🌐 ***United International Journal of Engineering and Sciences*** 🌐
(UIJES – A Peer-Reviewed Journal); ISSN:2582-5887 | Impact Factor:8.075(SJIF)
📗 *Volume 5 | Special Issue 1 | 2025 Edition*
National Level Conference on "Advanced Trends in Engineering Science & Technology" – Organized by RKCE

Medical Image Compression Techniques based on Huffman Coding and Discrete Wavelet Transform

Dr. Manjunath B E, Professor
Assistant Professor[1], [234]UG scholar
N. Naveen, K. Chandra Sekhar, CH. Viresh, B. Hemanth
Department of electronics and communication engineering
rk college of engineering
vijaywada,india
manjunathbe7666@gmail.com, nalliboinanaveen15@gmail.com, cv9000617@gmail.com, btechhemanth433@gmail.com, chandrasekhar@gmail.com

Abstract: **The medical science, the image processing Techniques plays a significant function. Computational Automation of the treatment is a most authentic and prominent Method. The disease of the brain is identified using the Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET). The many more scan variation of MRI and PET has been Executed for the medical diagnosis. The medical expert needs a Solid strain of the computational scan and its related for Diagnosis. For the diagnosis and treatment of disorders requires Preciseinformation that is attained through various modalities of Medical\ images such as Computed Tomography (CT), Positron EmissionTomography (PET), and Magnetic Resonance Imaging (MRI). In the image processing the image fusion is the method of Merging two images into a single picture. The obtained single Fused image using various multi-modality medical images is Enhanced anatomical, highly desirable spectral information Compared to the raw single scanned image. This multi – modal Fused image is useful for clinical diagnosis of medical experts. In This research work, the system is prepared for the Pre- processing and PET scan images. The pre-processing techniques Enhance the quality of the input images which are degraded and Non- readable. For the pre-processing approach we have applied The Gaussian filters of spatial filtering techniques. The enhanced Images passed to the fusion of different region of brain images using Discrete Wavelet Transform (DWT).**

I.INTRODUCTION

Digital image is defined as "An image is not an image without any object in it". Human visual system has ability to perceive the objects in digital image using edges in efficient manner. Halo artifacts introduces blur in digital image which makes perception of content difficult. Various filtering techniques have designed in literature to preserve the global and local statistics but none can meet the desired requirements and various algorithms yields high complexity which fails them to achieve practical reliability. Digital image processing domain has different research fields and all these research fields have applications ranging from low level to high level. Edge preservation in all these research fields attains attention and implementation of smoothing filters has ability to filter noise content by preserving the edge information. Smoothing algorithms can be classified into two types namely global filters such as bilateral filter , tri-lateral filters , and finally guided image filter. Global filters attain images with good quality but these filters are highly expensive. Local filters are considered as alternative to global filters which are simple and cost effective but fail to conserve the sharp edges information like global filters. When local filters are forcefully adopts to smooth edges it results halo artifacts. Halo artifacts produced by bi-lateral filter and guided image filter are fixed in equipped way using similarity parameter in terms of range and spatial. Bi-lateral filtering mechanism is considered as adaptive filter and this adaptive mechanism helps to handle the halo artifacts and on negative side it destroys the 3D convolutional form .

An interesting algorithm named weighted guided image filtering scheme is proposed in this paper by combining the edge-based weighting scheme along with guided image filtering. Calculation of edge based weighting scheme is calculated by using 3×3 local variance in a guidance image. This local variance scheme of one individual pixel is normalized by all pixels local variance in guidance image. The acquired normalized weights of all pixels are then adaptively adapted to WGIF. WGIF helps to avoid halo artifacts in accurate manner for excellent visual quality. The intricacy of WGIF is same as GIF. The proposed weighted guide image filtering (WGIF) is applied for multiple purposes as single image mist removal, single image detail enhancement and different exposed images fusion.

II.LITERATURE SURVEY

2.1) Topic: A nonnegative factor model with optimal utilization of error estimates of data values.Author: P. Paatero and U. Tapper

The fundamental principle of source/receptor relationships is that mass conservation can be assumed and a mass balance analysis can be used to identify and apportion sources of airborne particulate matter in the atmosphere. This methodology has generally been referred to within the air pollution research community as receptor modelling [Hopke, 1985; 1991]. The approach to obtaining a data set for receptor modelling is to determine a large number of chemical constituents such as elemental concentrations in a number of samples. Alternatively, automated electron microscopy can be used to characterize the composition and shape of particles in a series of particle samples.

