A Review of Image Fusion Methods

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Abstract:- Image fusion is defined as the process of combining multiple images from similar background to form a whole single image. This combined image will provide a lot of information that cannot be found when they are available in separate images. This process is used mainly for obtaining certain major information that are hidden in a single image and they are also used for the noise available in the image. There are a number of varieties available that produces noise in an image. Some of the common noise include Gaussian, impulse, and various other noises available in the environment. Due to the problem of this process sometimes the quality of the images are being affected. So in order to find the problems existing in a image the fusion or combination technique is been used and they can be e done using three methods like pixel level method, feature level and decision level methods of combination. The basic technology that is being used for combining these multiple image is major special technique or temporal technique. Some of the most common special technique that are being used in spatial domains are average method, PCA Fusion method and high pass filtering method. Some of the temporal methods include direct cosine transform, discrete wavelet transformation and temporal domain fusion methods. Both of these methods have their own set of positives and negatives. One of the most common problem that occurs in this method is the colour artefact problem and hence this paper mainly focuses on the problems that occur in various fusion techniques and how to solve them.

I. INTRODUCTION

➤ *Introduction of Image Fusion*

There are two methods of visions available in the world. One is is the human vision where a human is able to view the objects based upon the stimuli and other senses related to vision. The vision has perfected over many years. The second concept is the computer vision that is done with the help of various programs and algorithms that has been embedded within the computer and the vision is done with the help of a camera along with the computer. For a perfect image analysis it is essential that the images should be of higher quality since images with low quality provide loan amount of information. Also when the camera zones on one portion of the image then the other surrounding portions are been automatically blurred to provide a better focus. So instead of depending upon a single image to analyse the errors occurring in the image the better option is to take a large number of shots of the same area and use them for analysis since multiple shots of a same image will provide much clear picture than the normal single shot. Also show all these multiple shots can be combined together to form a single perfect image that has all details in a perfect manner.

II. THE EVOLUTION OF IMAGE FUSION RESEARCH

Some of the various features available in this fusion method includes the ability to who use multiple images to provide single perfect image and all the important details in the image are being protected with this technique. The final product is extremely of high quality and they have the ability to protect the image of without any type of false information. This method is of high quality and strength. Also so they prevent themselves from exposing the hidden truth that is being securely embedded within these images.
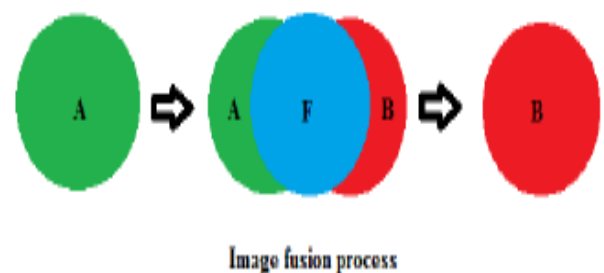

Image fusion process

Fig 1

In the first technique of combining the images and every single operation is done at the pixel level where various mathematical operations like addition subtraction division and age calculations are being done. Using these methods in the pixel level multiple number of images are combined together to form a single image.

A. Addition

In this method the intensity of each and every single pixel is calculated and they are added together to find the average value out of the total value Addition. This method provides a perfect output and it requires an accurate spatial and radiometric alignment for calculation. This method is also used for reducing the noise available in this images.

B. Average

In compared to addition technique this technique has certain negative points where some of the features of the image are being compromised in this technique and also the quality of the image is poor when compared to the addition technique images.

C. Subtraction

This method is mainly used to support the addition technique and they are also used as an and operator in certain algorithms that are used to determine various alterations in the images.

D. Multiplication

Multiplication is not a common method for combining images but they are mainly used in Brovey pan-sharpening method.
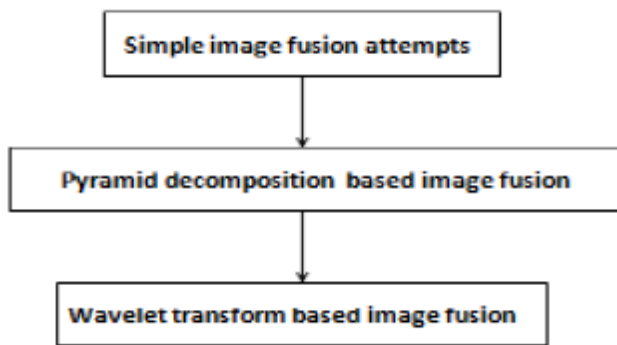

Fig 2:- Evolution of Image Fusion

Next to pixel by pixel calculation technique the next method is combining images with the help of pyramid technique. In this method a source image is taken as a base and various types of pollutions are done on the source image. This method has various other problems like the final output is of low quality with low amount of contrasting details. But this method gave rise to various other methods that provided images with high amount of quality and quantity. People preferred the method of using transform domain as a base for performing the combination and they also used the wavelet theory for perfect fusion technique. Instead of pyramid decomposition people use to the concept of wavelet decomposition which was way more effective when compared to the previous method. Wavelet transformation is a method of pyramid decomposition technique.

