

REVIEW ON IMAGE FUSION AND ITS TECHNIQUES

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Abstract-- Image fusion is really a system to combine applicable data from a couple of images right into a solitary image where in fact the resultant fused image is more instructive image. The fused image holds all of the vital data as contrast to information images. The fused image holds all of the vital data as contrast to information images. The fused image acquires all the info from source images. With fast advancement in technology, it is currently conceivable to have data from multi-source images to produce a great fused image. The result of image fusion is always to interchange image that has remaining parts probably the most attractive information and qualities of input image. The key objective of image fusion is to mix information from multiple images of exactly the same picture in order to transport only the useful information. The normal objective of this paper has gone to explore different methods for efficiently fusing digital images. It's been found that many the prevailing researchers have neglected many consequences; i.e. no technique is accurate for different type of circumstances.

Keywords :- Image Fusion, Pca, Dct,Dwt

I.INTRODUCTION

The requirement for better diagnosis and clear interpretation of the obtained images give rise to image fusion. The term fusion methods to combine the info acquired in a number of domains. Image fusion has changed into a popular technique used within medical diagnosis and treatment. Image fusion may be the procedure for integrating information from two or more images of a subject right into a single image[18]. Development of new imaging sensors such as for example optical cameras, infrared (IR) cameras, millimeter wave (MMW) cameras, X-ray and radar imaging systems, contributes to fast technological progress in the applications of the image fusion. Visual sensor networks, remote sensing, camera vision, medical imaging, defect assessment overexposure correction, military and surveillance applications are some practical examples[19]. The mainly

proposal of medical image fusion is forever to improve the readability of the image by processing the redundant data in multiple images and increase image sharpness by disposing the complementary information among multi images. The precondition of image fusion is picture superimposition. It is significant to image fusion that only pixels of the two image in the exact same position are corresponding same anatomic structure. The fusion of multi modality medical image is provide more comprehensive and accurate data for clinical by consolidating the valuable physiological functions information and the complete anatomical information. The basal way are based on pixel based and characteristics of the image for the moment. The former is processing point by point and weighted sum, fetched size of gray value. It is really a simple method but inefficient[20]. The later extract the feathers of the image. It is really a complicated mean but perfect impression is gained.

Image fusion is really a system to combining applicable data from a pair of images in a solitary image in that your resultant fused image is more instructive image. The fused image holds every one of the vital data as contrast to information images. The fused image will acquire all the info from source images. With fast advancement in technology, it's conceivable to obtain data from multi-source images to make an excellent fused image. Caused by image fusion is interchange image that remaining parts essentially probably the most attractive information and qualities of input Image. Image fusion is really a beneficial process for combining the sensor and multi-sensor images to strengthen the data.

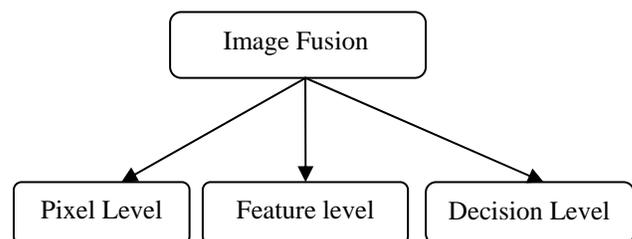


Fig 1: Three levels of image fusion

The motivation behind image fusion is obviously to participate data from group of images making time for the goal in making a picture that communicates just the accommodating information. Image fusion is really a task wherein images are extracted from distinctive sensors by way of a particular algorithm therefore the resultant image is more consistent, clear, and reasonable. Image fusion method like discrete cosine transform is appropriate and efficient in continuous framework. A fantastic way of fusion of multi focus images is focused around variance calculated in DCT domain. The primary objective of image fusion is always to generate a fused image that provides the whole and consistent data. Image fusion perform at three separate levels i.e. pixel, feature and decision, expects to accomplish the more correct, complete and consistent image description of exactly the same scene.

A.Pixel Level Fusion

In pixel level image fusion, firstly registration of images happens. At this time the pre-processing is preformed. Pixel level fusion meets expectations straight on pixels of source images. In pixel level image fusion, various requirements are focused for the fused results; the fusion methodology should protect beneficial data in the initial source image, the fusion probably should not present any component. Pixel level fusion reaches be the primary principle simply because it can secure unique data of source image however much as could be expected.

