Osteoporosis Detection by using CT Images based on Gray Level Co-occurrence Matrix and Rule based approach

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Abstract— Image processing has a huge potential to do virtually anything. This project comes to the extent of details on detection of osteoporosis through CT scan images. Osteoporosis is a health ailment which causes bones to become so porous that they'll break easily. Osteoporosis simply means 'porous bones'. Osteoporosis usually affects the complete skeleton however it most commonly causes breaks or fractures to the bones in the wrist, spine, and hip. The aim of the Osteoporosis detection by using CT images based on Gray Level Co-occurrence Matrix and Rule based approach is to recognize and distinguish between an ordinary bone image and osteoporotic bone image having its case as severe or non-severe.

Key words: Bone Images, GLCM, SVM

I. INTRODUCTION

Osteoporosis is called as the "silent disease" because bone loss occurs without the symptoms. People might not know they've osteoporosis until their bones become so weak that a sudden strain, bump, or fall causes a fracture or even a vertebra to collapse.

There are numerous causes for this disease. One cause is our genetic heritage. If your mom had it, and her mom had it, there's a good chance you will get osteoporosis. Another cause could possibly be an inadequate intake of vitamins and calcium.

Many systems have been developed to detect osteoporosis, but none is proficient to analysis in time for emergency situations. This system uses Image processing techniques using MATLAB to perform blood typing with Support Vector Machine as classifier

In the system, a part of orthopedic associated sickness known as osteoporosis is concerned. The system is stimulated for the poor people that aren't successful to head for expensive testing's carried out for finding the osteoporosis. It is designed for the convenience of use for the humans to understand approximately their degree of disorder with less time.

II. METHODOLOGY

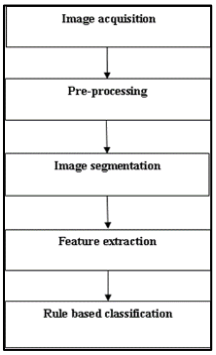

Fig 1: Block diagram

Fig 1 shows the basic block diagram of osteoporosis detection. CT scan images are taken for processing

A. Image Acquisition

CT -images are acquired from various hospitals by visiting the hospitals frequently. Images are classified into normal bone images and affected bone images. The images are acquired on the cornerstone of factors like age and gender. The data linked to the patients including the patient's name, age and gender aren't revealed in the images used for training our system.

B. Pre-Processing

Usually the images which can be obtained during image data collection might not be ideal for classification purpose due to certain factors, such as for instance lighting intensity and size variations and some noise introduced by devices. Resize and cropping had done in pre-processing.

C. Image Segmentation

In image segmentation, the mandatory part is obtained by segmenting CT images. Grey level thresholding is used. It's a fundamental tool for segmentation of grey level images in which objects and background pixels can be distinguished by their grey level values. After cropping and resizing of the grey level image, grey level thresholding is applied. Through the use of thresholding the difference between the normal and affected bone images by calculating the total quantity of white and black pixels is identified. If the white pixels tend to be more in number and black pixels are lesser in number, in an image then it is recognized as to be a normal bone image. If the black pixels tend to be more in number and white pixels are lesser in number, in an image then it's regarded as affected bone image. SVM was used for segmenting the images.

1) Support Vector Machines

Support Vector Machine (SVM) is supervised learning models with associated learning algorithms that analyze data and recognize patterns, useful for classification and regression analysis. The original SVM algorithm was invented by Vladimir N. Vapnik and the present standard incarnation (soft margin) was proposed by Vapnik and Corinna Cortes in 1995. The basic SVM takes some input data and predicts, for every single given input, which of two possible classes forms the output. The classification process is split into the training phase and the testing phase. The known data is given in the training phase and unknown data is given in the testing phase. The accuracy depends upon the efficiency of classification.

SVM is powerful classifier. Some important features of SVM are listed below:

- Less intensive
- Vigorous with noisy data
- Lack of training data is frequently not a severe Trouble

– Executes fine in higher dimensional spaces.

D. Feature Extraction

The Gray level co-occurrence matrix (GLCM) features are extracted. Among entropy, contrast, energy, homogeneity and correlation options that come with GLCM the contrast feature values provides accurate result. The input image's contrast values are then weighed against the obtained contrast values and the result is displayed as is the given input image is normal bone image or affected bone image. . If the image is affected bone image then it's further identified as whether it's severe bone image or non-severe bone image.

1) Gray Level Co-occurrence Matrix

Gray Level Co-occurrence Matrix, GLCM is just a feature detector. This technique looks for intensity relation in the images. GLCM builds a new matrix that counts different intensity relations. The idea behind GLCM is to describe the texture as a matrix of "pair gray level probabilities". The GLCM is just a square matrix with Ng dimension, where Ng equals how many gray levels in the image. Each element of the matrix is the number of occurrence of the pair of pixel with values i and a pixels with value j. A co-occurrence matrix is just a two dimensional array where both rows and columns represent set of possible image values.

