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Color Image Fusion Using Integrated Modified DCT and PCA Based Technique and Dark Channel Prior

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Abstract: Image fusion is becoming one of the most trendy and intresting topic in image processing.In numerous applications several image fusion techniques have been employed. The most important purpose to fuse image is uniting important aspects or helpful information of various different images of only one scene so as to convey just constructive information.Methods relating to discrete cosine transformation for fusing images are more appropriate and less time consuming in real-time systems.To eliminate the drawbacks of the previous work an integrated algorithm has been proposed in this paper. The proposed algorithm integrates the modified model of PCA and DCT to fuse the color images. The dark channel prior has also been used to remove color artefacts and improve the colors of the output image. This new algorithm has been designed and executed in MATLAB tool using image processing toolbox. The comparative analysis carried out on the basis of various performance evaluating parameters has shown the significance of the proposed algorithm.

Keywords: Image Fusion, Discrete Cosine Transformation, Principle Component Analysis, Color Artefacts, Multi-focus images.

I. INTRODUCTION

Fusion of image is practice of unification of related information from numerous images in a single image. The image which is obtained after fusion will prove to be extra helpful in favour of computer processing jobs in comparison to source images. Image fusion conveys useful information present within numerous images of an identical scene in distinct extremely informative image;significant information is dependant upon region of concern.Purpose of fusing image is to extract every bit of the constructive information from input images without introduction of artefacts.The aim of fusing image is combining information from many images of only one scene to convey only the constructive information. The image fusion practices related to discrete cosine transforms (DCT) are extra apposite as well as lesser time-consuming in real-time systems using DCT.

There are many situations in which information from a single source or image cannot be helpful. More than one sensors are used to capture scenes in such situations, unlike human and machine processing where information from a single source can be helpful., hence fused images are obtained from different sensors containing significant information of source images.Hence it can be said that, image fusion unites the significant information contained in numerous images into a single fused image.Image fusion is a wider and trendy area of research.Fusion can take place at three different levels i.e.pixel level,feature level and decision level. The lowest level which is helpful in examining as well as merging information from various sources before original information is approximated as well as acknowledged is pixel level of image fusion. The middle level of fusion that retrieves an essential attribute of an image such as shape, direction, segments, edges and length is feature level fusion.The highest fusion level that intent at relating real objective is decision level.There are two methods of image fusion i.e. spatial domain fusion and transform domain fusion.Averaging, Brovey and Principal Component Analysis (PCA) comes under spatial domain methods.The drawback of spatial domain methods are solved by transform domain methods which is the production of distortion on the fusion of images.

A. Discrete Cosine Transform Based Fusion

Image that is selected to get fused is fragmented into blocks of size NxN that are non-overlapping. .Computation of the coefficients of DCT is done for every block and then on application of fusion rules fused DCT coefficients are obtained.Then for obtaining fused image, IDCT is applied on the fused coefficients.

B. Principal Component Analysis (PCA)

The PCA engross a mathematical procedure for transformation of a correlated variables into uncorrelated variables known as principal Components.Former principal component is the direction of greatest variability in the data.Succeeding is the next orthogonal direction of greatest variability as perpendicular to the former.

Steps used in Principal Components Analysis method:

(i) Images are formatted in order to match up the size of low-resolution multi-spectral images with the high resolution image.

(ii) Transformation of images from low-resolution multi-spectral to principal component is done by means of PCA transformation.
(iii) Substituting the first principal component of an image with the high-resolution image that is stretched to have about the same variance and mean the same as the first principal component of an image.
(iv) The results of high-resolution PAN data substitute first principal component image earlier than the data is transformed back into the original space by PCA inverse transformation.

C. Discrete Wavelet Transform(DWT)

Wavelet dependant scheme of image fusion combines the DWTs of the input image and takes the IDWT. The wavelet transform decomposes the image into various frequency bands at various scales such as low-low, low-high, high-low, high-high.LL band includes approximation coefficients whereas other bands include directional information because of spatial orientation. LH band includes horizontal detail coefficients. HL band includes vertical detail coefficients; HH includes diagonal detail coefficients and also include the upper supreme values of wavelet coefficients that match up the salient features, for instance edges or lines.