B.Feature Level Fusion

Feature level fusion procedure is the second phase of processing where image fusion may happen. Fusion within the feature level needs removing features from your input images. Features might be pixel intensities or edge and composition characteristics. The Several types of features are measured depending en route of images and the usage of the fused image. You will includes the removing of feature primitives like edges, area, shape, size, length or image fragments, boasting with comparable intensity from the images being fused from unique variations of images of the comparative geographic range. Gets to something are then merged with the related features introduce from another data images using a pre-determined choice procedure to create the last fused image. Decision level fusion joins the outcomes from various algorithms to yield one final fused decision.

C. Decision Level Fusion

Decision level fusion is a really active of fusion which joins the outcomes from various algorithm to make a final fused decision.

II . LITERATURE SURVEY

Haghighat, M et al. [1] has fixed that the picture blending is a framework to solidify information from different pictures of exactly the same scene to spread this is the supportive information. The discrete cosine change (DCT) based schedules for picture fusion are considerably better and proficient ceaselessly system. In this paper a successful system for mixture of multi-base pictures concentrated on change discovered in DCT region is presented. The test outcomes shows the capacity change of our procedure both in quality and complication diminishing in examination with a couple generally proposed methods.

Ling Tao et al. [2] has inspected that therapeutic picture combination has greatly basic estimation useful for medicinal picture study and judgment. The conventional framework for wavelet combination is upgraded and an alternate calculation of restorative picture combination is presented. At that moment that picking high recurrence coefficients, the area edge intensities of each and every one sub-picture are figured to recognize versatile combination. The reduced recurrence coefficient picking is centered around edges of pictures, with the goal that the melded picture can ensure all profitable information and shows up doubtlessly. Apply the customary and improved combination calculations centered around wavelet change to breaker pictures and besides survey the combination results. It has been demonstrated that the calculation can effectively hold data of special pictures and update their edges and surface peculiarities. This new calculation surpasses conventional combination calculation centered around wavelet change.

Ujwala Patil et al. [3] recommended that consolidating several enlisted pictures of the unclear spot to obtain various instructive pictures is named picture combination. Essential part investigation is just a noticeable methodology for gimmick extraction and measurement diminishment. Picture combination calculation joins together pyramid and important segment investigation methods and remove the product quality dissection of progressive key part examination combination calculation without suggestion picture. There is a creating necessity for the product quality examination of the combination calculations. We indicate combination utilizing wavelet and essential segment examination combination strategies and takeout creation dissection for these combination systems utilizing remarkable quality measures for mixture of data sets and show that proposes picture combination utilizing various leveled chief part investigation is great for the combination of multimodal imaged.

Xing Su-xia et al. [4] has recommended that infrared and unmistakable picture combination routines can enhance the picture differentiate, and grow the night vision compelling. The rehashed infrared and noticeable pictures from the relative scene were vague by non-sub examined form let change; take following the evaluated mass found the middle value of, high-recurrence attributes segment according to the weighted of the area standard deviation share; then your combination picture is obtained by opposite non-sub inspected shape let change; the combination pictures were appear differently in terms of the effect acquired by Laplace change, wavelet change and form let change amid a boundless numeral of trails, and the product quality examination was carried out through the clamor test. Non-sub tested shape let change can accomplish pervasive combination result, and high caliber.

Ahmed Abd-el-kader et al [5] has mentioned that bend let change is definitely an as recently form multi-scale changes, which is further adequate for things with bends. Picture combination suggests the combining pictures into a picture that has the incredible information without making peculiarities that are story in the specific pictures. Two well-known applications of picture combination are located; combination of multi-center pictures and combination of multi presentation pictures. Combination effects were surveyed and balanced as shown by three measures of execution; the entropy (H), the shared data (MI) and the measure of edge data (QABIF). The three execution measures have showed that the bend let based picture combination calculation gives preferred combined picture within the wavelet calculation. The melded picture features a predominant eye perception than the info ones.

Ghimire, D et al. [6]has proposed a method for image enhancement in HSV space focused around the area processing of image. In this particular technique an upgrade is connected just on V component and H and S component usually are not changed during improvement so the first color with the improved image seriously isn't modified. Relying on the subjective and objective execution assessment, the proposed system has demonstrated experienced in image improvement. The destination criteria like Detail Variance, Background Variance and statistical attributes demonstrates that proposed strategy deliver better images when compared with other systems like histogram equalization and AINDANE.