Different features can be extracted using GLCM as follows:

a) Entropy

– Entropy shows the total amount of information of the image that's necessary for the image compression.
– The entropy is large once the image isn't texturally uniform.
– Complex textures generally have high entropy.
– Entropy is strongly, but inversely correlated to energy.

$$Entropy = -\sum_i \sum_j p_{ij} \log_2 p_{ij}$$

b) Contrast

– Measures the neighborhood variations in the gray-level co-occurrence matrix
– Measures the spatial frequency of a picture and is difference moment of GLCM.
– It's the difference between the highest and the lowest values of a contiguous group of pixels.
– It measures the quantity of local variations within the image.
– Contrast(con)= $\sum_i \sum_j (i-j)^2 p_{ij}$

c) Correlation

– It gives the joint probability occurrence of the specified pixel pairs

d) Energy

– Offers the sum of squared elements in the GLCM. Also referred to as uniformity or the angular second moment.
– It measures the textural uniformity that is pixel pair repetitions. Detects disorders in textures. Energy reaches a maximum value corresponding to one.
– Energy =$\sum_i \sum_j {p_{ij}}^2$

e) Homogeneity

– Measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal. Also called as Inverse Difference Moment.
– Measures image homogeneity since it assumes larger values for smaller gray tone differences in pair elements.
– It is more sensitive to the clear presence of near diagonal elements in GLCM.
– It has maximum value when all the elements in the image are same.
– Homogeneity decreases if contrast increases while energy is kept constant.
– Homogeneity =$\sum_i \sum_j \frac{1}{1+(i-j)^2} p_{ij}$

III. RESULTS

The fig 2 depicts the result of a normal bone image.

By comparing the features of test image with trained dataset, the system outputs the result.

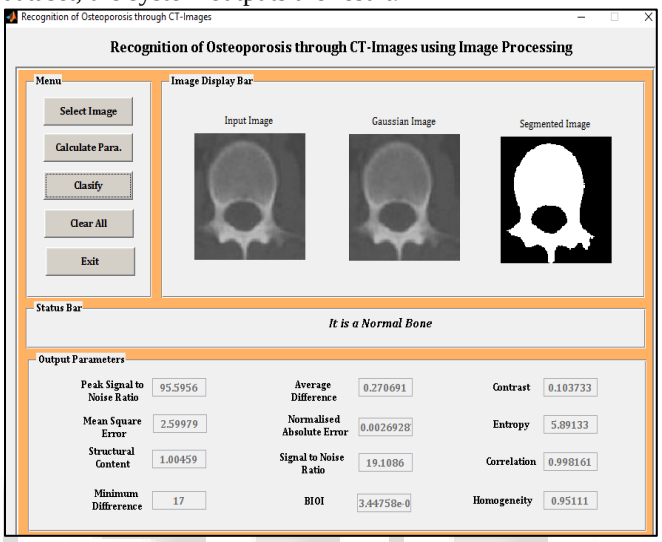

Fig. 2: Normal bone image detected

The fig 3 depicts the result of an osteoporotic image with the case of nonseverity.

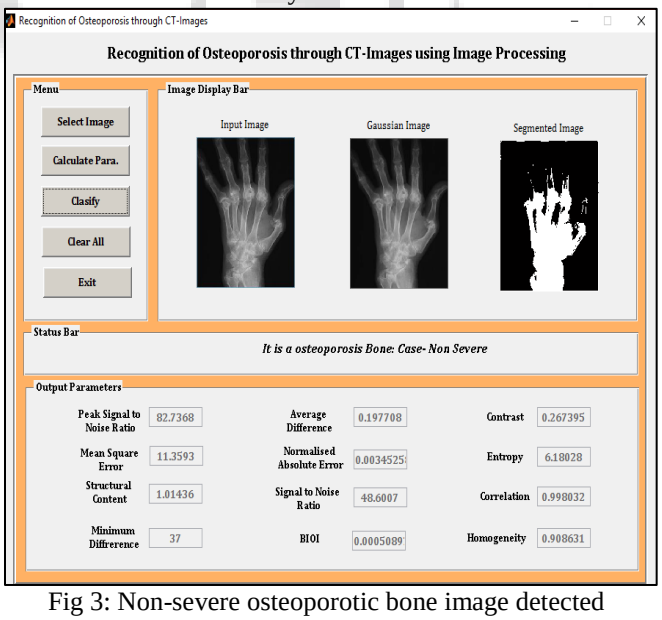

Fig 3: Non-severe osteoporotic bone image detected

IV. CONCLUSION

Feature extraction is very important part of recognition of osteoporosis system. Gray level Co-occurrence matrix feature extraction method and segmentation is used. This system classifies among normal and abnormal images and detects the osteoporosis with the case severity and non-severity. The results demonstrated convincingly that this

system can indeed provide powerful means for osteoporosis analysis. Thus the presented methodology seems a useful supplement to diagnose osteoporosis.

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