III. IMAGE FUSION TECHNIQUES

There are various level of fusion methods available. They include signal, pixel, feature and decision level technique.

A. Signal Level Fusion

In this method the signals are collected from various types of sensors and they are attached together to form a single signal that has low amount of noise than the previous one.

B. Pixel/ Data Level Fusion

Pixel/ Data level fusion is a method in which various data collected from various files and their yaar fused into a single data file. This method is much more effective than the previous methods and take a container lot of information.

C. Feature Level Fusion

Each and every single data is made up of multiple number of features like edges, lines, colours, textures, materials, etcetera... Various data from various maps are combined together to form a single data map. They are used for providing them as a data for dividing a image or to determine various alterations occurring in these images.

D. Decision Level Fusion

In this method various algorithms are being fused to form Final Decision can be used to determine various results. When the final decision is considered as a confidence then it is called as a soft fusion but when the final decision is compulsory then it is called as a hard fusion. There are various types of techniques that are being used including voting technique statistical technique and other logical based techniques.

IV. LITERATURE REVIEW

In 2014, Ansar MK [et.al] in his paper conducted a detailed study on to techniques that are being used for combining the images. This techniques are called PCA and DWT. The result obtained from both these techniques are compared in this study. Here in this technique and underwater image fusion technique is being used where the images are placed below the surface of water and the most detectable features are being extracted and inserted as data. In DWT technique each and every single data that is being inputted is divided into 24 some bands and the band with the lowest frequency is taken for the process of combination. In PCA based method eigenvalues are being calculated and the one with the highest value is taken into account for the fusion technique. After collecting the results both of them are analysed in detail and compare with each other with various features like peak signal to noise ratio values and mean square error values along with the entropy values. The dwt technique is much more efficient when compared to the other techniques especially in underwater calculations and combinations. [1].

Gagandeep Kour[et.al] in the year 2013 created a paper that provides in detail about the various concepts involved in image fusion technique. This paper concentrates on the technique that are used upon certain non clear images to convert them into perfectly detailed image. Both SVD and DWT techniques are being used for converting the image into a perfect clarity. For this with the help of various objects like optical sensor and image with low pixel is being taken and also process to prove many methods to make them blurred. Noida to blur the image various techniques like circular averaging filter method along with a variety of values that ranges from 1-5 where being used. After applying this technique various amount of values were being calculated including PSNR value, RMSE, signal to noise ratio (SNR), and universal image quality index (UIQI). These values are calculated for both dwt and svd techniques along with the values for normal blurred image before processing. The SVD values were much more effective than other values. [2].

Deepak Kumar Sahu [et.al] in 2012 uses a image fusion method where several images were being converted into a single image by joining them together. Is finalized image contains several details that was not available in normal images. In this paper a detailed analysis of the literature review from various authors or be in combined ID they also analyse certain techniques that are being used for combining these images like primitive fusion (Averaging Method, Select Maximum, and Select Minimum), Discrete Wavelet transform based fusion, Principal component analysis (PCA) based fusion etc[3].

Surabhi Agarwal [et.al] in 2018 created images fusion technique where multiple pictures that are available in a serious are being taken and combined into a single picture along with it various other features were being calculated and compared with each other. It was found that at the method of fusion increase the quality of the image. For example when a multiple number of 2D images are beating combined together to form final 2D image with multiple quality and resolution they provide a multiple resolution picture in 2D. This technique is mainly used in various cans and satellite pictures where multiple pictures are being combined together to form a clear diagnosis diffusion technique was done with the help of wavelet transformation method. It was found that the fusion result that was formed jas advantages both qualitatively and quantitatively. The Bovey transform technique is used to calculate various values like PSNR, Mean Square Error or MSE, and Cross-Correlation or CR. Also for providing perfect final output both the PSNR and CR values are being utilised and the value should be reduced for MSE [4].