Aribi, W. et al. [7]explained that the character with the medical image might be assessed by few image fusion techniques. The fusion of images improves the information to be ready by combining the information from selected images and picking a fusion technique will depend on upon the application. For instance, this paper addresses the MRI and PET images. Here, eight image fusion methods referred as Laplacian, FSD, Gradient, RATIO, Morph, Contrast, DWT and SIDWT systems have talked about. The

parameters considered to the assessment of the desired info is Mutual Information, Universal Image quality Index and mean SSIM. The acquired result demonstrates that this RATIO and contrast procedures introduce the best comes about.

Kiran parmar et al. [8] has analyzed that this outline is to help the image content by fusing images like computer tomography and magnetic resonance imaging images; magnetic resonance imaging gives high-quality data on delicate tissue while computed tomography gives better more knowledge about substantial tissue. Fusing both these types of images produce a complex image that's more instructive than different signals gave by a person modality. Image fusion has become a typical operation used within medical diagnostics and therapy. Fast Discrete Curve let Transform using Wrapper algorithm based image fusion method, is execute, examine and contrasted with Wavelet based Fusion Technique. Fusion of images concentrates at diverse purposes, power through distinctive systems helps doctor to withdraw the qualities that most likely are not normally visible within an individual image by different modalities.

Vivek Kumar gupta et al. [9] has analyzed that in remote sensing program the raising accessibility of space persevered sensors offer spark to picture combination calculations. Remote sensing picture combination plan at arranging the info exchange by data got which hide unique parts of the electromagnetic range at various spatial, transient and phantom determination; we can secure multi-fleeting, multi-determination and multi-recurrence picture information for basis for gimmick extraction, demonstrating and arrangement. The combined picture is quite a bit serviceable for human data. Intertwined picture is a bit more useful for programmed machine dissection errand for example characteristic extraction, division and article distinguishment.

Sruthy, S et al. [10] has mentioned which the Image Fusion is the process of joining data of a couple of pictures right solitary picture which often can hold immeasurably imperative peculiarities of the all unique pictures. Here the data to combination includes set of images extracted from diverse modalities of the scene. Yield is really a superior quality picture; which utilizes upon a specific application. The marked of combination is to generate a picture which depicts a scene preferable or significantly higher over any single picture concerning some significant properties giving an instructive picture. These combination strategies are critical in diagnosing and treating disease in restorative fields. This paper concentrates on the improvement of a graphic combination technique utilizing Dual Tree Complex Wavelet Transform. The outcome demonstrate the proposed calculation carries a finer visual quality than the bottom routines. Additionally the character of the intertwined picture is assessed utilizing a collection of value measurements.

Desale, R.P. et al. [11] has examined different image fusion methods such as PCA (principal Component Analysis), DCT (Discrete Cosine Transform) and DWT (Discrete Wavelet Transform) based image fusion methods. Authors have recommended picking a DWT based fusion solution to top quality and exactness applications. On this paper two algorithms focused around DWT are proposed for example, Pixel averaging and maximum pixel replacement algorithm. The execution of above said DWT's are contrasted along with the PCA and DCT fusion techniques. The examination is executed focused around seven parameters named as PSNR, MSE, Normalize absolute error, Maximum Difference, Average difference, Normalized Cross-Correlation and structural content. The outcome portrays which the execution of DWT based fusion strategies is altogether better as contrast with an alternate routines for image fusion.

Om parkash et al. [12] has analyzed that the purpose of image fusion is to take appropriate data out of a couple of images of the area right solitary image and that is much informatory and it is considerably better for human information. Spatial domain based operations make spatial distortions from the fused image. Spatial domain distortion can be totally overseen by the use of wavelet transform based image fusion processes. Using supreme greatest fusion rule wavelet coefficients at unique decomposing levels are fused. Two weighty characteristics wavelet symmetry and linear phase of BWT are took preferences (exploited) for image fusion in light that they might ensure edge data. It has been revealed that the wavelet transform technique improve fusion quality by decreasing loss of significant data usable in solitary images.

Shutao Li et al. [13] has analyzed that the quick and powerful image fusion techniques is proposed to make an extremely instructive fused image through uniting numerous images. Image fusion strategy is with different two-scale decomposition of your image right first layer containing large scale variations in intensity, and also a priority layer catching little scale information. A book guided filtering- based weighted average technique is proposed to make full consumption of spatial consistency for fusion of the bottom and priority layers. It has been revealed that the proposed system can acquire state-of-the-art execution for fusion of multispectral, multi-focus, multimodal, and multi-exposure images.