Wavelets-based approach performs the following tasks:-

1. It is a multi resolution approach compatible with the various image resolutions and helpful in various applications of image processing that includes the image fusion.
2. The DWT lets the image to be decomposed into various types of coefficients conserving the information in the image.
3. Coefficients like this approaching from various images can be properly united to attain novel coefficients in order that the information in the original images is collected properly.
4. After the coefficients are combined then the absolute fused image is attained by applying the inverse (IDWT), where the information in the combined coefficients is conserved as well.

II. LITERATURE SURVEY

A.Soma Sekhar et al. (2011) [1] suggested a multi-resolution algorithm for fusion by integrating PCA and wavelet transforms for medical diagnosis. By combining the characteristics of region based and pixel-based fusion a multi-resolution based fusion is attained. Amutha et al. (2013) [2] proposed a very simple, rapid and energy efficient DCT based multi-focus image fusion scheme which outperforms other DCT based fusion methods.The fusion rule does not involve any complex arithmetic floating point operations like mean or variance calculations, it is extremely simple and energy efficient.Aribi, W et al. (2012) [3] described the evaluation of the medical image quality could be done through numerous techniques of image fusion. Information to be processed in the medical images is enhanced by combining the information from selected images and the fusion technique's selection is dependant on the application. In this paper the MRI and PET images are taken for instance. Bedi S.S. et al. (2013) [4] presented a reassesment on literature of image fusion techniques and image quality assessment parameters are analysed to set up the algorithm for image fusion that is more apt for clinical diagnosis.B.K. et al. (2013) [5] proposed to fuse multifocus images in the multiresolution DCT domain instead of the wavelet domain to reduce the computational complexity. The comparisons of the performance of the fused image in the proposed domain with that of the wavelet domain with four recently-proposed fusion rules is done.The proposed method is applied on several pairs of multifocus images and the performance compared visually and quantitatively with that of wavelets. Cao et al. (2010) [6] gave proposal for multi-focus image fusion and suggested that it is dealing with the image stack that is attained from images captured from different focus points but every single object in view being captured and considered.Multi focus noisy image fusion algorithm using the contour let transform has been proposed. Making use of confined information based on direction by means of contour let transform,directional windows are utilized in determining fusion weight. Desale, R.P et al. (2013) [7] has observed the different methods to fuse images such as PCA, DCT and DWT dependent techniques for image fusion.For better-quality and accurate applications, the implementation of DWT based fusion technique have been suggested in this paper. Gintautas, P et al. (2011) [8] has proposed an image fusion framework which provides the multi resolution image fusion and at the same time conserve spectral qualities of images that are of low resolution. For fusing multi sensor data like optical-optical, optical-radar imagery an outline for image fusion has been proposed. Haghighat, M et al. (2010) [9]introduced a proficient technique designed for multi-focus image fusion derived from calculation in DCT domain. All coefficients of DCT which are taken as a criterion of contrast in image processing applications computes the value of variance.. Haozheng, R et al. (2011) [10] presented M-band Multi For the above suggested method, firstly the multi focus image fusion method based on single wavelet followed by multi wavelet, multi-band multi-wavelet is considered along with arithmetic decomposition and reconstruction. In this paper, various methods based upon pictures, regions and windows are compared for selection of fusion arithmetic operators. He, D et al. (2004) [11] represented a new image fusion method by integrating high Spatial resolution image to low spatial resolution image and resultant fused image maintain the spectral qualities of the low resolution image as well as integrate the spatial features of high resolution image. Kiran , P et al. (2012)[12] represented a of Multimodality Medical Image Fusion Methods on the basis of Comparative Analysis to enhance the content of the image by fusing medical images like computed tomography and magnetic resonance imaging as they both offers better information at different parts, magnetic resonance imaging offers better information of soft tissues whereas computed tomography is better for denser tissue. Lavanya, A. et al. (2011) [13] projected a novel fusing method dependant upon wavelet pooled IHS with PCA conversions for remotely sensed lunar image data so as to dig out features correctly. From the assessment of statistical parameters, it is proved that PCA in combination with wavelet gives better results than other techniques. Liang et al. (2013) [14]proposed an algorithm for image fusion that is region-based. This method takes into consideration the properties of multifocus images in the way that in focus regions are clear, but out of focus regions are blurring. Li, H et al. (1997) [15] represented a wavelet transform based scheme for fusion. To begin with, in this approach, DWT is applied on source images, and then by combining all the wavelet coefficients ,resultant fused image is attained on applying the IWT. Mohamed, M et al. (2011) [16] suggested a new method which is making use of FPGA which is a hardware based design for image fusion. The hardware execution of DCT, DWT and pulse coupled neural network based fusion algorithms is done in FPGA system.The experimental studies have proved the FPGA based fusion method better in comparison to existing fusion methods. Mohamed et al. [17] recommended to merge the two categories of image fusion Principal Component Analysis and High Pass Filtering to offer pan sharpened image having superior spatial resolution and less spectral distortion that holds huge importanance in many remote sensing applications. It has been proved by experiments that new proposal for fusion holds on to the spectral characteristics of the multi-spectral image as well as at the same time improves spatial resolution of the fused image. Min et al.(2011) [18] observed the problems in fusing remote sensing illustrations based on Markov random field models as well as fusion algorithms are developed as a solution. Markov random field models are influential means to model image characteristics precisely and applied on a mass of image processing applications. Experiments have been presented to illustrate the upgrading of fusion performance with this algorithm.

