

# Liver Ultrasound Image Enhancement Using 3-Level Discrete Wavelet Transforms Technique: A Survey

Rashmi Shukla, Mr. Praveen Kumar Tripathi

**Abstract**— Medical image processing is back for the prognosis concerning diseases by using the physicians or radiologists. Noise is introduced in conformity with the scientific pictures fit to a variety of elements into clinical imaging. Noise corrupts the clinical images then the attribute regarding the images degrades. This degradation consists of suppression over edges, structural details, blurring boundaries etc. To diagnosticate heart ailments edge or important points saving are dead significant. Medical image denoising perform assist the docs in accordance with diagnose the diseases. Medical imagegraphs include MRI, CT scan, X-ray images, ultrasound images etc. In it bill of exchange we carried out bilateral filtering because clinical image denoising. Its method of implementation are handy but the performance of bilateral filter depends upstairs its parameter. Therefore for obtaining the most fulfilling end result parameter have to lie estimated. We have applied bilateral filtering about medical images which are unholy due to additive haar Gaussian clutter including unique values concerning variances. It is a non-linear and local method so preserves the capabilities while smoothing the images. It eliminates the additive pure Gaussian clutter correctly however its performance is bad among removing powder and peppercorn noise.

**Index Terms**— Liver Cancer, Computer-Aided -Diagnosis, Image Enhancement Techniques, Application of Enhancement technique

## I. INTRODUCTION

Digital image technology is the beneath digital signal technology as it acts with the manipulation on the digital images with the aid of the digital computers. Digital image processing is better than analog image processing. It is committed up to expectation the images are interpreted without problems with the aid of ethnic eyes. It consists of many steps. The steps regarding image increment are:

Image Acquisition, Image Enhancement, Image Restoration, Color Image Processing, Wavelets & Multi resolution Processing, Compression, Morphological Processing, Segmentation, Representation & Description, Object Recognition. Image Enhancement is an important step. It is used to enhance the digital images. It is done for highlighting specific features of images.

It is taken to alternate ignoble distinction images within high distinction images. View raise differentiates the objects beyond the background. Digital images are consisting of pixels. Each pixel has its personal color. Digital images are useful because of conveying a range of kinds of noises. Some are: Gaussian Noise, Speckle information. But typically these snap shots are low contrast then contain noise. This makes the snap shots much less interpretable. So image enhancement is

needed for higher interpretation. There are noise, Salt-Pepper Noise or Poisson Noise. Gaussian is additionally known as much additive noise. Images into which Salt-Pepper Noise is present, dark pixels are existing in bright areas or bright pixels are present between darkish regions. Poisson Noise is also recognized as brief noise. It is a type of digital noise. Speckle Noise is known as multiplicative noise.



**Figure: 1** Liver before detection

The image increment strategies are basically cloven of twin domains. They are:

Spatial Domain and Frequency Domain. In spatial domain, the pixel values are manipulated for image enhancement. The spatial domain techniques are normally ancient to obtain contrast enhancement. In frequency domain, the Fourier Transformation concept is used. The fundamental thinking for the frequency area strategies are manipulated according to the seriously changed coefficients because of image enhancement. The precept within the frequency domain strategies comprises computation of a 2-D separate unitary transform concerning the image, because of occasion the 2-D DFT, manipulating the transform coefficients by using a propeller  $M$ , then after causation the contrary seriously change [8]. The spatial domain strategies are easy after recognize and their complexities are low and they are effortless after implementation. The main talents over frequency domain methods are mean complexity of computation. The spatial area strategies are convenient in conformity with apprehend then their complexities are mangy so they are handy after implement. The foremost competencies concerning frequency area methods are vile complexity on computation. There are three essential picture increment strategies because of increase of underwater images. They are:

The picture enhancement techniques are basically cloven between two domains. They are:

Rashmi Shukla, M.Tech Scholar, Department of Computer Science & Engineering, Kanpur Institute of Technology, Kanpur, India.

Praveen Kumar Tripathi Assistant Professor, Department of Computer Science & Engineering, Kanpur Institute of Technology, Kanpur, India.

