Review of various Fractal Detection Techniques in X-Ray Images

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***Abstract* - This paper represents the various detection and segmentation techniques of X-Ray bone fracture Detection using Edge detection algorithms. Edge detection is applied to find the fracture in a bone in the body (like skull, Hand, and Leg, Wrist, Bar room fracture, Chest, and Spine).Fracture is a medical situation in which there is a separation between two or more pieces of bones. The work of various researchers is discussed, about the fracture present in X-Ray images and their detection techniques.**

***Index Terms* - Edge Detection, Fractured X-Rays Images, Image Segmentation Methods, SVM**

I INTRODUCTION

Digital image processing is a field that can deal with the various digital images through the digital computers and it is widely used to develop the communication between the images, teleconferencing, digital libraries, image database, feature extraction, pattern recognition and other particular applied for the usage. For the implementation of remote sensing images like radar and ultrasound etc., extract as much information as from the images, and the techniques have been developed for the image processing and analysis. The vast collection of digital images is collected by the enhancement of the storage media and the Image capturing devices like web cameras, printers, digital cameras, phones etc. For rapid and efficient retrieval of visual information in the different fields of life such as medical, medicines, art, architecture, education, crime prevention, etc., digital image processing is used. Due to the technological and software advancements, Medical image processing is gaining wide acceptance in the healthcare industry. It plays an important role in disease diagnosis and improved patient care by helping medical practitioners during decision making. Human organs in digital forms are produced by several states of art equipment such as X-Ray, Mammography, MRI, Ultrasound, Endoscopy, and Positron Emission, Tomography, Fluoroscopy and Medical photography and the scan of the bones etc. X-Ray is non-invasive, painless and economical oldest approaches. An X-ray can make the image of the bone in the body like wrist, knee, ankle, and leg etc.

A typical bone disorder may occur when bone cannot suffer outside force and a person, is unable to move that part of a body is called Fracture. A fracture cracks in bones and is defined as the breaking up of a continuous bone. As due to fracture, the patient can suffer from severe pain, dissatisfaction, expensive litigation, so the detection and correction treatment should be done quickly. Detection of fracture can be done by passing X-ray emission through that part of the body with the help of X-Ray machine. Medical imaging has become possible to approach the problem of automated diagnosis image with the advancement of computer processing capabilities. As the fracture cannot be seen to ith naked eyes, a radiologist can experience difficulties in reading and understand the X-ray images due to the presence of noise or lack of proper illumination source. By building the system, one can hope the system to help the radiologist on detecting bones anomalies properly.

II TYPES OF FRACTURE

In the Human body, there are several types of fractures. The fracture may include hip, wrist, ankle, spine, Jaw, ribs etc. Hip is the joint between the upper end and the femur. It can happen to those peoples who are more than 65; it can be caused by falls. In the Younger and children the hip likely to break because of the accident of due to sports injury [15].The different types of fracture may be defined as following [16]:-

1.) Simple Transverse Fracture: - A straight break across a bone. It is a fracture at a right angle to the bone's axis. It has a Horizontal Fracture line.

2.) Simple Oblique Fracture: - Fracture has an angled pattern. A fracture in which the break is at an angle to 30 degrees or to the bone's long axis.

3.) Greenstick Fracture: - It is an incomplete break in a bone. It tends to occur in children whose bones are more flexible than those of adults.

4.) Compound Fracture: - It is also called open fracture, the bone breaks through the skin. There are two types of compound fractures; Fracture opens from within out and fractures open from without in.

5.) Comminuted Fracture: - It is also known as the multi-fragmentary fracture. The bone being broken into several smaller pieces. There are several subtypes like spiral wedge fracture, Bending wedge fracture, complex spiral fracture, complex segmental fracture, complex irregular fracture.

6.) Impacted Fracture: - In this the bones ends are driven into each other. It commonly occurs with arm fractures in children.

7.) Complicated Fracture:-It is a broken bone that has damaged surrounding structures or organs.

8.) Compression Fracture: - also called crush fracture, it happens when cancellous bone is compressed by a force(s) greater than the bone can withstand.
9.) Pathological Fracture:-It is a break in a bone when the bone itself is either abnormal or diseased.

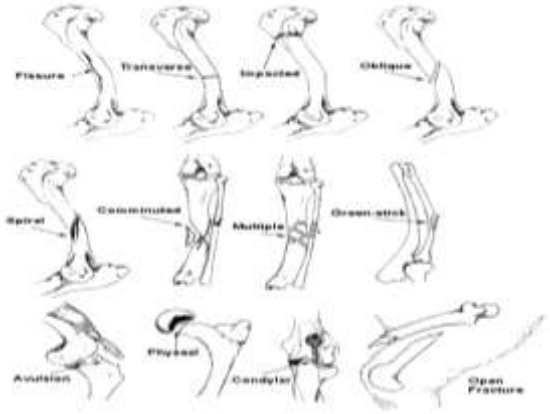

Fig 1:- Types of Fracture [17]