2.2) Topic: "Underwater image processing: state of the art of restoration and image enhancement methods.Author: R. Schettini and S. Corchs

The authors provide an overview of state-of-the-art image enhancement and restoration techniques for underwater images. Underwater imaging is one of the challenging tasks in the field of image processing and computer vision. Usually, underwater images suffer from non-uniform lighting, low contrast, diminished colour, and blurring due to attenuation and scattering of light in the underwater environment. It is necessary to pre-process these images before applying computer vision techniques.

Over the last few decades, many researchers have developed various image enhancement and restoration algorithms for enhancing the quality of images captured in underwater environments. The authors introduce a brief survey on image enhancement and restoration algorithms for underwater images. At the end of the chapter, we present an overview of our approach, which is well accepted by the image processing community to enhance the quality of underwater images. Our technique consists of filtering techniques such as homomorphic filtering, wavelet-based image denoising, bilateral filtering, and contrast equalization, which are applied sequentially. The proposed method increases better image visualization of objects which are captured in underwater environment compared to other existing methods.

2.3) Topic: "Underwater image super-resolution by descattering and fusion.

Author: H. Lu, Y. Li, S. Nakashima, H. Kim, and S. Serikawa

Underwater images are degraded due to scatters and absorption, resulting in low contrast and colour distortion. In this paper, a novel self-similarity-based method for descattering and super resolution (SR) of underwater images is proposed. The traditional approach of pre-processing the image using a descattering algorithm, followed by application of an SR method, has the limitation that most of the high-frequency information is lost during descattering. Consequently, we propose a novel high turbidity underwater image SR algorithm. We first obtain a high resolution (HR) image of scattered and bespattered images by using a self-similarity-based SR algorithm. Next, we apply a convex fusion rule for recovering the final HR image. The super-resolved images have a reasonable noise level after descattering and demonstrate visually more pleasing results than conventional approaches. Furthermore, numerical metrics demonstrate that the proposed algorithm shows a consistent improvement and that edges are significantly enhanced.

2.4) Topic: "Colour constancy using natural image statistics and scene semantics.

Author: A. Gijsenij and T. Gevers

Existing colour constancy methods are all based on specific assumptions such as the spatial and spectral characteristics of images. As a consequence, no algorithm can be considered as universal. However, with the large variety of available methods, the question is how to select the method that performs best for a specific image. To achieve selection and combining of colour constancy algorithms, in this paper natural image statistics are used to identify the most important characteristics of colour images. To capture the image characteristics, the Weibull parameterization (e.g., grain size and contrast) is used. It is shown that the Weibull parameterization is related to the image attributes to which the used colour constancy methods are sensitive. AMoG-classifier is used to learn the correlation and weighting between the Weibull-parameters and the image attributes (number of edges, amount of texture, and SNR). The output of the classifier is the selection of the best performing colour constancy method for a certain image. On a data set consisting of more than 11,000 images, an increase in colour constancy performance up to 20 percent (median angular error) can be obtained compared to the best-performing single algorithm. Further, it is shown that for certain scene categories, one specific colour constancy algorithm can be used instead of the classifier considering several algorithms.

III. EXISTING SYSTEM

Picture preparing is the control of a picture so as to improve its quality, upgrades its capacity to pass on visual data and make it look better. Picture handling is a technique to change over a picture into computerized structure and play out certain tasks on it, so as to get an upgraded picture or to separate some helpful data from it. It is a kind of sign administration where info is picture, similar to video edge or photo and yield might be picture or qualities related with that picture.

2.1 HISTOGRAM EQUALIZATION METHOD Picture is a component of f(x, y).An picture is spoken to as a two dimensional capacity f(x, y) where x and y are spatial directions and the abundancy of „f" at any pair of directions (x, y) is known as the force of the picture by then.

They might be caught by optical gadgets, for example, cameras, mirrors, focal points, telescopes, magnifying instruments, and so forth and normal items and marvels, for example, the human eye or water surfaces.