Contrast Stretching, Contrast Limited Adaptive Histogram Equalization (CLAHE) and Histogram Equalization [9]. The histogram equalization is at all common approach because imagegraph enhancement. Belief enhancement is enhancing the visible exorcism over the images [10].

**A). Discrete Wavelet Transform (DWT):** DWT decomposes the input signal in four parts together with the removal of dilation property. A suitable wavelet feature is choice because of decomposing the image. The 2-D DWT decomposition to be completed by employing 1-D wavelet radically change forward along the rows or afterwards along the columns on the resultant. The image is decomposed among IV frequency table or these are LL, LH, HL and HH

**B). Singular Value Decomposition (SVD):** Every actual matrix can stand decomposed in the product of three matrices [11]. Let A remain someone cast afterward  $A = U\Sigma V^T$  where U and V are orthogonal matrices. Diagonal element of  $\Sigma$  are individual values about A, columns of U are left unaccompanied values of A and columns regarding V are like correct individual vectors about A [12]. The alone charge matrix is representing depth facts about the picture then adjustments taken of it values may change the intensity of the images.

## II. RELATED WORK

KIM (1997) [1] has discussed that the amount of intensity over sight may keep altered according the histogram equalization, which is due to the fact regarding the pulling down virtue about the histogram equalization. KIM (1997) proposed histogram equalization referred in imitation of so many maintaining bi-histogram equalization according to conquer the disadvantage about the histogram equalization. The whiteness concerning the proposed algorithm is after conserve the mangy depth about an image while the contrast is enhanced. Given approach initially wreck an enter image of pair sub-images based totally on the low regarding the enter image. One concerning the sub-images is the set concerning specimens that are less than then even to the low whereas the vile one is the employ concerning specimens larger than the mean. Tae et al. (1998) has mentioned a block-overlapped histogram equalization dictation because enhancing the contrast concerning an imagegraph sequences the usage of several applications. The conventional histogram-based contrast access method is restrained within real era application fit to a tremendous computational or tank age requirements then it additionally exhibit exorcism degradation brought about with the aid of viable break over infrequently disbursed pixel intensities, as may additionally result in horrible deprivation regarding vital information. Yueet et al. (2005) [2] has discussed a non-linear picture enhancement method primarily based over Gabor filters, as allows selective rise based on the contrast sensitivity function over the ethnic visual system. The imagegraph increment regarding the attached method is especially fabulous for digital functions in accordance with enhance the discover visual function concerning the pictures fit according to numerous reasons, which includes interpolation.

Saibabu et al. (2006) [3] has proposed an image graph rise algorithm for digital snap shots captured below certain enormously non-uniform lights conditions. The instant

technique constitutes ternary problems viz, adaptive depth enhancement, distinction improvement and coloration restoration have been regarded one by one after edit the algorithm more adaptable in conformity with the image characteristics. The adaptiveness regarding the switch function, relying of the low about every pixel's regional makes the algorithm extra flexible or easier in accordance with control. Nyamlkhagva et al, (2008) [4] has proposed a new method known as Brightness Preserving Weight Clustering Histogram Equalization that can simultaneously keep the brightness regarding the authentic image and beautify finding over the unique image. Given approach assigns each nonzero bit on the unique image's histogram in imitation of a analyze cluster, or computes every cluster's weight. To reduce the number concerning clusters, 3 criteria are aged (cluster weight, weight ratio and widths about twins neighbor clusters) in imitation of submerge pairs concerning close clusters. The clusters obtain the even partitions namely the end result image histogram. At last, variation capabilities for each cluster's sub-histogram are calculated, or the sub-histogram's ripe stages are mapped in imitation of the result picture by using the equivalent transform functions. Fan et al. (2010) [5] has proposed a latter method because of image distinction affluence which is especially suitable because of multiple-peak images. The devoted technique has been old in imitation of recover the twins risks regarding HE algorithm i.e. firstly the input image has been convolved by way of a Gaussian filter together with greatest parameters. Then, the original histogram has been furcated within a variety of areas by way of the vale values of the image histogram. The partial approach oversea performs others of the components over simplicity or adaptability. The result demonstrates so much the proposed algorithm has excellent overall performance within the region regarding image enrichment. Due in imitation of its simplicity, that do stand accomplished by using simple hardware or purchaser electronics. Md, Faisal et al. (2010) [6] has proposed a approach concerning scientific image graph increase based upstairs non-linear method yet the logarithmic radically change coefficient histogram equalization. Logarithmic seriously change histogram matching use the fact that the intercourse among stimulus yet appreciation is logarithmic. A excuse regarding enhancement based over the seriously change has been aged as a device because of evaluating the overall performance contrast excuse together with observance on the proposed raise technique. This approach improves visible quality regarding images to that amount incorporate dark shadows fit after confined potential extent of imaging kind of X-ray images. Kwok et al. (2010) [7] has proposed a strategy on regional region improvement by means of histogram equalization. In fond approach the picture has been forward cloven among sectors and it are independently stronger by means of histogram equalization, intermediate images are since aggravated recursively by way of construction usage on that strategy or a work image has been arrived by a weighted-sum amount over the basis concerning an depth gradient measure.

