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Bone fracture detection using GLCM Feature Extraction

Ambika M[1], Mallikarjun Mudda[2]

[1]Ambika M, assistant Professor, Department of Electronics and Communication Engineering, Nalla Malla Reddy Engineering College, Hyderabad, India

[2]Mallikarjun Mudda, Associate Professor, Department of Electronics and Communication Engineering, Sreenidhi Institute of Science and Technology, India,

ABSTRACT

Bone fracture is the common problem in the human beings. It occurs due to the high pressure which is applied on the bone. It may also occur due to osteoporosis and bone cancer. Therefore the accurate diagnosis of bone fracture is an important aspect in medical field. In this we use X-ray/CT images to analyze the fracture. The main theme of this project is to develop an image processing efficiently for a quick and accurate classification of bone fractures based on the given information which we got from the x-ray / CT images. We get the Images of the fractured bone are from hospital. For identifying the fractured bone we use different techniques like pre-processing, segmentation, edge detection and feature extraction methods. These processed images are further classified into fractured and non-fractured bone that can be compared with the other methods. This project is done with the help of MATLAB 7.8.0 and the algorithm used in this process is Fuzzy for loading image, image processing and user interface development. Finally this can be performed very accurately with 85% output but has some limitations.

Keywords: Image registration, Segmentation, k-means, GLCM, Feature extraction, ANN.

1. INTRODUCTION

Bones are the strong organs in our body protecting many important organs like brain, heart, lungs and other internal parts of the body. The human body has 206 bones with different shapes, size, features and structures. The largest bones in our body are the femur bones, which is at thigh and the smallest bones are the auditory ossicles which is at the ear. Bone fracture may happen due to an accident or due to some high pressure applied on the bones. There are different types of bone fracture like transverse, compound, communicated, spiral, greenstick in which it can be done.

There are various types of medical tools in imaging that are available to detect many types of abnormalities like Computed Tomography(CT), X-ray, ultrasound, Magnetic Resonance Imaging (MRI),etc. Doctors will use more frequently the X-rays and CT in diagnosis because they are the fastest way for the doctors to study the injuries of bones and joints. Doctors generally use x-ray to define if the bone is fractured or not, and the location where it is fractured. The data used is DICOM images. In present hospitals, images are protected in the standard DICOM (Digital Imaging and Communications in Medicine) format which involves text into the image. Any chance to regain and display these images should go by Picture Archives and Communication System.

Some of the experimental applications of image segmentation are:

- ✓ Locate tumors and other diseases
- ✓ Medical visualizing
- ✓ Measuring tissue volumes
- ✓ Computer-guide surgery
- ✓ Identifying and Testing
- ✓ Treatment designing
- ✓ Locating objects through satellite images
- ✓ Face and fingerprint recognition
- ✓ Traffic command systems
- ✓ Machine vision
- ✓ Study of body structure

Various general-purpose methods and algorithms have been proposed for image segmentation. Since there is no perfect

solution for the image segmentation problem, these various techniques often are to be combined with domain the knowledge in order to solve effectively and accurately about an image segmentation problem for a main domain.

Edge detection is a well-known field on its own with reference to image processing. There are two different procedures to detect the edge detection. They are gradient and Laplacian. Gradient method can be said as the first derivative and the Laplacian can be said as the second derivative. Edge detection method is therefore a base of other segmentation process. The edges can be identified by edge detection sometimes gets disconnected. To chunk an object from an image one needs a closed region anyhow.

A long research has been done in this area for which we got a best result in the field of interactive manually or fully automatic. The following is the brief overview about which many researchers have been done. The nesting structure which is described below is specific for one dimensional image but insignificantly specifies for high dimensional images. Finally this idea inspired many different authors to establish the truth for coarse-to-fine schemes for segmentation. Koenderink who suggested to study about iso-intensity contours how develop over scales and this step was investigated by the great authors Lifshitz and Pizer. Suddenly,this image intensity features changes over the scales,which is hard to find the coarse-scale image features to find for the better scales with the information based on the iso-intensity.