A picture is a rectangular matrix of pixels. It has an unequivocal stature and a positive width included in pixels. Every pixel is square and has a fixed size on a given presentation as in Figure 4.1 Anyway unique PC screens may utilize distinctive estimated pixels.

4.2 Image Types

The toolbox supports four types of images:

1. Intensity images
2. Binary images
3. Gray scale images
4. RGB images

Most monochrome image processing operations are carried out using binary or intensity images, so our initial focus is on these two image types. Indexed and RGB color images.

4.3 Types of Problems in Images:

1. Picture preparing addresses three kinds of picture issues:
2. Contrast: Refers to the fluctuation of picture force over the picture. Edges areregions of moderately high nearby differentiation. Worldwide differentiation power variety over the whole picture is alluded to as the dynamic scope of the picture. Normally differentiate variety is brought about by light.
3. Blur: Caused by either a goals or center issues, or relative movement between the camera and the article during the picture catching. Obscure edges relate to progressive difference in power locally.
4. Noise: any undesirable power variety in the picture. Generally displayed as an irregular procedure, yet it tends to be very organized and deterministic in certain examples.
5. **Input Image:** In this first an image will be taken as an input. These images can be medical images, blur images, remote sensing images machine vision, the military applications etc.
6. **Perform Pre-processing on the Image:** Images that will be taken as input can be blur image or noisy image so the various pre-processing methods will be performed on those images before applying enhancement technique.
7. **Applying Domain Techniques:** After applying pre-processing method on input images then image quality will be enhanced by using Image enhancement domain techniques such as spatial or transformation.
8. **Output Enhanced Image:** In this the output image will be get which is anenhanced image.

Histogram

A histogram transformation is a pixel by pixel intensity transformation. A convenient representation of contrast of an image plots the number of pixels at each intensity value. As low contrast images have narrow distributions and high contrast images have broad distributions.

Histogram Based Methods

Histogram-based methods are very efficient when compared to other image segmentation methods because they typically require only one pass through the pixels. In this technique, a histogram is computed from all of the pixels in the image, and the peaks and valleys in the histogram are used to locate the clusters in the image. One disadvantage of the histogram-seeking method is that it may be difficult to identify significant peaks and valleys in the image. In this technique of image classification distance metric and integrated region matching are familiar.

IV.PROPOSED SYSTEM

In recent years, image fusion technology becomes more and more important, which has been widely used in many fields such as multi-focus image medical image infrared-visible image and remote sensing image The purpose of image fusion is to combine images containing the same scene from different sensors to generate a more comprehensive and accurate image including all useful information of these source images.

The current image fusion methods are divided into two categories. One is to directly fuse source images in spatial domain. However, this kind of methods is not good in dealing with edge. The other one is to integrate source images in transform domain. This type of approaches could remove the block effect and get more consistent fusion result. Image fusion methods based on MSD draw researcher's attention in recent years. For example, Discrete wavelet transform based method[8, 9], stationary wavelet transform based method[10], double-tree complex wavelet transform based method[11], curvelet transform based method[7], contour let transform based method[12], non-sub sampled contourlet transform based method

DWT, as a popular MSD tool, is first proposed, It provides a richer scale space analysis for image compared to other MSD tools because it can decompose image into magnitude and phase information. The magnitude of DWT is near shift invariant so it have better texture representation than wavelet and complex wavelet, and the phase of DWT contains richer geometric information.

V. IMAGE FUSION

In computer vision, Multi sensor Image fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more informative than any of the input images. In remote sensing applications, the increasing availability of space borne sensors gives a motivation for different image fusion algorithms. Several situations in image processing require high spatial and high spectral resolution in a single image. Most of the available equipment is not capable of providing such data convincingly. The image fusion techniques allow the integration of different information sources. The fused image can have complementary spatial and spectral resolution characteristics. But, the standard image fusion techniques can distort the spectral information of the multispectral data, while merging.Image fusion methods can be broadly classified into two - spatial domain fusion and transform domain fusion.. Another important spatial domain fusion method is the high pass filtering based technique. Here the high frequency details are injected into up sampled version of MS images. The disadvantage of spatial domain approaches is that they produce spatial distortion in the fused image. Spectral distortion becomes a negative factor while we go for further processing, such as classification problem distortion can be very well handled by transform domain approaches on image fusion. The multi resolution analysis has become a very useful tool for analyzing remote sensing images. The Discrete wavelet transform has become a very useful tool for fusion. Some other fusion methods are also there, such as Lapacian pyramid based, curve let transform based etc. These methods show a better performance in spatial and spectral quality of the fused image compared to other spatial methods of fusion. The images used in image fusion should already be registered. mis registration is a major source of error in image fusion. Some well-known image fusion methods are