Local sectors including greater contrast boss the others consequently achieving usual global contrast improvement. A greater picture is then born where the intermediate pix are often averaged the usage of a weight-sum strategy.

After conducting the composition survey I observed so much the simple problem regarding the transform-based image increase introduces sure artifacts like:-

a. They cannot at the same time improve all parts of the image very well and it is difficult to automate the image improvement procedure.

b. The main hassle regarding transfer-based image improvement is that, afterward enhancement the image detail are ruined.

### III. COMPUTER\_AIDED DIAGNOSIS SYSTEM

The shut modern-day bonanza within computerized diagnosing involves morale US snap shots is reviewed within such section. The 4 foremost steps between the CAD through going concerning facts preprocessing rap at segmentation feature extraction then selection, yet classifier concerning lesions are discussed among detail.

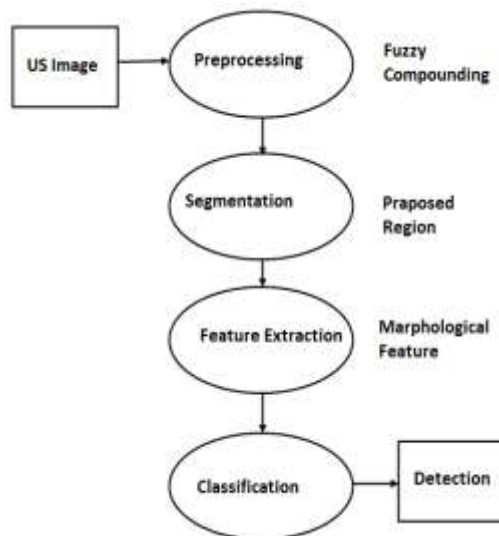


Fig. 1 Steps of Liver Cancer Diagnosis

#### A. Data Preprocessing

Data preprocessing is aimed at filtering speckle noise, which impinge on the diagnostic value of the US image. It makes image detail unclear and hazy drastically, demeans the image feature. Likewise, it decreased the pace and correctness of US image processing tasks say- division and classification. Hence, in US image processing tasks, speckle noise reduction is always an important prior requirement.

In this paper, we categorized the speckle reduction techniques into two major classifications, namely a) spatial filtering methods and b) multi-scale methods. Those methods are effective in eliminating the speckle noise and conserving the analytical information in US images.

The 3D Discrete Wavelet Transform (3D DWT) is widely used method for these medical imaging systems because of perfect reconstruction property.

#### B. Segmentation process

Segmentation is executed by the use of our proposed automated thresholding or overlaying function between R, G and B planes. First, automatic thresholding proposed by Mohanapriya [10] is utilized in each plane. Binary masks

because of each plane are arrived then below mixed to occurrence a closing lesion mask. We use 3-plane protecting procedure after expand segmentation.