III. PROPOSED ALGORITHM

This section contains the various steps of the proposed algorithm. Subsequent section contains the detail of the each step.

Step1:Two partially blurred images are passed to the system .Then size of an image is evaluated using equation

$$.[\mathrm{M}, \mathrm{N}, \mathrm{D}] = \mathrm{size}(\mathrm{I}(\mathrm{x}, \mathrm{y})) \text{ .... } (1)$$

Here M represent rows, N represent columns, D represent dimensions. I(x, y) is an input image.

Step 2: Then RGB2PCA is applied to transform given image into PCA plane.

(a) For conversion of RGB image into PCA, each RGB image constituent must be transformed into vector first. Every vector is then concatenated by making use of the equation given below:

$$\mathrm{IIV} = \mathrm{cat}(2, \mathrm{R}, \mathrm{G}, \mathrm{B}) \text{........ } (2)$$

Here IIV is representing the Input Image Vector , cat is representing the concatenate function.

(b) Then, by the use of principal component function ,Eigen values are being computed. Principal component function is represented by the following equation

$$\mathrm{VV} = \mathrm{princomp}(\mathrm{IIV}) \text{....... } (3)$$

Here VV is representing the vector values ,princomp is inbuilt function in MATLAB.

(c) Then by using vector values, PCA vector is obtained by making use of following equation

$$\mathrm{Vector} = \mathrm{VV}/(\textstyle\sum(\mathrm{VV}) \text{........ } (4)$$

(d) At last from vector representation, PCA image is obtained by using following function

$$\mathrm{OVI} = \mathrm{IIV} * \mathrm{Vector} \text{......... } (5)$$

Here OVI is representing the output vector image , IIV is representing the Input Image Vector

Step 3: Then PCA of image1 and image2 are differentiated into 3 planes as PCA1, PCA2 and PCA3 of Image1 and Image2 as image is assumed to be in RGB by making use of the following equations:

$\mathrm{impca1} = \mathrm{pcaim}(:,:,1)$....... (6)

$\mathrm{impca2} = \mathrm{pcaim}(:,:,2)$......... (7)

$\mathrm{impca3} = \mathrm{pcaim}(:,:,3)$....... (8)

Here Impca1, Impca2, Impca3 represents the pca1, pca2, pca3 of image1 and image2 respectively. Pca1 represent r component, pca2 represent g component and pca3 represent b component.

Step 4: For PCA (:,:, 1) of image 1 and image 2 will be passed for fusion by DCT. And also PCA (:,:,2) & PCA(:.:.3) of image 1 and image 2 will evaluate new components by taking their averages respectively also called fusion of chrominance.