Lindeberg had gone through the problem of linking local extrema and supportive points over scales, and suggested the representation of an image called as scale-space primary sketch that makes indetail with the relations between different scales of structures and also makes indetail explanation with the features of an image which are fixed for long ranges of scaling covering locally approximate scales for all those. Bergholm suggested discovering edges at coarse scales in space and then discovering back to the best scales with good choice for both localization scale and coarse detection scale.

Gauch and Pizer had gone through the complementary problem of valleys and ridges at multiple scales and started developing an interactive image segmentation based on watersheds of multiple scale . The benefit of using this watershed with application for a gradient map has also been established by Nielsenand and Olsen who carried to their clinical use by dam vinclen who proposed a hyper stack to define probabilistic relations among structures of images at various scales .The main theme of using stable image structures over sales has been developed by Ahujaand and his co-workers into an automated form.

In recent days the ideas for multiple scale image segmentation through the linking process over scale image segmentation through the linking process by Florack, Kuijper and Rue who associated the structure defeated in scale –space above a noise with minimum threshold above a noise with minimum threshold into an object tree which is extent to multiple scales and related to a kind of features in signal which is original .Features which are extracted accurately re-established using a method of iterative conjugate matrix gradient

2. EARLIER WORK

Many different algorithms were developed in detecting the bone fracture using image processing. V.Vijaykumar presented papers for filtering the noise. There are many noises presented in the ct scans or in the X-ray images because of the changed pixels in it or due to blur images. The noises presented in the images are mainly of Gaussian noise or salt or pepper noise. Based on the threshold values the surrounding pixels are being replaced by mean of the sum of pixels. Alpha-trimmed mean, Wiener, K-means, bilateral and trilateral, are some of the algorithms which gives the lower mean absolute error and higher signal to noise ratio.

Usually the noises like salt and pepper noises and the guasssion noises are presented in the X-rays and CT scan images. By using 3x3 window which is contained with white and black pixels the k-fill algorithm are applied for removing the salt and pepper noise which are present in the images. This is proposed by the Al-khaffaf.

By taking the noise presented images a poisson and a gaussion noises are taken so for estimating the parameters like component of poisson and mean and variance of the gaussion are presented in the images.

Image enhancement and speckle reduction problems for filtering techniques are being addressed by the Zain and M.L .

Methods like wavelet and the curvelets transform are used in the feature extraction method which was proposed by the Chan and k.p.

For achieving the higher accuracy rate the method called “Haar method” is being used. By comparing the other methods the Haar gives the higher accuracy results.

For measuring the neck-shaft angle in the femur bone Tian proposed the system for detection of fracture in femur.

The works done by the Lim, Yap, Lum they used Gabor, Random feild, Marcov and the gradient intensity for extracting the features from the X-ray and CT scan images and they have fed to the Support vector Machines classifiers.

By observation of this while combining all the SVM classifiers the accuracy and sensitivity are being improved instead of using individual classifiers. By this the femur bones fractures can be detected by using the “hierarchical” SVM classifiers system.

Tibia bone fractures can be automatically detected by using fusion classification technique which was proposed by the Mahendran.

The binary conversion , edge detection, noise removal and segmentation are the pre-processing steps. The feed forward back propagation neural networks, support vector machines and naive bayes are classifiers uses majority vote technique.

The segmentation is the next step in the process which was proposed by the Chai which was based on the GLCM method.

It is used to segment the X-ray or the CT scan image of any part in the body and seperates the bone regions and the soft tissue regions.

The pre-processing techniques are binary conversion, and edge detection and the K-means segmentation and GLCM methods are used in the feature extraction process.

Automatic segmentation method for X-rays and CT scan images was proposed by the Hao.

At first the edges of the images will start detecting automatically determine the region of the interest. At last the image is segmented and only the bones are being extracted.

The automated algorithm was developed for computing the joint width in the

X-rays/ CT scan images which was proposed by the Bielecki.

In this work, using the image processing the automatic classification of bone fracture information is been gained for the X-rays/CT scan images with a higher accuracy rate and in this all types of bone fractures can detected.

3. PROPOSED METHOD

From the hospitals we can obtain different types of fractured and non fractured bones images in the form of X-Rays/CT images. In the first step of image processing, apply the preprocessing method ,that can coverts the image from RGB to grayscale and by using filtering algorithm it can enhance them by removing the noise from the image. By using the edge detection and segmentation techniques it can detects the edges in the image. After segmentation by using feature extraction techniques it can convert each image into set of features. Based on the extracted features we can build a classification algorithm. Finally, the accuracy and the performance of the proposed system has been evaluated. In the below figure it shows the flow diagram for detecting the bone fracture in X-Rays/CT images as per the proposed system.

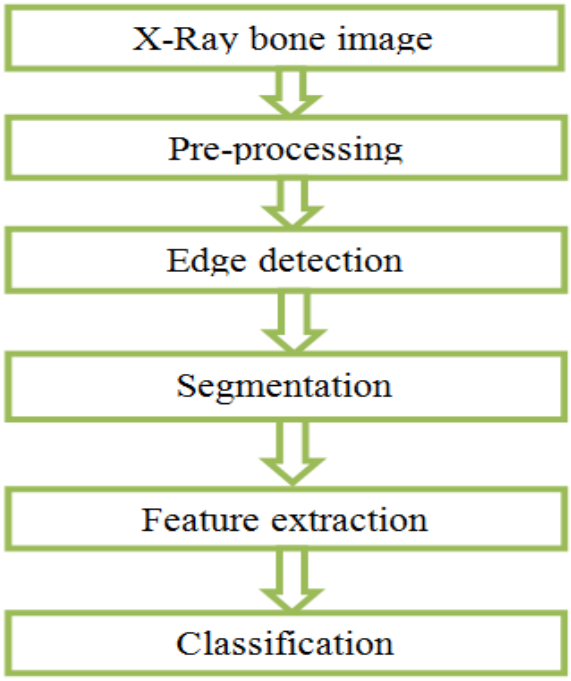

Figure 1: The flow diagram for detecting the bone fracture in X-ray/CT images

3.1 Image Pre-processing

In computer based diagnosis of medical images like X-rays, Image processing techniques for removing noise, segmentation of image and feature extraction will play a important role in such systems. In hospitals different types of fractured and no fractured bone images are obtained in the form of X-rays/CT images. In the first step of pre processing, it converts image from RGB to grayscale. By using the Median filter it removes the noise from the image.

3.2 Noise Removal

Noise is termed as the unwanted pixels that are present in the image. The quality of the image can be degraded by the presence of noise in the image. The noise equation is given as $f(p,q)= g(p,q)+ \eta(p,q)$ where $f(p,q)$ is the combination of noise and actual image, $g(p, q)$ is actual image and $\eta(p,q)$ is noise present in the image. There are various types of noises that are exists in the image are salt and pepper noise and Gaussian noise. One of the common noises that is present in the X-ray image is salt and pepper noise, which is caused due to failure in capture or because of the appearance of transmission in the image as black and light dots. This noise can be removed from the images by applying mathematical transformation on the images. while removing the noise it can also preserves the edges. For removing the salt and pepper noise a Median filter, which is a non linear digital filter is used.

3.3 Edge Detection

Edge detection is one of the important methods in image processing. In this method the structure of an image can be saved by determining the boundaries of an objects in the image by reducing the pixels of an image. In this technique it identifies points in a digital image where the brightness of an image changes sharply or more formally and which has discontinuities. Edges, the set of curved line segments that are formed at the points where the brightness of an image changes sharply and typically. There are two different methods in edge detection they are: Gradient and Laplacian methods. First derivative of the image is used by Gradient method and the second derivative of the image is used by Laplacian method for finding the edges of the image. In this work we used the SOBEL edge detector which is a Gradient family.

3.4 Segmentation

Segmentation is the phenomenon of dividing the image into different regions that are homogeneous with respect to certain features like colour, intensity etc. In this project we used K-mean clustering technique. The purpose of K-mean clustering is to minimize the absolute difference function. In this technique the absolute difference between pixel and cluster center has been measured or the distance s squared. This difference is typically depends on pixel intensity, location, texture and colour. Based on the initial values of cluster and the value of K, the solution quality depends. After doing the segmentation process the area of fracture and the image are cropped with some limitations.

3.5 Feature Extraction

Feature extraction is one of the important step in different image processing applications. For feature extraction and selection Gray level co-occurrence matrix (GLCM) is used. GLCM was given by Harlick, in 1973. It is an important tool used in different image texture analysis. Image textures are complex visual patterns which are composition of entities or regions with sub patterns and having the characteristics of brightness, shape, colour, size, etc. By statistically sampling the patterns of grey levels, we can indicate the structure of an image texture statistically by using GLCM in relation to other gray levels. For extracting the textural features such as Homogeneity, entropy, correlation and contrast we use GLCM technique.

3.6 Classification

Classification is a method of data analysis that is used to study a set of data and categorizing them into different categories. Each and every category has its own characteristics and the data that belonging to such category has similar properties of that category. In this method, different types of classifiers are used some of them are Decision tree, Neural network and Meta classifier. Depending on textural features of GLCM, Classifiers can classify the given X-ray image into fractured bone or Non fractured bone.

4. RESULT AND ANALYSIS

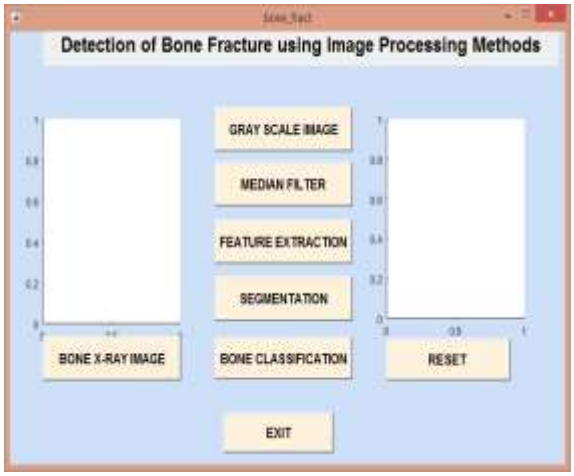

Figure 2: GUI interface

Figure 3: Select an input X-ray/CT image

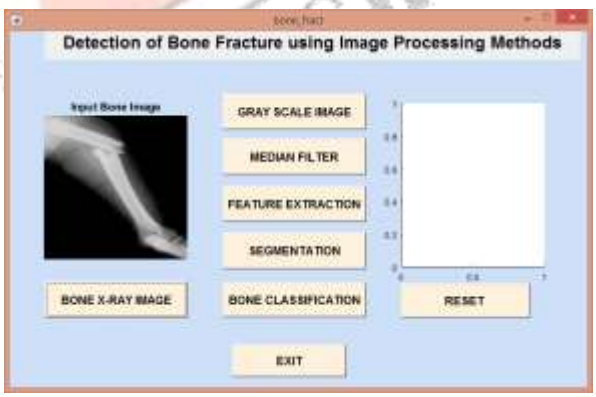

Figure 4: Input image is selected.