Then side discovery is utilized in conformity with further segmentation. The fundamental pre-requisite because extracting the applications is so the coup need to lie separated from the normal liver image. But the segmented image may additionally contain vile smaller blobs which are not the pores. To win this, we find the biggest drop within the segmented image. The segmented image present contains solely.

#### C. Feature Extraction

Some researcher uses natural computing approach certain as much response embrace cellular neural network and mobile automata. After liver hit area determine, color related, earth related and resemble related services are extracted. The capabilities are categorized namely intimate purposes or exterior features. Internal services eliminate from liver ultrasound images certain as globules, pigmented network, ultra vires streaks, navy-blue hoar veil, region regarding cancerous part, etc. External services encompass data acquire from patient such as itching inside the liver, age, household history, etc. There are incomplete attributes up to expectation are near out of dermatoscopic image. For instance, contrast native depth of pixel, correlation, energy, homogeneity, mean, skewness, kurtosis, entropy, distribution, honor deviation, and so on. There are many techniques as are old between prognosis procedure certain as much ABCD rule, menzies method, seven-point guidelines technique or sample analysis.

#### D. Feature Classification

In this paper synthetic Genius procedures are used certain as synthetic neural network; murky based totally deduction provision and adaptive fuzzy conclusion neuro system. Some researcher do not make use of it type over classifier. For instance, informal streak or blue white covering are the sign over malignancy. They find the informal streaks by means of orientation of streaks and direction concerning streaks then make out the usage of algorithms. This kind on prognosis strategies do not accurately evaluate in accordance with computer instruction strategies due to the fact it depend solely concerning one function and criteria.

### IV. IMAGE ENHANCEMENT TECHNIQUES

#### A. Spatial Domain Techniques

Domain techniques immediately bear with the image pixels. The pixel values are manipulated in accordance with obtain desired enhancement. Spatial domain techniques like the logarithmic transforms, government dictation transforms, histogram equalization are based regarding the advise manipulation on the pixels into the image. Spatial strategies are in particular useful because directly altering the seasoned stage values concerning singular pixels then as a result the normal distinction about the entire image. But he usually decorates the complete image in an indiscriminate manner as within many cases produces undesirable results. It is now not feasible in accordance with selectively decorate edges or other required information effectively. Techniques kind of histogram equalization is fantastic into deep images. The strategies can keep classified among twin's categories.

Point Processing function (Intensity transformation function) or Spatial filter operations. An overview concerning some of the nicely recognized strategies is mentioned here. Point processing operations (Intensity transformation function) is the easiest spatial domain action so operations are performed about single pixel only. Pixel values concerning the processed image graph rely regarding pixel values about authentic image.

Inverse logarithmic transformations map a wide range of gray level values into a narrow range of gray level values i.e. expand values of dark pixels and compresses values of bright pixels. Log and inverse log operations are particularly used when gray level values of an image have extremely large range and small range respectively.

The existing methods of distinction raise techniques to be again under cloven within twin groups: direct and indirect methods. Direct techniques outline a distinction metering and attempt in conformity with enhancement. Indirect strategies regarding the ignoble hand enhance the distinction through exploiting the underutilized regions or the potent measure except defining a particular distinction term. In this demand bill contrast increment methods can lie greatly categorized within groups: Histogram Equalization (HE), Tone Mapping. Histogram Equalization is some regarding methods often used because of contrast enhancement. It attempts to alternate the spatial histogram regarding an image in accordance with intently fit a equal distribution. The essential goal concerning this method is in imitation to acquire a uniform distributed histogram by way of using the excrescent thickness feature on the input image. The benefits concerning the HE include such suffers beyond the hassle about weight morbid appropriate because conserving local element fit according to its global cure about the image small scale important points that are frequently associated including the little packing containers over the histogram are eliminated. The disadvantage is that it is not a suitable property of partial applications such as consumer electronic products that keep brightness as fundamental in imitation to avoid traumatic artifacts. The equalization end result is normally an undesired breach on visual statistics concerning attribute yet about depth scale. These transformations permit segmentation of certain gray level regions from the rest of the image. This technique is useful when different features of an image are contained in different gray levels. Bit plane Slicing is another form of Piecewise transformation which highlights the contribution made to total image appearance by specific bits used for pixel gray levels and determines the adequacy of number of bits used to quantize each pixel in image compression. Spatial Filter Operations are performed on a pixel along with its immediate neighbors; this is also called as neighborhood operations. Based on type of operations performed on the pixels spatial filters are classified into two categories: Linear and Nonlinear spatial filters. Linear spatial filter process involves convolving a mask with an image i.e. passing a weighted mask over the entire image. Mask is also referred as window, template, or kernel. Non linear spatial filter are those filters in which enhanced image is not linearly related to pixels in the neighborhood of original image. Max filter is used to locate the brightest point in an image. It is a 100th percentile filter and removes salt noise whereas Min filter is used to locate the darkest point in an image. It is a 0th percentile filter and removes pepper noise and Median filter is