(a) The two chrominance components are used to represent color information and it is supposed that the images that are to be fused are having alike hue and saturation , therefore, chrominance components can be averaged by using following equation:

$\mathrm{cf2} = (\mathrm{im1pca2} + \mathrm{im2pca2})/2$............ (9)

$\mathrm{cf3} = (\mathrm{im1pca3} + \mathrm{im2pca3})/2$............ (10)

Here cf represents chrominance fusion.

(b) Now fusion based on DCT will be carried out using expand and reduced function.

Reduced function is for reduction of the size of an image. Image reduction is carried out by taking dct and then applying the idct on an input image. Image reduction is done by using following equations:

(i) Firstly, the size of an image is evaluated by using following equation:

$\mathrm{imsize} = \mathrm{size}(\mathrm{pca1im})/2$....... (11)

Here imsize function is used to find the size of an image , pca1im indicates the pca1 of image1 and image2 respectively.

(ii) Now dct is applied by making use of following equation:

$$\text{im} = \text{dct2}(\text{pca1im}) \ldots\ldots (12)$$

Here im is the 2d discrete cosine transform of an image ,dct is Discrete Cosine Transformation function which transforms an image into discrete frequency variables.

(iii) Now idct is applied by making use of following equation:

$$\text{opr} = \text{round}\left(\text{idct2}\left(\text{im}, \left(\text{size}(\text{im1})\right), \left(\text{size}(\text{im2})\right)\right)\right) \ldots\ldots (13)$$

Here opr represents an output image of reduced function, round represents quantized function in which approximate coefficients are quantized to zero.

An Expand function is exactly the opposite of the reduced function. An expand function is used for expansion of the size of an image from m*n to the 2m*2n by making use of dct and idct function. Image expansion will be done by making use of following equations:

(i) Firstly, the size of an image will be evaluated by making use of following equation:

$$\text{imsize} = \text{size}(\text{pca1im}) * 2 \ldots\ldots (14)$$

Here imsize function is used to find the size of an image , pca1im indicates the pca1 of image1 and image2 respectively.

(ii) Now dct is applied by making use of following equation:

$$\text{im} = \text{dct2}(\text{pca1im}) \ldots\ldots (15)$$

Here im is the 2d discrete cosine transform of an image ,dct is Discrete Cosine Transformation function which transforms an image into discrete frequency variables.

(iii) Now idct is applied by making use of following equation:

$$\text{ope} = \left(\text{idct2}\left(\text{im}, \left(\text{size}(\text{im1})\right), \left(\text{size}(\text{im2})\right)\right)\right) \ldots\ldots (16)$$

Here ope represents an output image of expand function ,idct2 represents an inverse discrete cosine transformation function.

After computing both the expand and reduced function, finally the output of pca1 of image 1 and image2 is achieved by making use of following equation:

$$\text{im1id} = \text{im1R} - \text{E}(\text{im1R}) \ldots\ldots (17)$$
$$\text{im2id} = \text{im2R} - \text{E}(\text{im2R}) \ldots\ldots (18)$$

Here im1id, im2id represents image identities of image1 and image2 respectively. R indicates reduced function and E indicates the expand function.

Now aggregation function comes into action and is applied to make the choice which image has more variations in pixels by making use of following equation:

$$\text{ag} = \text{abs}(\text{im1id}) - \text{abs}(\text{im2id}) \geq 0 \ldots\ldots\ldots\ldots (19)$$

Here ag represents aggregate function, abs return an absolute value for each element of an image.

Then finally effect of fusion is computed by making use of following equation:

$$\text{fe} = \text{ag} * \text{im1id} + (\sim\text{ag}) * \text{im2id} \ldots\ldots (20)$$

Here fe represents fusion effect,ag represent aggregate function in which image has more variation in pixels and (~ag) indicate not aggregate function.

And lastly the output image is obtained by following equations:

$$\text{op} = \frac{\text{im1r} + \text{im2r}}{2} \ldots\ldots (21)$$
$$\text{opf} = \text{fe} + \text{E}(\text{op}) \ldots\ldots (22)$$

Here opf represents final output image, Fe represents fusion effect, E indicated expand function and op is an output image of reduced function.