Deb [et.al] in 2012 used a method in his paper that provides a detailed study on image fusion techniques. This technique is mainly used for developing them and applying them in the field of facial recognition. It is nothing but the process where algorithms are developed for recognising the facial features of a person and comparing them to others. In the fusion technique multiple images are being combined together to form a single image that has every detail without any form of destruction or blurriness. Multiple number of images with varying resolution and contrast are being combined together in this method. Hence as a result both redundant and complementary images are combined together to form a perfect day that can be used as a identification for the scene. So most of the algorithms available in this technique mainly concentrate on combining both redundant and complementary features to create a better image that would go easy on human eyes. This paper mainly deals with the usage of principal component analysis technique where the hidden values are calculated for getting a better perception of the particular image in both machine and human level with the help of pixel-level technique . This technique will remove the inconsistencies in the images and produce a consistent perfect image. This PCA weather concentrates on calculating the egg and values and the value with the highest frequency is being used as a input.[5].

In 2015, C. Saranya [et.al] pixel evaluation technique for combining the images. This method add users two or more Single images to combine them together to form a whole detailed fusion image. The fusion technique is done in a pixel by pixel and they are mainly used to create and image with proper removal of redundancy and detailed accuracy. To transform and combine them various techniques like discrete wavelet transform method discrete cosine transform method and hybrid transform methods are being used. Name of this method is to create an image without any disturbance and with perfect clarity. This technique is mainly used to reduce the PSNR and MSE value.**[6].**

Mamta Sharma [et.al] in 2016 for creating a image which uses multiple images to create a single image that have better clarity. They provide a perfect Panasonic view of the image with proper clarity. They are mainly used along with various other techniques like IHS, PCA, DWT, Laplacian pyramids, Gradient Pyramids, DCT, SF for providing a proper image output. With the help of multi algorithms these multiple images that are extracted from the scene are combined to form a fusion image that provide proper visual perception and various other forms of visual processing.various features are extracted for assessing them. Each and every single method of gray scale technique analysis is used to measure the quality at both pixel and feature level.[7].

ASWIN KUMER S V [et.al] presented a paper in 2011 about image fusion technique and various methods used to achieve the fusion process. Various features like low resolution for MS (Multi Spectral) image and high resolution PAN (Panchromatic) image are combined together for better clarity. Search fuse images will provide high level of clarity and detail when compared with the multiple Single images. When the single images of low resolution with low amount of detail combining them together to form a single high clarity image is one of the most important focus point of this paper. This paper also provides a detailed analysis of various techniques that needs to be e handled before processing the images for fusion. Each and every single image is processed to form the greatest A grade and they are fused with the help of matlab operations and various other operations. Depending upon their PSNR value and MSE value the along with maximum difference values and this technical is way better than the other techniques that were presented before[8].

Pavneet Kaur [et.al] in 2015 explain the process of combining multiple images into a single image where the single image contains all the informations when compared with the other images that were used as input for the processing. The single image Aaj Maut put created uses all types of information from this multiple images to create a perfect image fusion. With the help of principal component averaging technique the process of fusion is carried out and it has been found that this technique uses much less time and the accuracy is higher when compared to other techniques. The variance is calculated from the output image and in the domain of the principal component

averaging technique. Demand a trial lateral filter is also being used to who perform the analysis and the final output is checked with the help of peak signal noise ratio values. [9].

Aditi Rana [et,al] in 2013 in his paper explained in detail about various fusion methods in the area of medicine to provide a proper result in radiography department. The quality of the result was checked with the help of the values and parameters provide a proper result. In case of MRI and CT scans it is impossible to produce a single image with the clear picture and hence as a result multiple images are being taken when the patient is exposed to radiations. These multiple images are being processed together to form a single clear image that represents the condition of the patient with atmost clarity E and help the doctors to have a clear diagnosis. MRI scanning is mainly used for detecting problems in soft tissues and CT Scan is used for detecting problems in hard tissues. The principal component analysis technique along with wavelet transformation technique and Fuzzy Logic techniques are being used for comparing the results and providing a proper image that is a representation of both MRI and CT scan. The value of the final output is cross checked with the help of peak signal to noise ratio value, entropy value, and root mean square error value to determine their quality. [10].

V. CONCLUSION

The aim of the survey was to analyze the basic process of image fusion collectively with its categorization based on its modals systems and algorithms. The analysis showed that huge work has been done in the domain of image fusion but still there is enormous room for new and innovative work in this context. The analysis also has shown that every algorithm in this context has its own strengths and weaknesses. An Analyst may observe clearly, no image fusion technique is superior over another; the selection and effectiveness of a particular method are dependent on its application. According to research point of view, it can be concluded that PCA based image fusion techniques result in a better-enhanced image without altering the spatial and spectral details of the image. The wavelet based approaches are suitable in the applications where original values of RGB components are to be saved. And wavelet based approaches results in less distortion in the image. Lastly, proven transformations resulted in sharper images but alter the original colors of the image by making dark areas of image darker and white areas whiter in the resultant image.

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