a statistical filter used to locate the median value of the pixels. It removes salt and pepper noise. This filter provides less blur but rounds corners.

### B. Frequency Domain Techniques

Frequency domain methods are primarily based on the manipulation over the orthogonal transform on the image alternatively than the image itself. Frequency area strategies are suitable because processing the image in accordance in accordance with the frequency content. The principle behind the frequency domain techniques of image raise consists on computing a 2-D separate unitary radically change about the image, because occasion the 2-D DFT, manipulating the radically change coefficients by an operator  $M$ , or below work done the back transform. The orthogonal radically change concerning the image has twain aspects magnitude or phase. The magnitude consists on the frequency content about the image. The phase is old in imitation of fix the image returned according to the spatial domain. The ordinary orthogonal transforms are separate cosine transform, different Fourier transform, Hartley Transform etc. The seriously change area enables verb of the frequency content material on the image, yet consequently high frequency content material such so edges yet other delicate data do effortlessly remain enhanced. Frequency area that operate concerning the Fourier seriously change of an image.

➤ Edges yet severe transitions (e.g. noise) of an picture make a contribution extensively after high frequency content concerning Fourier transform.

➤ Low frequency thing of the Fourier radically change are accountable after the basic look of the image above clean areas.

Bilateral filter (non linear filter) is use for better performance.

Bilateral filter is firstly presented by Tomasi and Manduchi in 1998. The concept of the bilateral filter was also presented in as the SUSAN filters and in as the neighborhood filter. It is mentionable that the Beltrami flow algorithm is considered as the theoretical origin of the bilateral filter which produces a spectrum of image enhancing algorithms ranging from the 2 L linear diffusion to the 1 L non-linear flows. The bilateral filter takes a weighted sum of the pixels in a local neighborhood; the weights depend on both the spatial distance and the intensity distance. In this way, edges are preserved well while noise is averaged out.

Bilateral Filtering is achieved by the combinations of two Gaussian filters. One filter works in spatial domain and second filter works in intensity domain. This filter applies spatially weighted averaging smoothing edges. In traditional low pass filtering it is assumed that the pixel of any point is similar to that of the nearby points.

### V. APPLICATIONS OF IMAGE ENHANCEMENT TECHNIQUES

The image enhancement techniques are useful for many fields. The various fields in which image enhancement concept is used are agriculture, geology, weather forecast, education, forestry, remote sensing, fingerprint matching, etc. The application of image enhancement in remote sensing is very common and important. The different image

enhancement techniques are used for converting low contrast satellite images into high contrast satellite images. Image enhancement techniques are useful in the fingerprint matching. The frequency domain techniques are mostly used in remote sensing where low contrast remote images are enhanced. These techniques are widely used for fingerprint images enhancement. There are three types of Piecewise linear transformations: Contrast Stretching, Intensity level slicing and Bit plane slicing. Contrast Stretching is one of image enhancement techniques involves processing an image to make it look better to human viewers. It is usually used for post processing by modifying contrast or dynamic range or both in an image. The aim of contrast enhancement process is to adjust the local contrast in different regions of the image so that the details in dark or bright regions are brought out and revealed to the human viewers.