Mohammed Hossny et al. [14] has discussed that image fusion methodology join together various images into individuals enlightening image. Image fusion metrics are creating from image processing variance metrics. In Image fusion metrics: evolution simply speaking the evolution of objective image fusion performance metrics along with subjective and goal acceptance. It clarify as to what way fusion execution metric create starting with image difference measurement, its understanding into image fusion

connections, it limit weighting component along with the acceptance operation.

R. Amutha et al.[15] has discussed that classy and efficient multi-focus image fusion framework clearly planned for wireless visual sensor framework prepared with resource constrained, unsafe setting like battlefields. The fusion of multi-focus images is focused around higher esteemed Alternating Current coefficients computed in Discrete Cosine Transform domain. Discrete cosine transform defeats the computation as well as confinement of low power gadgets and it is explored with regards to image quality and computation energy. It confirm the functional efficiency enhancement of the proposed system in yield quality as well as consumption, when contrasted to fusion techniques DCT domain.

III. GAPS IN LITERATURE

By conducting the review it has been found that the most of the existing literature has neglected at least one of the following.

1. As most of the existing methods are based upon therefore it may results in some color artefacts which may reduce the performance of the transform based vision fusion methods.
2. It is also found that the problem of the irregular illuminate has also been neglected in the most of existing work on fusion.
3. Most of the existing work has focused on gray scale images not much work is done for color images.

IV. IMAGE FUSION TECHNIQUES

Within the Image Fusion techniques the high-quality data from greater part of the given images is fused commonly build a resultant image whose quality surpasses considered certainly one of the input image.

A.Principal Component Analysis

It is really a mathematical means from applied linear algebra .It is really a simple non-parametric method of extracting related information from confusing data sets. PCA is really a useful statistical method that has found application in fields such as for instance face recognition and image compression, and is really a common method for finding patterns in data of high dimension. The origins of PCA lie in multivariate data study, it includes a wide range of other applications PCA has been called surely one of the most important results from applied linear algebra and perhaps its most typical use is whilst the first step in wanting to analyses big data sets.

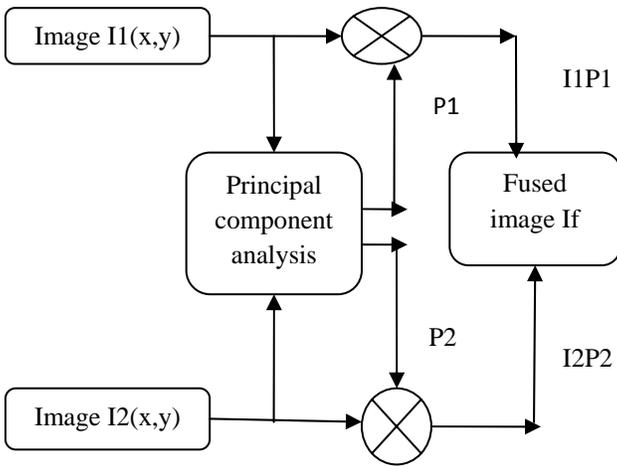


Fig. 2. Image Fusion Process using PCA

In common terms, PCA uses a vector gap transform to cut back the dimensionality of large data sets. The procedure flow diagram of PCA algorithm is shown in under figure 2. The input images $I_1(x, y)$ and $I_2(x, y)$ are set in two column vectors and their empirical means are subtracted. The consequential vector has a measurement of $n \times 2$, where n is period of the every image vector. Calculate the eigenvector and eigenvalues with this resulting vector are computed and the eigenvectors corresponding to the larger eigenvalue obtained. The normalized mechanism P_1 and P_2 are computed from the obtain eigenvector. The fused image is given by equation, $I_f(x,y) = P_1 I_1(x,y) + P_2 I_2(x,y)$

