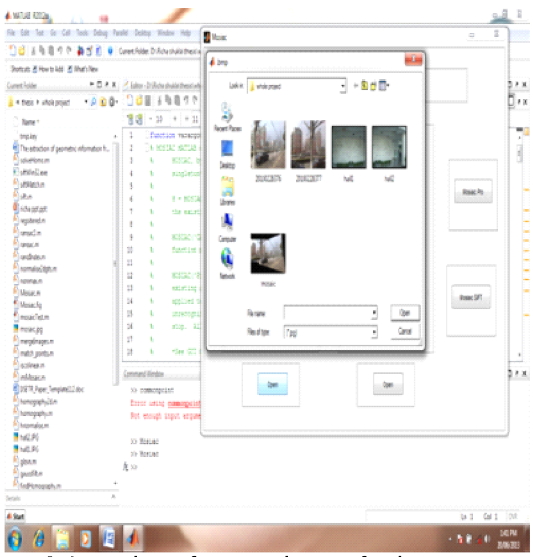

Figure 4: Insertion of source image for image mosaicing

Figure 5, indicates the insertion of source image, while figure 6 represents the Opening of target image for insertion. The windows for insertion of both source and target image has been shown in the figure 7. Selection of S.I.F.T method has been described in figure 8.

Matching and verification of common points in S.I.F.T method represents with the blue lines as shown in figure 9 and transformation and stitching of target image with reference to source image described in figure 10.