Step5: Here each output of step IV will be concatinated with the use of following equation:

$$\text{a} = \text{cat}(3, \text{opf}, \text{cf2}, \text{cf3}) \ldots\ldots\ldots\ldots (23)$$

Here cat represents concatenate function, opf represents final output image of dct based fusion of the first component of image1and image2. cf2, cf3 represents chrominance fusion of second and third component of image1 and image2 respectively.

Step6: Then to get original fused image PCA2RGB conversion will be applied. PCA2RGB conversion is done using the following equation:

$$\text{cv} = \text{cat}(2, \text{im1}, \text{im2}, \text{im3})) \ldots\ldots (24)$$

Here cv is combined vector , im1, im2, im3 represent the pca1, pca2, pca3 respectively.

Then at last RGB vector is obtained using the following equation:

$\text{iv} = \text{cv} * \text{inv}(\text{vector})$….. (25)

Here iv is image vector, cv is combined vector ,inv vector represents the inverse vector obtained in rgb2pca conversion.

Step7: Now DARK CHANNEL PRIOR will come into action to enhance the fusion results further.

Lets take J(x) as input image, I(x) as foggy image, t(x) as the transmission of the medium. The image attenuation due to fog can be represented as:

Iatt(x) =J(x) t(x)….. (26)

In homogeneous atmosphere, transmission t(x) is represented as:

$$t(x) = e^{-\beta d(x)} \ldots\ldots \quad (27)$$

Here β represents the scattering co-efficient and d(x) represents the depth of the scene at point x.

The another effect of fog is Airlight effect and it is represented as:

$$lairtight(x) = A\,(1 - t(x)) \ldots. \ (28)$$

Here A represents Atmospheric light .As fogy image is degraded by a combination of attenuation and atmospheric light effect, it is represented as:

$$I(x) = J(x)\, t(x) + A\,(1 - t(x)) \ldots. \ (29)$$

Dark channel for any image J, represented as J dark is defined as:

$$Jdark(x) = \min_{y \in \Omega(x)} \left(\min_{C \in \{r,g,b\}} (J^C(y)) \right) \ldots \ (30)$$

Jc is representing color image comprising of RGB components.Ω(x) is representing a local patch having its origin at x. After implementation of Dark Channel prior, Estimation of transmission map and Atmospheric light, haze free image can be restored using:

$$J(x) = \frac{I(x) - A}{\max(t(x), t0)} + A \ldots. \ (31)$$

Step8: After applying DCP to the fused image, an adjusted image based upon the measured DCP is obtained .On applying the following nonlinear function to the obtained adjusted image, we get the final fused image.

equailization_factor = stretchlim(img_adjusted, 0.015);… (32)

final _image = imadjust(img_adjusted, equailization_factor, [ ])…. (33)

Step9:END

IV. EXPERIMENTAL RESULTS

Figure 1.1 has been taken to show the input images for experimental analysis. Fig 1.1 (a) is shows blurred image 1(left) and Fig 1.1 (b) shows blurred image 2(right).The final goal of image fusion is to unite significant information from more than one images into a single more informative image suitable for both visual perception and further computer processing.

Figure 1.1(a): Blurred image1(left)

Figure 1.1(b): Blurred image2(right)

Figure 1.2: DWT based image fusion

Figure 1.2 is showing the output image given by the wavelet based fusion(DWT).The output image is preserving the brightness of original blurred images but color is imbalanced due to which the quality of image have been degraded.

Figure 1.3: DCT based image fusion

Figure 1.3 is showing the output image given by DCT based fusion. The output image is showing too much brightness and imbalance in colors in comparison to original blurred images.

Figure 1.4: PCA based image fusion

Figure 1.4 is showing the output image given by PCA based fusion. The output image is showing low brightness and low contrast in comparison to original blurred images due to which the quality of image have been degraded.

Figure 1.5: Final proposed image

Figure 1.5 is showing the output image given by the proposed algorithm which is using integrated DCT and PCA based fusion with the popular fog removal technique Dark Channel Prior. The image obtained is haze free and the brightness of the image is enhanced as all the fog has been removed.The quality of output image is quite good with our proposed method with respect to all the techniques discussed.