III GENERAL APPROACH TO CLASSIFICATION

The various methods used by the fracture detection system involve the following steps: preprocessing, segmentation, edge detection and fracture detection and classification.
The Preprocessing enhances the X-ray input by removing the noise from the X-ray or other unwanted effects or unwanted noise present in the X-ray by making it more suitable for segmentation. The preprocessing can be done by using the median, wiener, and bilateral filter etc.The wiener filter gives the better results than the other filters. In the segmentation process, the separation of the fractured part is done from the body structure and identification of that part is done. Various methods for segmentation are:

1. Region Growing methods
2. Watershed segmentation
3. Edge Detection Methods
4. Clustering segmentation

Mostly algorithm used for segmentation is the Edge Detection, which separates the boundary of the object from the background. Then, the Fracture Detection which is a tough task verifies that the segmented image is fractured or not fractured. The various edge detections methods that are used in image processing are Canny, Prewitt, Roberts, and Sobel etc.
For the Feature Extraction, the GLCM features (Gray Level Co-occurrence Matrix (GLCM) are used. The GLCM calculate the texture of an image. With the help of GLCM, the several features are extracted. Some of the GLCM features are Autocorrelation, Correlation, Prominence, Cluster Shade, Energy, Entropy, Contrast, Homogeneity, Dissimilarity, Difference Entropy, Sum Average, Sum entropy, Difference Variance etc. For the classification problem Entropy and Energy get the good results. The local binary pattern (LBP) method is widely used for texture feature extraction of images [18].
A classification technique is an organized approach to classification of various models from an input training set and data set and this data set may contain the observations with the measurement of different variables [1]. For example, Decision Tree Classifiers(DT), Genetic Algorithms, Naive Bayes Classifiers, Memory-Based Reasoning, Rule-Based Classifiers, Ensemble classifiers, Neural Networks (NN), and Support Vector Machines (SVM), Nearest Neighbor classifier, etc. Each technique utilizes an algorithm to identify a model that gives the better relationship between the attribute set and class label of the input data and also generated tree over fits the training sets. The model generated by a learning algorithm should both fit the input data and correctly predict the class labels of records it has never seen before [1]. Therefore, a key objective of the learning algorithm is to build models with good generalization capability, i.e., models that accurately predict the class labels of previously unknown records. First, a training set consisting of records whose class labels are known must be provided. The training set is used to build a classification model, which is after applied to the test set, which may consist of records with unknown class labels [1].

IV RELATED WORK

Authors Name	Pre-processing & Segmentation Methods	Edge Detection Method & Smoothing	GLCM Features & Classifier	Feature Extraction	Conclusion/ Gaps/ Future work
S.K.Mahendran et al.[1]	**Preprocessing Methods:-** SACEN (Simultaneous Automatic Contrast adjustment, Edge Enhancement		**GLCM Features** Mean, Variance, Energy, Entropy, Markov Random Field,Homogeneity Gabor Orientation &Intensity	Modified Hough transform with gradient analysis to find fracture	**Conclusion:-** The authors improve the results of accuracy in detecting fractures and also improved the speed of fracture detection.

	&Noise Removal) Wavelet based Anisotropic Diffusion (WEAD)for denoise **Segmentation Methods:-** 1)1-level Haar wavelets, Dilation, Opening and closing 2.)Active Contour based segmentation		Gradient Direction **Classifiers:-** Fusion based combine three classifiers 1.)Back Propagation Neural Networks 2.) Support Vector Machine 3.) Naïve Bayes classifier.		**Future Work:-** In future, the Features like shape are to be considered & its affect on detection rate is to be analyzed. **Gaps:-** The Edge Detection and Smoothing method is not used.
K.Komathy et al.[2]	**Preprocessing Methods:-** Median Filter **Segmentation Methods:-** Using threshold approach	**Edge Detection Method:-** Canny edge detection **Smoothing :-** Probability and cumulative function	**GLCM Features:-** Contrast ,Entropy, Homogeneity & Energy **Classifiers:-** Neural Network	Mean, Median, Variance, Standard deviation	**Conclusion:-**The authors implemented a new scheme to diagnose the presence of rheumatoid arthritis by a series of image processing techniques. The system may be further enhanced by the improvement of the edge detection as well as finding a better segmentation technique.
MAHMOUD AL-AYYOUB et al.[3]	**Preprocessing Methods:-** Remove the Gaussian and salt and pepper noise	**Edge Detection Method:-** Canny gives better results	**Classifiers:-** SVM, Neural Network, Naïve Bayes, Decision Tree	Folds, Precision, Recall, F-Measures and AUC	**Conclusion:-** In this work the SVM classifier was found to be the most accurate with more than 85% accuracy under the 10-fold cross-validation technique. **Gaps: -** The Segmentation and smoothing methods is not used.

Authors Name	**Pre-processing & Segmentation Methods**	**Edge Detection Method & Smoothing**	**GLCM Features & Classifier**	**Feature Extraction**	**Conclusion/ Gaps/ Future work**
R.Vijayakumar ME et al.[4]	**Preprocessing Methods:-** Binary Conversion **Segmentation Methods:-** Thresholding and Region Growing Methods	**Edge Detection Method:-** Sobel filter	**GLCM Features:-** Homogeneity, Angular Second Moment (ASM), Contrast, Entropy, Correlation, Variance, Local Homogeneity, Inverse Difference Moment (IDM), Sum of Squares, