A Review on Osteoporosis Detection by using CT Images Based on
Gray Level Co-Occurrence Matrix and Rule based Approach
Maya Deoker¹, Prof. S.N.Patil²
M.E Student¹, AssociateProfessor²
Department of Electronics Engineering
P.V.P.I.T, Budhgaon, Sangli, Maharashtra, India

Abstract:
Osteoporosis is a progressive bone disease that's characterized by a decrease in bone mass and density and that leads to an increased risk of fracture. In osteoporosis, the bone mineral density (BMD) is reduced, bone microarchitecture deteriorates, and the amounts of variety of proteins in bone are altered. The objective of the Osteoporosis detection by using CT images based on Gray Level Co-occurrence Matrix and Rule based approach is to identify and distinguish between a normal bone image and osteoporotic bone image with its case as severe or non-severe.

Keywords: Osteoporosis, GLCM, Rule base Approach, BMD

I. INTRODUCTION
Osteoporosis is defined by the World Health Organization (WHO) as a bone mineral density of 2.5 standard deviations or more below the mean peak bone mass (average of young, healthy adults) as measured by dual-energy X-ray absorptiometry; the term "established osteoporosis" includes the presence of a fragility fracture. The disease may be classified as primary type 1, primary type 2, or secondary. The form of osteoporosis most common in women after menopause is referred to as primary type 1 or postmenopausal osteoporosis. Primary type 2 osteoporosis or senile osteoporosis occurs after age 75 and is seen in both females and males at a ratio of 2: 1. Secondary osteoporosis may arise at any age and affect men and women equally. This form results from chronic predisposing medical problems or disease, or prolonged use of medications such as glucocorticoids, when the disease is called steroid- or glucocorticoid-induced osteoporosis. The risk of osteoporosis fractures can be reduced with lifestyle changes and in those with previous osteoporosis related fractures medications. Lifestyle change includes diet, exercise, and preventing falls. The utility of calcium and vitamin D is questionable. Bisphosphonates are useful in those with previous fractures from osteoporosis but are of minimal benefit in those who have osteoporosis but no previous fractures. Osteoporosis is a component of the frailty syndrome. Bone Mineral Density or BMD is a term that refers to the quantity of mineral content per square centimeter of bone. It is the measurement of the amount of calcium in bone. The BMD is the gold standard for the evaluation of the bone mass quantity. It is measured by a procedure called densitometry, often performed in the radiology or medicine departments of hospitals or clinics. Measurements are most commonly made over the lumbar spine and over the upper part of the hip. The forearm may be scanned if the hip and lumbar spines are not accessible. Average density is around 1500 kg m⁻³. BMD is used in clinic as an indirect indicator of osteoporosis and fracture risk. Many works have been carried out on calculating BMD of bone using DXA, DEXA, CT, and XRAY.

II. REVIEW
Mahantesh Elemmi, Gurusiddappa Huga, Shanta Kallur developed a system that classifies among the normal and abnormal images and detects the osteoporosis with the severity and non severity using CT images.[1] Liu ZQ, Austin T, Thomas CD, Clement JG suggested Bone feature analysis using image processing techniques. They demonstrate that such a system is able to extract various bone features consistently and is capable of providing more reliable data and statistics for bones. In this paper they present a new approach to quantitative analysis of cross-sections of human bones using digital image processing techniques.[2]

Abdurrahim Akgundogdu, Rachid Jennane, Gabriel Auffort, Claude Laurent Benhamou have developed various image processing and simulation techniques to investigate bone micro architecture and its mechanical stiffness and have evaluated morphological, topological and mechanical bone features using artificial intelligence methods. A clinical study is carried out on two populations of arthritic and osteoporotic bone samples. The performances of Adaptive Neuro Fuzzy Inference System (ANFIS), Support Vector Machines (SVM) and Genetic Algorithm (GA) in classifying the different samples have been compared. Results show that the best separation success (100 %) is achieved with Genetic Algorithm.[3]

Yi-King Choi, Leong, Lu Wenping Wang explained a new system, called VISBONE, for visualizing the 3D BMD distribution within a bone. Design issues and specific considerations required by this application are discussed.[4]

Humbert, Whitmarsh, De Craene, Del Rio Barquero suggested a 3D reconstruction method of both the shape and the Bone
Mineral Density (BMD) distribution of the proximal femur from routinely used DXA images. The reconstruction accuracy that can be obtained from single-view and multi-view DXA devices was assessed [5].

Sooyeul Lee, Ji-Wook Jeong, Jeong Won Lee, Done-Sik Yoo develop a simple technique for distal radius bone mineral density estimation using the trabecular bone filling factor in the X-ray image and apply the technique to the wrist X-ray images of 20 women. Estimated bone mineral density shows a high linear correlation with a dual energy X-ray absorptiometry (r=0.87) [6].

Tristan Whitmarsh, Karl D. Fritscher, Ludovic Humbert, Luis M. Del-Rio-Barquero, Rainer Schubert and Alejandro F. Frangi suggested a method to discriminate between healthy and fracture patients from DXA images by incorporating a 3D reconstruction method. A statistical model of the 3D shape and BMD distribution was registered onto the DXA scans of fracture and non-fracture patients. The resulting values for the scale and the first model parameter, together with the femoral neck area BMD, was processed by Linear Discriminate Analysis and the discriminating accuracy was evaluated by generating the Receiver Operating Characteristic curve. [7]

Sahiti Lahari M., Vijay, Anburajan M said that finite element analysis is performed to give stress, strain values of osteoporosis, osteopenic and normal femur. The analysis can be used as a caution for the osteopenic and normal patient’s [8].

Zhi Gao, Wenxue Hong, Yonghong Xu, Tao Zhang, Zhijie Song, Jian Liu suggested that the multi fractal spectrum features of micro-CT images were extracted and classified the features of multifractal spectrum using C4.5 decision trees which can help doctors to diagnose osteoporosis [9].

Yung-Yen Chiang, Shu-Li Wang, Shunghao Liu, Fan Wu exploited the cone beam computed tomography (CBCT) images for getting the BMD by exploring the relationship between trabecular bone and the gray levels of these images through the gray level of trabecular of the CBCT images [10].

Sangeetha.S.; Dept. Of Instrum. Eng., Anna Univ., Chennai, India; Sujatha, C.M.; Manamulli, D; suggested that estimation of mechanical strength of bones is an essential component in clinical measurement for assessment of osteoporosis and fracture[11]. In the past, several systems have been presented, which detects the osteoporosis on parts of the body such as hip, arm and few systems were designed only for the classification of the diseases. There were less works carried out on the lumbar vertebrae bone. Thus, the development of faster classification methods and more accurate and precise features is very important in order to run such systems in real-time. This system classifies among the normal and abnormal images and detects the osteoporosis with the case severity and non severity.

III. METHODOLOGY

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

![Flow chart of proposed system](http://ijesc.org/)

**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 basis of factors like age and gender.

**Pre-processing:**

Usually the images that are obtained during image data collection may not be suitable for classification purpose because of certain factors, such as lighting intensity and size variations and some noise introduced by devices. Following work will be carried out in pre-processing

- **Resize:** The acquired images are resized into a specific dimension.
- **Crop:** The part of the image is cropped as needed.

**Image segmentation:**

In image segmentation the required part is obtained by segmenting CT images. Grey level thresholding is being used. It is a fundamental tool for segmentation of grey level images when objects and background pixels can be distinguished by their grey level values. After cropping and resizing of the grey level image we apply grey level thresholding. By applying thresholding we identified the difference between the normal and affected bone images by calculating the total number of white and black pixels. If the white pixels are more in number and black pixels are lesser in number, in an image then it is considered to be a normal bone image. If the black pixels are more in number and white pixels are lesser in number, in an image then it is considered to be affected bone image.

**Feature extraction:**

The Gray level co-occurrence matrix (GLCM) features are extracted. Among entropy, contrast, energy, homogeneity and correlation features of GLCM the contrast feature values gives the accurate result. The mean and standard deviation values are calculated for the contrast feature values.
The input image's contrast values are then compared with the obtained mean and standard deviation values and the result is displayed as whether the given input image is normal bone image and affected bone image. If the image is affected bone image then it is further identified as whether it is severe bone image or non-severe bone image.

IV. CONCLUSION

Feature extraction is very important step in recognition of osteoporosis system. In this system feature extraction method is described. We have used Gray level Co-occurrence matrix feature extraction method and segmentation. This system classifies among normal and abnormal images and detects the osteoporosis with the case severity and non severity.

V. REFERENCES


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