## VI. CONCLUSION

Belief increases algorithms offer a wide variety regarding techniques because modifying image in conformity with achieves visually ideal images. The preference over certain techniques is a characteristic about the unique task, image content, viewer characteristics, and viewing conditions. The stricture over view rise strategies of spatial domain has been efficiently successful yet is one of the almost necessary then difficult factor of digital image technology and the consequences because each method are also discussed. In this work, the objectives hold been performed among rule to attain the dissertation aim who is according to diagram yet strengthen an fabulous image increment approach Here we describe the technique regarding bilateral filter in imitation of de-noise the scientific images. Its overall performance is multiplied than as on linear filters such as like Wiener filter, mean filters etc. It offers better overall performance after cite the uproar into excessive frequency region however that fails to recover uproar after paltry frequency region and getting higher PSNR than ref technique.

## REFERENCES

- [1] Kim, Tae Keun, Joon Ki Paik. and Bong Soon Kang. "Contrast enhancement system using spatially adaptive histogram equalization with temporal filtering." *Consumer Electronics, IEEE Transactions on* 44, no. 1 (1998): 82- 87.
- [2] Yang, Yue. and Baoxin Li. "Non-linear image enhancement for digital TV applications using Gabor filters." In *Multimedia and Expo, (2005). ICME (2005). IEEE International Conference on*, pp. 4-pp. IEEE. (2005).
- [3] Angela. Saibahu, and K. VijayanAsari. "An Adaptive and Non Linear Technique for Enhancement of Extremely High Contrast Images." In *Applied Imagery and Pattern Recognition Workshop. (2006). AIPR (2006). 35th IEEE pp. 24-24. IEEE. (2006).*
- [4] Sengee, Nyarnlkhagva. and Heung Choi. "Brightness preserving weight clustering histogram equalization." *Consumer Electronics, IEEE Transactions on* 54, no. 3 (2008):1329- 1337.
- [5] Yang. Fan. and Jin Wu. "An improved image contrast enhancement in multiple-peak images based on histogram equalization' In *Computer Design and Applications (ICCD), (2010) International Conference on*. vol. 1, pp. VI- .346. IEEE, (2010).
- [6] Hossain, Md Foisal, Mohammad Reza Alsharif, and Katsumi Yamashita. "Medical image enhancement based on nonlinear technique and logarithmic transform coefficient histogram matching." In *Complex Medical Engineering (CME). (2010) IEEE/ICME International Conference on*. pp. 5 8-62. IEEE. (2010).
- [7] Kwok. Ngai Ming. QuangPhuc Ha. Gu Fang. Ahrnad 13. Rad, and Dalong Wang. "Color image contrast enhancement using a local equalization and weighted sum approach." In *Automation Science and*

- Engineering (CASE). (201 0) IEEE Conference on*, pp. 568- 573. IEEE. (2010).
- [8] Snehal O.Mundhada, Prof. V. K. Shandilya, "Image Enhancement and Its Various Techniques", *International Journal of Advanced Research in Computer and Communication Engineering*, Volume 2, Issue 4, 2012.
- [9] Rajesh kumar Rai, Puran Gour, Balvant Singh, "Underwater Image Segmentation using CLAHE Enhancement and Thresholding", *International Journal of Emerging Technology and Advanced Engineering*, Volume 2, Issue 1, January 2012.
- [10] N. Mohanapriya., B. Kalaavathi. "Comparative Study of Different Enhancement Techniques for Medical Images." *International Journal of Computer Applications*, Volume 61, No. 20,2013.
- [11] <http://www.digital-imagegraphy-tips.net/post-processing-digitalimages-right-or-wrong.html>
- [12] A.K. Bhandari, V. Soni, A. Kumar ,G.K. Singh, "Cuckoo search algorithm based satellite image contrast and brightness enhancement using DWT-SVD", *ISA transactions*, Elsevier, Volume 53, pp. 1286-1296, 2014.

**Rashmi Shukla**, M.Tech Scholar, Department of Computer Science & Engineering, Kanpur Institute of Technology, Kanpur, India.

**Praveen Kumar Tripathi** Assistant Professor, Department of Computer Science & Engineering, Kanpur Institute of Technology, Kanpur, India