ESTIMATION OF BONE MINERAL DENSITY TO IDENTIFY OSTEOPOROSIS

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Abstract— Advances in the field of image processing envision a new era of evaluation techniques and application of procedures in various different fields. One such field being considered is the biomedical field for prognosis as well as diagnosis of diseases. This plethora of methods though provides a wide range of options to select from, it also proves confusion in selecting the apt process and also in finding which one is more suitable. Our objective is to use a series of techniques on bone scans, so as to detect the occurrence of Osteoporosis as accurately as possible. Amongst other techniques existing in the field our proposed system tends to be more effective as it depends on new methodologies that have been proved to be better and more consistent than others. Computer aided diagnosis will provide more accurate and infallible rate of consistency that will help to improve the efficiency of the system. The image first undergoes histogram smoothing and specification, morphing operation, boundary detection by edge following algorithm and finally image subtraction to determine the presence of Osteoporosis in a more efficient and effective way. Using pre-processing noises are removed from images and using segmentation, region of interest is found and Histogram smoothing is applied for a specific portion of the images. Gray level co-occurrence matrix (GLCM) features like Mean, Median, Energy, Correlation, Bone Mineral Density (BMD) and etc. After finding all the features it stores in the database. This dataset is trained with inflamed and non-inflamed values and with the help of neural network all the new images are checked properly for their status and rough set is implemented for further reduction.

I. INTRODUCTION

In the present scenario, medical industry, astronomy, physics, chemistry, forensics, remote sensing, manufacturing and defence are just some of the many fields that rely upon images to store, display and provide information about the world around us. The challenge to scientists, engineers and business people is to quickly extract valuable information from raw image data. The primary purpose of image processing is to convert images to information. Today's medical imaging systems produce enormous amounts of data and the speed and quality of patient care depending upon how fast and effectively that data can be turned into high resolution diagnostic images. Medical imaging is used to create images of the human body for clinical purposes. The production of visual representations of body parts, tissues, or organs are used in clinical diagnosis and allowing doctors to find diseases earlier and improve patient outcomes.

Osteoporosis is a "silent" condition where the bones are weak and prone to fracture. Bone is living tissue that is in a constant state of regeneration. That is, the body removes old bone (called bone resorption) and replaces it with new bone (bone formation). By their mid-30s, most people begin to slowly lose more bone than can be replaced. As a result, bones

become thinner and weaker in structure. It may come to your attention only after you break a bone. When you have this condition, a fracture can occur even after a minor injury, such as a fall. The most common fractures occur at the spine, wrist and hip. Spine and hip fractures, in particular, may lead to chronic (long-term) pain and disability, and even death. Bone Mineral Density refers to the ratio of weight to the volume or area of the bones. Bone density is used as an indirect indicator to identify bone weakness and fracture risk. 70 percent weight of bones is made from minerals. Calcium and magnesium are the most prevalent minerals in bone, although numerous trace mineralsare also present. These trace minerals include silicon, strontium, vanadium, phosphorus, zinc, copper and boron.

This paper is used to identify various tissue properties in a bone. It is used to determine the fracture risk of a bone based on its properties. We use quantitative computed tomography (QCT) to determine the volumetric BMD. It is used to find out whether BMD is positive or negative with fatigue life .It is found that the standard deviation of BMD is negatively associated with fatigue life. Fatigue life is defined as the no of applications of a given stress to which a sample of metal can be subjected before failing The QCT scans were obtained with the specimens and simulated and are in .8mm isotropic voxel size with 1mm thickness of images. All the specimens were fatigue loaded using load levels. Fatigue loading is stopped when 1000 cycles is reached or when vertebrae is fractured. Hazardal situations are measured during the calculation of BMD.

II. EXISTING SYSTEM

At the present a large amount of research has been started in image processing for medical field as per the specifications of diagnosis, but the number of true positives generated is very low and limited. This leads to inaccuracy and the methods are not reliable for continuing. Various segmentations, and clustering techniques based on discrete cosine transform (DCT), NCuts Algorithm, SOFES Algorithm and even manual segmentation have been employed to perform and help in computer aided diagnosis from scans with accuracy. The various disadvantages result from the methods inefficiency for the procedure as they cannot sufficiently deal with the respective image scans properly or give a proper diagnosis. Also, a certain amount of negative results ensure that the methods be refined more to give precise results. Employing canny edge detector are less accurate and the sobel filter smoothens the image allowingedge analysis more accurately by producing considerably higher values for similar edges and hence giving a better detection

III. PROPOSED SYSTEM

The design of the system is based on various technologiesfrom image processing likewise for providing complete diagnosis automatically. Our proposed method consists of stepwise processing where first the image is normalizedthrough histogram smoothing and specification, and then itundergoes morphological operation of dilation and erosion to enable extraction of the bones area termed as the region of interest (ROI). Next using boundary detection, we find out the edges of the bones sufficiently underlining the joint area foranalysis which is the subtracted from previous image and theresults are generated as a diagnosis where if the value is above a specific standard, it can be positive for osteoporosis. Digital image processing is concerned primarily with extracting useful information from images. Ideally, this is done by computers, with little or no human intervention. The image will be converted to digital form using a scanner digitizer. To get originality of information, it has to undergo various phases of

processing Image processing algorithms may be placed at three levels. At the lowest level are those techniques which deal directly with the raw, possibly noisy pixel values, with denoising and edge detection being good examples. In the middle, algorithms which utilize low level results for further means, such as segmentation and edge linking. At the highest level are those methods which attempt to extract semantic meaning from the information provided by the lower levels, for example, handwriting recognition. Important applications are medicine, film and video production, photography, remote sensing, and security monitoring.

A. Histogram Smoothing and Specification

Histogram of an image shows a strong peak because the image is dominated by a large area of a single gray-level value, this can cause problems when using Histogram Equalization. One method, Piecewise Therefore preference to this method in which segments yield the original means of the modes, maximizing their entropy as suggested in the method of Brightness Preserving Histogram Equalization with Maximum Entropy, is natural. Further contrast improvements can be achieved if the valleys between the modes that have areas much smaller than the rest can be eliminated, choosing a single valley in between. Additionally, the number of valleys between two consecutive peaks that are close together should be reduced by eliminating the valley in the middle.

B. Morphological Operation

Morphological operation is a transformation technique in the object image that consists of the set of theory operation to extract the specific feature from given binary image or gray image. There are two types of morphological operations; erosion and dilation. The opening processing is processing that performs dilation after erosion and the closing processing is processing that performs erosion after dilation. When the opening processing is performed on the image, the part, where pixel value is large, becoming not dim and disappears. Finally, we obtain the differences of original image and the opening processing image is performed, the outline part of which becomes dim will be extracted. The general expressions for the two operations are: These two processes hence help in extraction of our ROI from the image scan by gradual processing.In Fig. 1 Under preprocessing noises are removed from images and using segmentation, region of interest are found and Histogram smoothing is applied for a specific portion of the images. Gray level co-occurrence matrix (GLCM) is applied and found many features like Mean, Median, Energy, Correlation, Bone Mineral Density (BMD) and etc. After finding all the features it stores in the database. This dataset is trained with inflamed and non-inflamed values and with the help of neural network all the new images are checked properly for their status and rough set is implemented for further reduction.

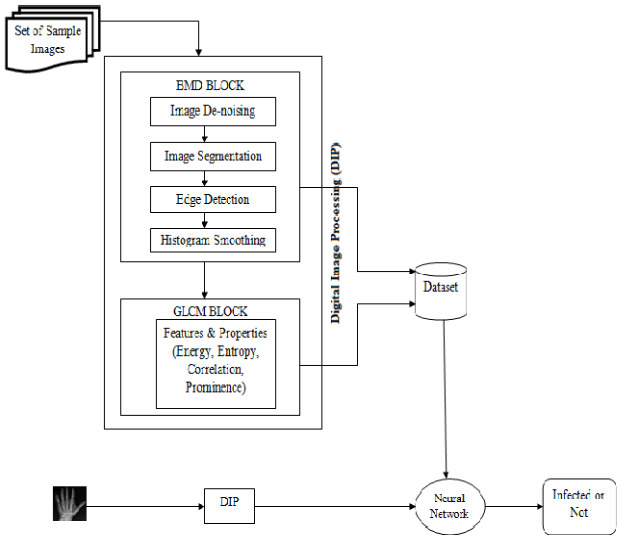

Figure 1. Block Diagram

C. Boundary Detection

A wide range of edge detection techniques has been available in the image processing. Sobel, Prewitt, Costella, Laplacian and Canny operators which are all based on the difference in intensity of gray levels but still different in the mathematical aspects There
fore, we extend the capability of the previous edge vector fiel by
applying a local averaging operation where the value of each vector is replaced by the average of all the values in the local neighborhood.

D. Image Subtraction

This step requires the subtraction of images, one of a previous time and one processed image to find out the changes affected into the bones at the ROI and hence helps in diagnosing the presence of RA in the patient more effectively.

E. Working Principle

Our proposed method consists of a stepwise processing where first the image is normalized through histogram smoothing and specification, and then it undergoes morphological operation of dilation and erosion to enable extraction of the bones area termed as the region of interest (ROI). Next using boundary detection we find out the edges of the bones sufficiently underlining the joint area for analysis which is the subtracted from previous image and the results are generated as a diagnosis where if the value is
above a specific standard it can be a positive for RA. The complete flow of proposed system can be seen in Fig. 1.In our proposed system, Neural Network is used for classification. Whenever a new bone image is given as input to the proposed system, it is pushed into the BMD block. Then various steps are performed on this input bone images. Finally, BMD and GLCM features are extracted from input bone image. These values are compared against the dataset using neural network and then it is classified as whether infected or not infected.

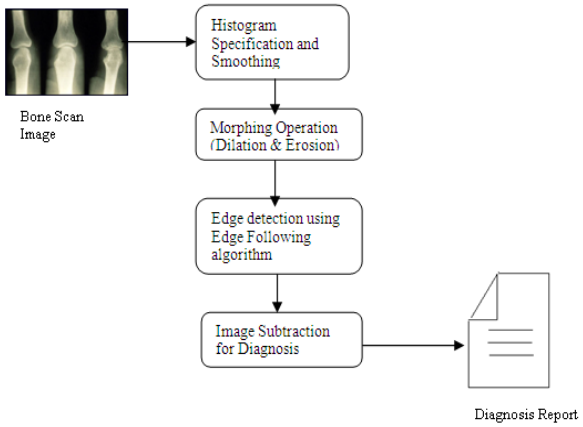

Figure 2. System Design And Flow

Figure. 3 Original Image
Bone images are collected from various laboratories and onlineimage database

Noise may be accumulated in the image during image acquisition. So, the given image is subjected to Median filtering techniques in order to enhance

the image because median filter shows average performance on all types of noise. New procedure is created for measuring these performance parameters. From the result of these performance parameters, we can identify that median filter gives average performance on all type of noise.

Figure. 4 Image after Denoising using Median Filter

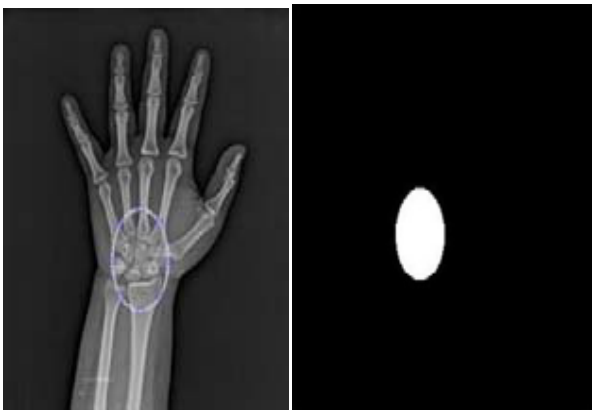

Figure. 5 Segmentation using threshold approach

Probability and Cumulative distribution function method based smoothing is used to identify those different types of objects appearing in the image and makes segmentation process easier.

Algorithm 1: The probability of each occurrence

Input: Noise free Image
Output: Smoothed Image
Procedure:

```
numofpixels=size(GIm,1)*size(GIm,2);
%freq counts the occurrence of each pixel value.
%The probability of each occurrence is
calculated by
probf.
for i=1:size(GIm,1)
for j=1:size(GIm,2)
value=GIm(i,j);
freq(value+1)=freq(value+1)+1;
probf(value+1)=freq(value+1)/numofpixels;
end
end
sum=0;
no_bins=255;
```

INCONSISTENT REDUCED TABLE

Image	Area	Entropy	Perimeter	BMD	Result
Image 5	5796	0.6678	993	0.4544	Inflamated
Image 8	5938	0.6817	1002	0.8823	Non Inflamated
Image 17	5787	0.6649	995	0.5859	Inflamated
Image 18	5978	0.6839	1002	0.5859	Non Inflamated
Image 11	5811	0.6893	1001	0.8859	Non Inflamated
Image 16	5494	0.6789	995	0.4545	Inflamated
Image 20	5965	0.6856	1000	0.6899	Non Inflamated
Image 21	5700	0.6489	998	0.6283	Inflamated
Image 22	5700	0.6940	1002	0.6283	Non Inflamated
Image 23	5700	0.6590	994	0.459	Inflamated

IV. CONCLUSION

The performances of various kinds of filters over different noise types were analyzed and it is clear that Median filter and Gaussian filter gives the best performance over almost all the types of noise examined. On comparing these two filters it is seen that median filter shows average performance on all types of noise. So, in the preprocessing step median

filter is applied to obtain the enhanced image. From the comparison of various types of edge detection, it can be seen that the canny edge detector is an efficient algorithm in identifying the edges clearly even though canny takes more time when compared to others edge detection algorithms. The proposed work is to diagnose osteoporosis using digital x-ray images by applying Gray Level Co-occurrence Matrix (GLCM) features and calculating Bone Mineral Density (BMD).

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