V. PERFORMANCE ANALYSIS

The following tables show cross-validation among active techniques and the proposed techniques. Various performance evaluation parameters for digital images have been used to prove the proposed algorithm's results improved over existing algorithms.

Table 1.1 is representing the objective analysis of the mean square error. The lesser the mean square error is, the better is the image quality.So the proposed algorithm is giving improved results over other techniques as the mean square error is reduced in every case.

Table 1.1 Mean Square Error Evaluation

Image name	PCA	DCT	DWT	Proposed
image1	3843	1525	93	84
image2	9326	1023	754	2
image3	5675	1535	262	1
image4	4588	1341	186	0.9232
image5	7665	1881	671	9
image6	8701	1238	716	2
image7	4476	1055	268	2
image8	6249	1268	316	0.4693
image9	3519	1108	178	9
image10	5983	1065	569	3

Figure 1.1 has represented the quantitate analysis of the mean square error on different set of images using fusion by DWT transform , by DCT transform, by PCA transform and fusion by Proposed approach. The above plotted figure is showing the decrease in MSE with the proposed algorithm over other techniques. So it is apparent that results with the proposed algorithm are improved over other techniques.

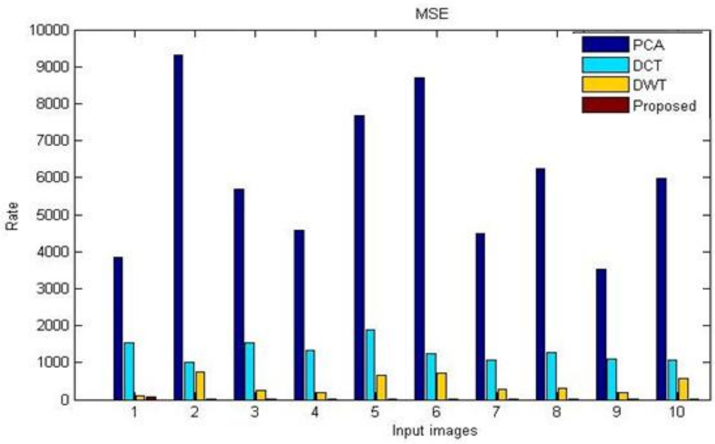

Figure 1.6 MSE of DWT, DCT, and PCA& Proposed Approach for different images

Table 1.2 is representing thepeak signal-to-noise ratio, between the original image and the fused image.The morethe peak signal to noise ratio is, the better is the image quality. So the proposed algorithm is giving improved results over other techniques as the peak signal to noise ratio is increased in every case.

Table 1.2 Peak Signal to Noise Ratio Evaluation

Image name	PCA	DCT	DWT	Proposed
image1	24.5671	32.5944	56.8004	57.7487
image2	16.8676	36.0557	38.7096	88.1515
image3	21.1816	32.5342	47.8678	96.0151
image4	23.0284	33.7071	50.8307	96.9560
image5	18.5707	30.7700	39.7261	76.4612
image6	17.4699	34.4011	39.1592	90.1890
image7	23.2437	35.7892	47.6715	88.7086
image8	20.3452	34.1933	46.2618	102.8320
image9	25.3329	35.3685	51.2496	76.9262
image10	20.7231	35.7090	41.1492	85.7975

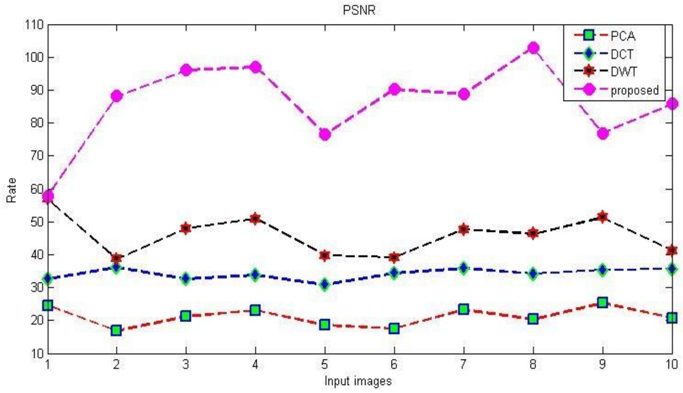

Figure 1.7 PSNR of DWT, DCT, PCA& Proposed Approach for different images

Figure 1.2 has represented the peak signal to noise ratio on differentset of images using fusion by DWT transform , by DCT transform, by PCA transform and fusion by Proposed Approach. The above plotted figure is showing the increase in PSNRwith the proposed algorithm over other techniques. So it is clear that results with the proposed algorithm are improved over other techniques.