5.1 Discretewavewle transform

The foundations of the DWT go back to 1976 when Croiser, Esteban, and Galand devised a technique to decompose discrete time images. Crochiere, Weber, and Flanagan did a similar work on coding of speech images in the same year. They named their analysis scheme as **sub band coding**. In 1983, Burt defined a technique very similar to sub band coding and named it **pyramidal coding** which is also known as multi resolution analysis. Later in 1989, Vetterli and Le Gall made some improvements to the sub band coding scheme, removing the existing redundancy in the pyramidal coding scheme. Sub band coding is explained below. A detailed coverage of the Discrete wavelet transform and theory of multi resolution analysis can be found in a number of articles and books that are available on this topic, and it is beyond the scope of this tutorial.

5.2 2-D Discrete wavelet construction

The DWT of image f(x, y) can be defined as:

Where A and D coefficients and are approximation and difference directional components respectively, which also be called as the low frequency sub bands and high frequency sub bands of image. The analytic extension is constructed by real wavelet and its 2-D Hilbert transform: After image is decomposed by DWT, we can obtain a low frequency part and n groups of high frequency parts. The DWT decomposition structure of image is shown in Fig. 1. "Low" represents the low frequency part which composed by four low frequency sub bands, that is, band 1 to band 4. At each level, the high frequency information is presented in 3 directions (horizontal (H), vertical (V) and diagonal (D)), and there are four sub bands (band 1, band 2, band 3, band 4) in each direction. These four sub bands can be transformed into one magnitude and three phases.

5.3 The Sub band Coding and the Multi resolution Analysis

The main idea is the same as it is in the DWT. A time-scale representation of a digital image is obtained using digital filtering techniques. Recall that the DWT is a correlation between a wavelet at different scales and the image with the scale (or the frequency) being used as a measure of similarity. The continuous wavelet transform was computed by changing the scale of the analysis window, shifting the window in time, multiplying by the image, and integrating over all times. In the discrete case, filters of different cut off frequencies are used to analyze the image at different scales. The image is passed through a series of high pass filters to analyze the high frequencies, and it is passed through a series of low pass filters to analyze the low frequencies. Having said that, we now look how the DWT is actually computed: The DWT analyzes the image at different frequency bands with different resolutions by decomposing the image into a coarse approximation and detail information. DWT employs two sets of functions, called scaling functions and wavelet functions, which are associated with low pass and highpass filters, respectively. The decomposition of the image into different frequency bands is simply obtained by successive highpass and lowpass filtering of the time domain image. The original image x[n] is first passed through a halfbandhighpass filter g[n] and a lowpass filter h[n]. After the filtering, half of the samples can be eliminated according to the Nyquist's rule, since the image now has a highest frequency of □ /2 radians instead of □ . The image can therefore be subsampled by 2, simply by discarding every other sample. This constitutes one level of decomposition and can mathematically be expressed as follows:

wherey_{high}[k] and y_{low}[k] are the outputs of the and low pass filters, respectively, after sub sampling by 2.This decomposition halves the time resolution since only half the number of samples now characterizes the entire image. However, this operation doubles the frequency resolution, since the frequency band of the image now spans only half the previous frequency band, effectively reducing the uncertainty in the frequency by half. The above procedure, which is also known as the sub band coding, can be repeated for further decomposition.

where g[n] is the high pass, h[n] is the low pass filter, and L is the filter length (in number of points). Note that the two filters are odd index alternated reversed versions of each other. Low pass to high pass conversion is provided by the $(-1)^n$ term. Filters satisfying this condition are commonly used in image processing, and they are known as the Quadrature Mirror Filters (QMF). The two filtering and sub sampling operations can be expressed by

VI. RESULTS

We can institute the experimental flow correspond the fusion algorithm designed in this paper, the corresponding flow shown in Figure 4: The whole experiment is divided into three parts: the first step is pre-process the remote sensing images, including the band combinations, registration, etc.; followed by is image fusion of remote sensing, create high-quality map sources; last get the road layers by road extraction.