B. Discrete Cosine Transform

The digital images are displaying on a display right after they are captured. You will find two represent types for digital image that is spatial domain or frequency domain. Spatial domain image may be realizes through our human eyes, but frequency domain use to analysis of spatial domain A Discrete Cosine Transform (DCT) is a significant transform in image processing. It is obviously used expressing a sequence of finite data points when it comes to a amount of cosine functions oscillating at dissimilar frequencies. Large DCT coefficients are concerted in the reduced frequency region; hence, it is acknowledged to have brilliant energy compactness properties. Discrete Cosine Transformation (DCT) are essential to frequent applications in art, engineering and in images compact, like MPGE, JVT, etc. In DCT the Images to be fused are divided into non-overlapping blocks of size $N \times N$ as showing in above Fig-3. For every block DCT coefficients are computed and fusion rules are applied to get fused DCT coefficients. Then apply the IDCT on the fused coefficients to

create the fused image/block. The following only two fusion rule is used for image fusion process. They are the straightforward averaging method and by using equation method as in eq. Allow the X_1 function as DCT coefficients of image block from image 1 and similarly let X_2 function as DCT coefficients of image block from image 2. Suppose the image block is of range $N \times N$ and X function as fused DCT coefficients. Here, all DCT coefficients from both image blocks are averaged to get fused DCT coefficients.

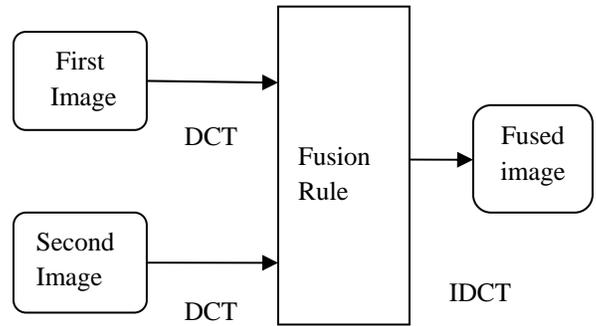


Fig. 3. process flow graph of DCT

C. Discrete Wavelet Transform

The Discrete Wavelet Transform (DWT) also converts the image starting the spatial domain to frequency domain. The image is divided by vertical and horizontal lines and represents the first-order of DWT, and the image could be separated with four parts. In additional, those four parts are represented four frequency areas in the image. Wavelet transform is first performed on every source images to generate a combination decision map centered on a couple of fusion rules. The fused wavelet coefficient map could be made of the wavelet coefficients of the origin images according to the fusion decision map. To conclude the fused image is obtained by performing arts the inverse wavelet transform.

The fusion rules play an essential role through the fusion process as shown in figure 4.

1. Implement the DWT on both input images to create lower decomposition wavelets.
2. By utilizing different fusion rules fuse each decomposition levels.
3. Apply IDWT on fused decomposition levels, to recreate the original image that is fused image.

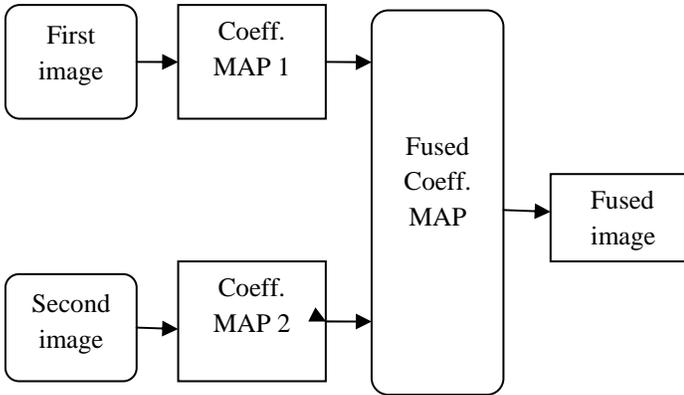


Fig. 4.Processof image fusion using DWT

D.DWT Decomposition

In discrete wavelet transform (DWT) decomposition, the filters are specifically designed so that successive layers of the pyramid only include details that are not already offered by the preceding levels. The DWT decomposition uses a cascade of special low pass and high-pass filters and a sub-sampling process. The outputs from 2D-DWT are four images having size add up to half how big the first image. So from first input image we will find HHa, HLa, LHa, LLa images and from second input image we will get IDWT

LHb, LLb images. LH ensures that low-pass filter is applied along x and followed closely by high pass filter along y. The LL image offers the approximation coefficients. LH image offers the horizontal detail coefficients. HL image offers the vertical detail coefficients, HH offers the diagonal detail coefficients. The wavelet transform may be performed for multiple levels. The next degree of decomposition is completed using only the LL image. The outcome is four sub-images each of range add up to half the LL image size as shown in figure 5.

E.Algorithms

The algorithm of image fusion with DWT has follow common steps applicable to proposed ways of fusion.

- a)Accept the two input images.
- b) Resize both images to 256 x 256.
- c) Convert to Gray scale image.
- d) Convert to double precision format.
- e)Take Discrete Wavelet Transform of both images.
- f) Allow for first image OUT bands be HHa, HLa, LHa, LLa and for second image be HHb, HLb, LHb, LLb.