Table 1.6 is representing the comparative analysis of the bit error rate. The lesser the bit error rate is, the better is the image quality. So the proposed algorithm is giving better results than the other techniques as the bit error rate is reduced in every case.

Table 1.3 Bit Error Rate Evaluation

Image name	PCA	DCT	DWT	Proposed
image1	0.0407	0.0307	0.0176	0.0173
image2	0.0593	0.0277	0.0258	0.0113
image3	0.0472	0.0307	0.0209	0.0104
image4	0.0434	0.0297	0.0197	0.0103
image5	0.0538	0.0325	0.0252	0.0131
image6	0.0572	0.0291	0.0255	0.0111
image7	0.0430	0.0279	0.0210	0.0113
image8	0.0492	0.0292	0.0216	0.0097
image9	0.0395	0.0283	0.0195	0.0130
image10	0.0483	0.0280	0.0243	0.0117

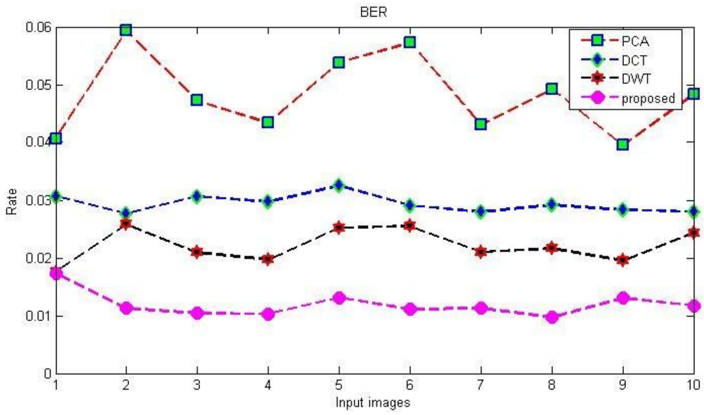

Figure 1.8 BER of DWT, DCT, PCA& Proposed Approach for different images

Figure 1.6 has represented the performance analysis of the bit error rate on differentset of images using fusion by DWT transform, by DCT transform, by PCA transform and fusion by Proposedapproach.The above plotted figure is showing the decrease in BERwith the proposed algorithm over other techniques. So it is clear that results with the proposed algorithm are better over other techniques.

VI. CONCLUSION

Image fusion integrates information from numerous illustrations of the same picture to attain the informative image that is highly suitable for vision processing applications.The image fusion is becoming one of the major pre-processing techniques in image processing. Many image fusion methods have been developed in a number of vision methods. An overall aim for carrying out fusion is merging the useful contents from the numerous illustrations of same picture so as to bring only the useful material. Discrete cosine transform dependant approaches are highly appropriate for image fusion and less time consuming in actual systems. DCT dependant fusion some time may result appropriate results due to fusion process also called fusion artefacts. So in order to overcome this problem an integrated well-known fog removal technique "dark channel prior method" to enhance the results further and remove the color artefacts has been proposed. However most of the DCT based techniques has focused on grayscale images so integration of PCA and DCT domain has also been done in order to authenticate the results for color images. The comparison among existing techniques like DCT based fusion, PCA based fusion,DWT based fusion and proposed technique has also been carried out in order to analyse the significant improvement of the proposed algorithm to authenticate the proposed work. The comparative analysis carried out on the basis of various performance evaluating parameters has shown the significance of the proposed algorithm.

In respect to the time complexity ,image fusion algorithms are found to be the complex algorithms so in future a new technique will be proposed by us that will make use of parallel computing that will contribute in improving the speed of the proposed algorithm.

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