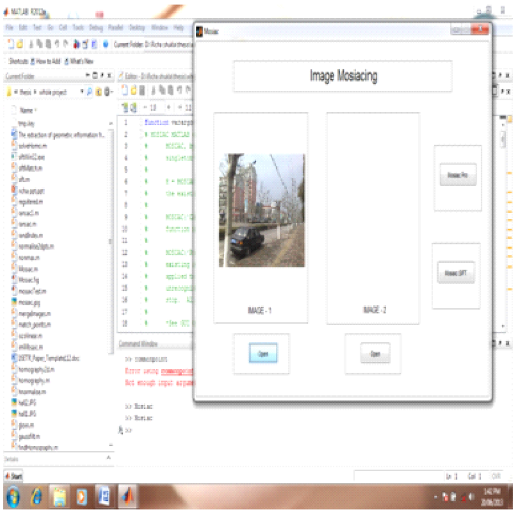

Figure 5: Source image is inserted

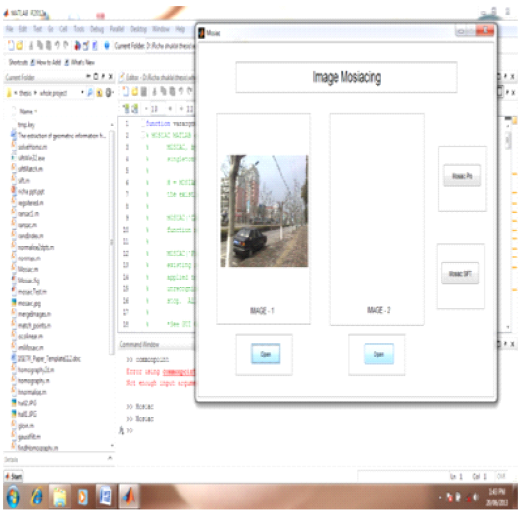

Figure 6: Opening of target image for insertion

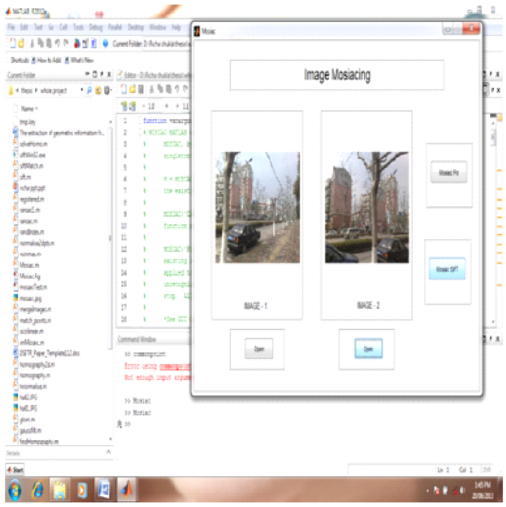

Figure 7 : Insertion of both source and target image

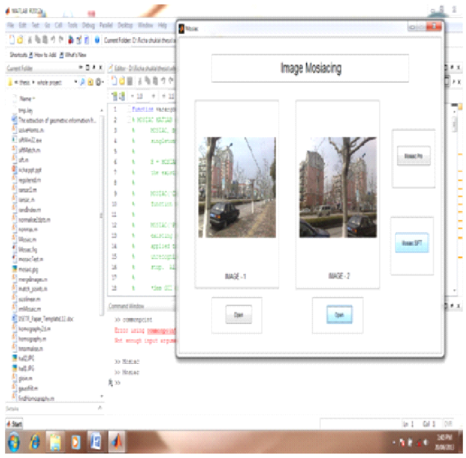

Figure 8 : Selection of S.I.F.T method

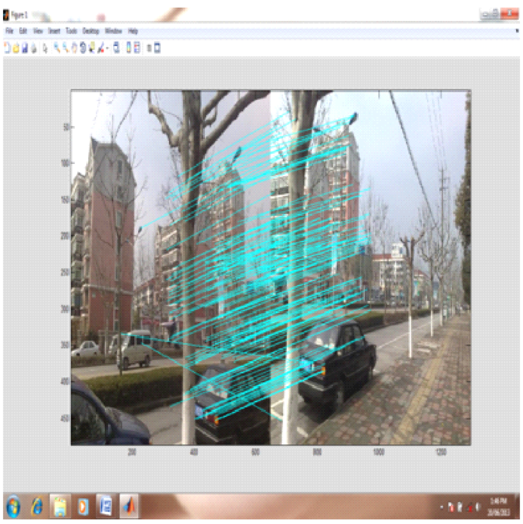

Figure 9 : Matching and verification of common points in S.I.F.T method in blue lines

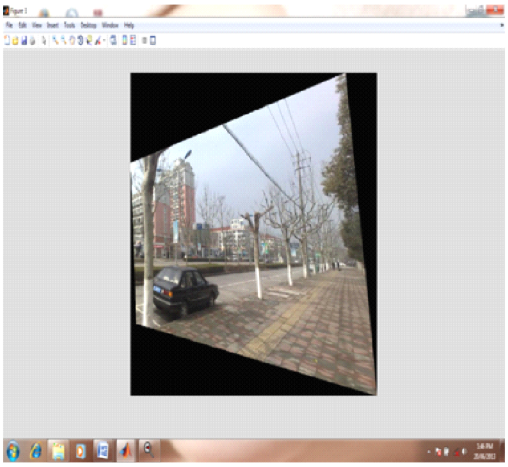

Figure 10: Transformation and stitching of target image with reference to source image

Table 1: Matching points for S.I.F.T method

H	H1	H2	H3
	-0.0269	0.4791	286.01
	0.7690	-0.2456	110.31
	-0.2212	-0.0069	1.000

H1 indicates target image points, H2 indicates source image points and H3 indicates common points of mosaiced image. When the modules of work is executed, then these outputs are produced and give a clear picture about difference in number of common points and better quality achieved. The values of target image, source image and common points between the source image and target image are shown in the table 1.

P.S.N.R values

The red dotted lines explains the peak signal ratio values for S.I.F.T approach whereas blue line indicates grid based approach. Comparison of original P.S.N.R values and G.B.M.F based P.S.N.R values is shown in figure 11.

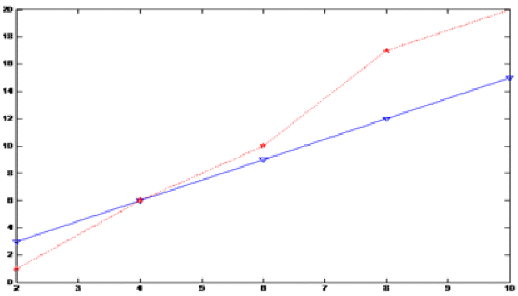

Figure 11: Comparison of original P.S.N.R values and G.B.M.F based P.S.N.R values

In the graph above shown in figure 11, X axis indicates peak signal-to noise ratio original values and Y-axis indicates peak -signal –noise-ratio of mosaiced image produced by grid algorithm.

Table 2: Representation of P.S.N.R original values and G.B.M.F based values

S.No	Original PSNR values	PSNR of mosaiced image
1	2.5	2.5
2	5.2	5.0
3	9.0	9.2
4	12.0	11.0
5	20.0	14.0

Here, P.S.N.R values comparison is done to find out whether our new algorithm has reduced it and produced much accurate data or not. The comparison of Original PSNR values and PSNR of mosaiced image is shown in table 2.

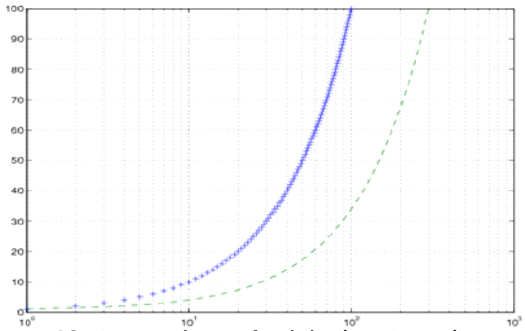

Figure 12: Comparison of original M.S.E values with G.B.M.F based M.S.E values

This figure 12, indicates mean square error comparison of S.I.F.T indicated by green dotted lines and blue line indicates G.B.M.F values.

The tables and figures indicated above give a clear picture of the less distortion of images of G.B.M.F approach which produces better quality as comparison to original image mosaicing approach. The graphs plotted indicates that our present algorithm ensures more accuracy by calculation of correlation and covariance method and normalization.