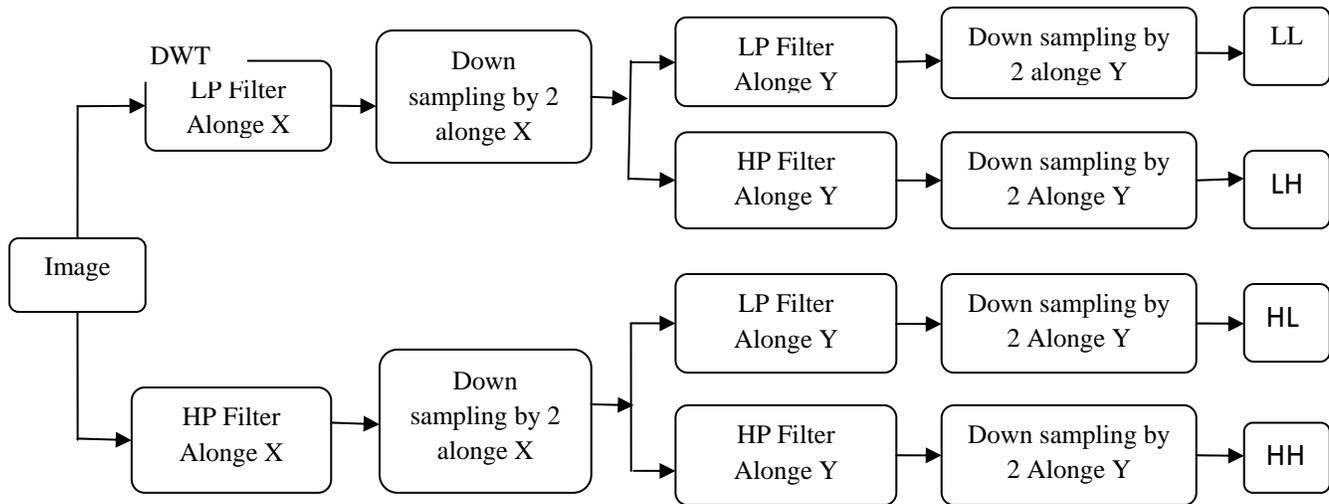


Fig. 5.The block diagram of 2D- DWT

Image fusion by Maximum Pixel replacement

- 1) Take the pixel having the most value of both bands i.e. HHa and HHb, and place in HHn.
- 2) Take the pixel having the most value of both bands i.e. HLa and HLb, and place in HLn.

- 3) Take the pixel having the most value of both bands i.e. LHa and LHb, and place in LHn.
- 4) Take the pixel having the most value of both bands i.e. LLa and LLb, and place in LLn.
- 5) Thus we will obtain HHn,HLn,LHn and LLn as fresh coefficients.

- 6) Take Inverse Discrete Walnut Transform.
- 7) Obtain the fused Image and Display.

Image Fusion by Pixels Averaging

- 1) Take the average of pixels of the two bands i.e. HHa and HHb ,and devote HHn.
- 2) Take the average of pixels of the two bands i.e. HLa and HLb, and devote HLn.
- 3) Take the average of pixels of the two bands i.e. LHa and LHb, and devote LHn.
- 4) Take the average of pixels of the two bands i.e. LLa and LLb, and devote LLn.
- 5) Thus we are certain to get HHn,HLn,LHn and LLn as new coefficients.
- 6) Get into Inverse Discrete Wavelet Transform.
- 7) Obtain the fused Image and Display.

V .CONCLUSION AND FUTURE SCOPE

Image fusion is a procedure of combining the related information from many images into a only image where the fused image will be more useful and accomplish than a number of the input images. Image fusion means the combining of multiple images into a sole image that has the most information content without producing facts which can be missing in certain image. The design of image fusion in multi-focus cameras to combine data from various images of the related landscape in order to take the multi focused image. Discrete cosine transform is a graphic fusion method that is more appropriate and suitable in real-time systems using discrete cosine transform based standards of stationary image or video. The image fusion methods using discrete cosine transform (DCT) are regarded as right and time-saving in real-time systems using stationary image or video standards predicated on DCT. But has been found that many the existing researchers have ignored a number of the well-liked issues of vision processing like image de-noising, image enhancement, and image restoration. So to manage these troubles a new algorithm is likely to be proposed in near future.

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