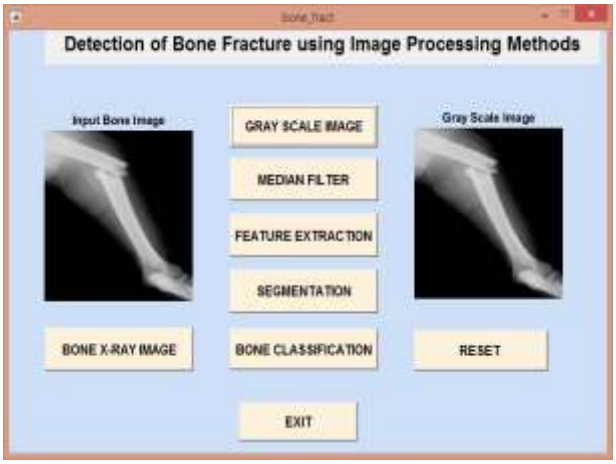

Figure 5: Gray scaled image

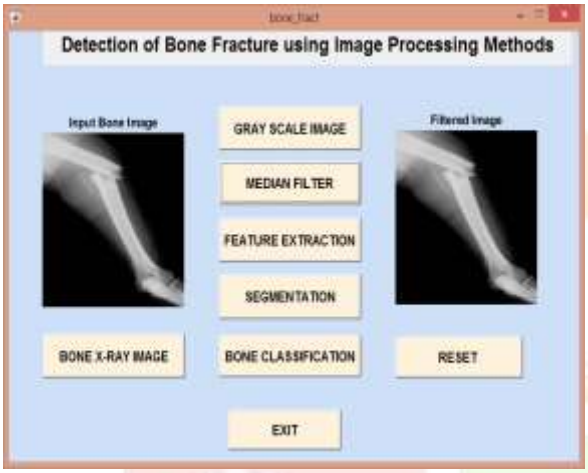

Figure 6: Image is filterd by median filter

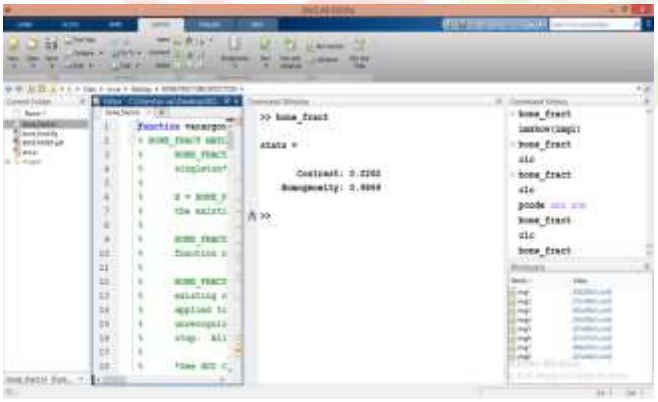

Figure 4: Feature extraction

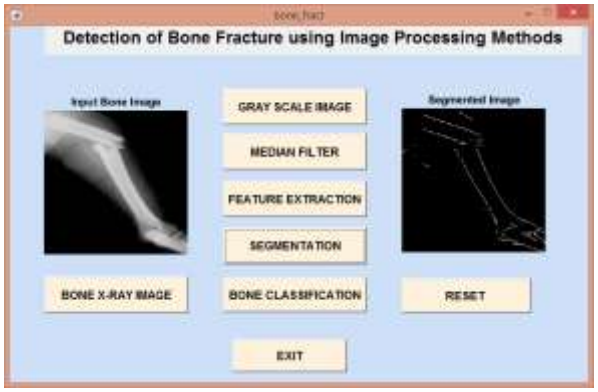

Figure 5: Segmentation of Image.

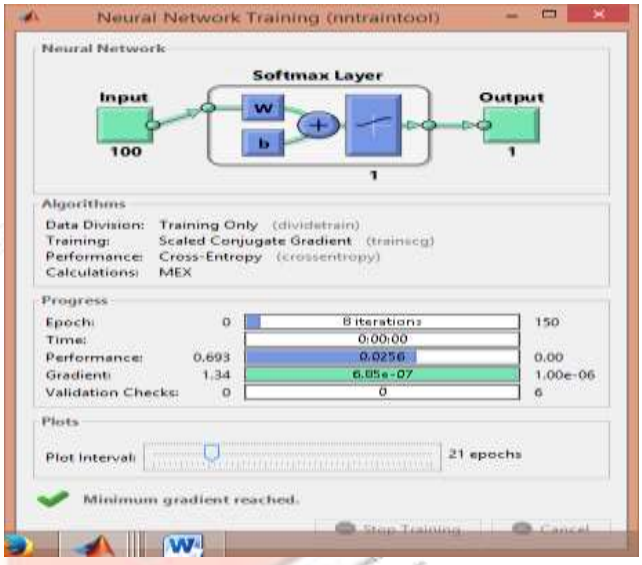

Figure 6: Classification done by neural network

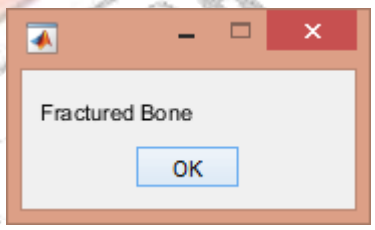

Figure 7: Final output of image.

CONCLUSION

A computer based analysis techniques for the detection of bone fracture using X-ray/CTimages has been presented in this work. It starts from the preprocessing to remove the noise and edge detected by using sobel edge detector. After the segmentation the area of the fracture is calculated. The method has been tested on a set of images and results have been evaluated based on GLCM features. Analysis shown that results obtained are satisfactory and accuracy of this method was 85%.

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