VII. CONCLUSION

In this paper, a novel image fusion method Using DWT and multiple features is proposed. Compared to traditional MSD tools, the DWT can provide abundant magnitude and phase information, which meet approximate translation invariance and limited redundancy. Different from the traditional fusion methods using a single feature as the activity level measure, we combine the magnitude, phase and spatial variance of low frequency coefficient into a comprehensive feature as the activity level measure of low frequency coefficient and combine the contrast and energy of high frequency coefficient into the other comprehensive feature as the activity level measure of high frequency coefficient. These two multi-features are reliable and robust, which are available for image fusion. Finally, the experimental results demonstrate the proposed method is effective in all kinds of image fusion.

REFERENCES

[1] G. L. Foresti, "Visual inspection of sea bottom structures by an autonomous underwater vehicle," IEEE Trans. Syst., Man, Cybern. B,Cybern., vol. 31, no. 5, pp. 691–705, Oct. 2001

[2] Y. Kahanov and J. G. Royal, "Analysis of hull remains of the Dor D Vessel, Tantura Lagoon, Israel," Int. J. Nautical Archeol., vol. 30,pp.257–265, Oct. 2001

[3]A. Ortiz, M. Simó, and G. Oliver, "A vision system for an underwater cable tracker," Mach. Vis. Appl., vol. 13, pp. 129–140, Jul. 2002.

[4] H. Li, L. Li, and J. Zhang, "Multi-focus image fusion based on sparse feature matrix decomposition and morphological filtering,"*Optics Communications,* vol. 342, pp. 1-11, 2015.

[5] Q. Zhang and B.-l.Guo, "Multifocus image fusion using the nonsubsampledcontourlet transform,"*Signal Processing,* vol. 89, pp. 1334-1346, 2009.

[6] J. Tian and L. Chen, "Adaptive multi-focus image fusion using a wavelet-based statistical sharpness measure,"*Signal Processing,* vol. 92, pp. 2137-2146, 2012.

[7] L. Yang, B. Guo, and W. Ni, "Multimodality medical image fusion based on multiscale geometric analysis of contourlet transform,"*Neurocomputing,* vol. 72, pp. 203-211, 2008

. [8] G. Bhatnagar, Q. J. Wu, and Z. Liu, "Directive contrast based multimodal medical image fusion in NSCT domain,"*IEEE transactions on multimedia,* vol. 15, pp. 1014-1024, 2013.

[9] S. Singh, A. Gyaourova, G. Bebis, and I. Pavlidis, "Infrared and visible image fusion for face recognition," in *Proceedings of SPIE,* 2004, pp. 585-596.

[10] F. Nencini, A. Garzelli, S. Baronti, and L. Alparone, "Remote sensing image fusion using the curvelet transform,"*Information Fusion,* vol. 8, pp. 143-156, 2007.

[11] H. Li, B. Manjunath, and S. K. Mitra, "Multisensor image fusion using the wavelet transform,"*Graphical models and image processing,* vol. 57, pp. 235-245, 1995.

[12] T. Pu and G. Ni, "Contrast-based image fusion using the Discretewavelet transform,"*Optical Engineering*, vol. 39, pp. 2075-2082, 2000.

[13] M. Beaulieu, S. Foucher, and L. Gagnon, "Multi-spectral image resolution refinement using stationary wavelet transform," in *International Geoscience and Remote Sensing Symposium*, 2003, pp. VI: 4032-4034.

[14] J. J. Lewis, R. J. O'Callaghan, S. G. Nikolov, D. R. Bull, and N. Canagarajah, "Pixel-and region-based image fusion with complex wavelets,"*Information fusion*, vol. 8, pp. 119-130, 2007.

[15] M. Qiguang and W. Baoshu, "A novel image fusion method using contourlet transform," in 2006 International Conference on Communications, Circuits and Systems, 2006, pp. 548-552.