Table 3: Representation of M.S.E original values and G.B.M.F based M.S.E values

S.No	Original Mean Square Values	M.S.E values of mosaiced image
1	10.3	5.5
2	15.6	11.0
3	20.9	16.5
4	26.2	22.0
5	29.5	27.5
5	31.8	30.0

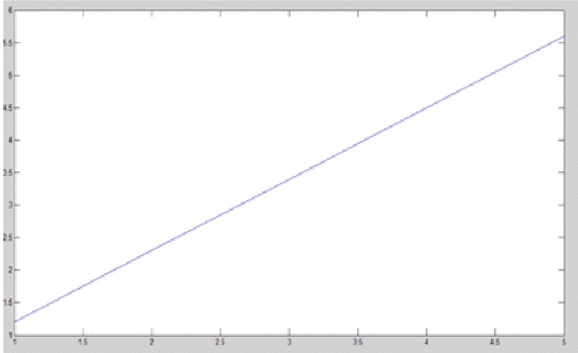

Figure 13: Peak-Signal to Noise-Ratio graph for grid based method

The graph plotted indicates the linear distortion of the image due to the peak signal to noise ratio**.**

The following table 4 is constructed below which gives a brief idea about the values:

Table 4: Peak-Signal to Noise-Ratio values for grid based approach

Serial no	i	j	Final value
1	1	1.2	1.5
2	2	2.3	2.35
3	3	3.4	3.45
4	4	4.5	4.5
5	5	5.6	5.5

Figure 13 indicates to Peak-Signal to Noise-Ratio graph for grid based method and Mean Square Error graph for grid based method is represented in figure 14. Finally, Histogram variations in grid based image mosaicing method is shown in figure 15.

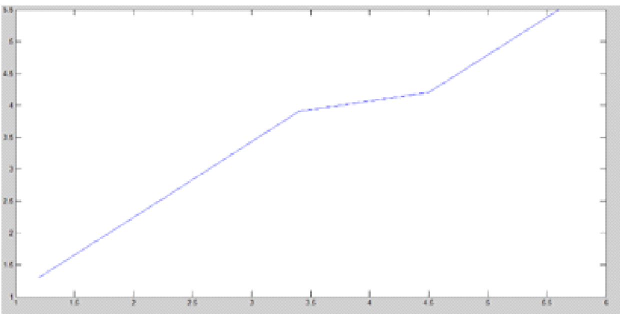

Figure 14: Mean Square Error graph for grid based method

The following table 5 is constructed below which gives a brief idea about the values:

Table 5: Tabular form of Mean Square Error for grid based approach

Serial no	i	j	Final value
1	1.2	1.3	1.35
2	2.3	2.6	2.45
3	3.4	3.9	3.36
4	4.5	4.2	4.4
5	5.6	5.6	5.6

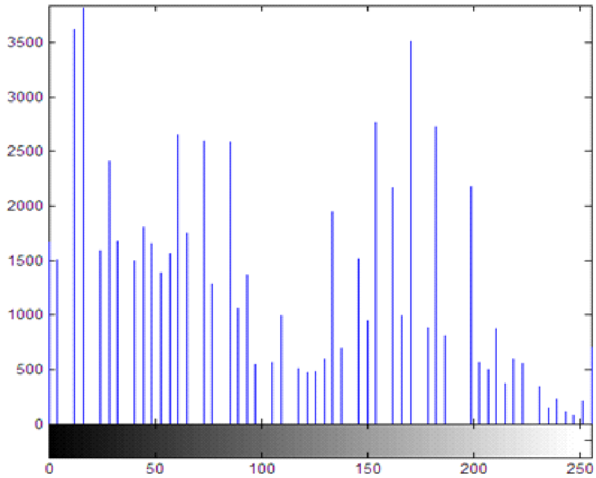

Figure 15: Histogram variations in grid based image mosaicing method

Conclusion

In this work, multiple feature extraction is done by using various algorithms. the work has been divided into six phases: image framing, feature extraction, image matching, image verification, image redrawing and image stitching. in the image mosaicing, first phase is framing in which whole image is divided into grids or blocks. second, feature extraction phase, geometrical features are extracted based on oriented pca algorithm, object oriented features and homographic features are extracted using homography estimation techniques and texture based features are extracted using linear wavelet transforms. third phase image matching is done with the help of matcher algorithm. fourth image verification which proposes a new algorithm called verifier. fifth phase defines image redrawing where all features matched and verified are redrawn. sixth phase introduces image stitching in which we stitched all different parts of an image and final mosaiced image is generated. In this paper, multiple new features like homographic and object oriented features are also considered which are different from other mosaicing approaches. also, two phases of image verification and image redrawing are newly introduced which improved quality of image and resulted in development of an image which can take out more common points. a comparison is made on the basis of scale invariant feature transform(sift) method and our present grid based approach which highlights the basic advantages of this new approach from previous sift approach. Also a program coding with MATLAB going through all the stages of the image mosaicing is built which is helpful in implementation of all algorithms. It is helpful to understand the procedures of image mosaicing and also a comparison of this approach from previous ones. it demonstrate the key issues of the image mosaicing.

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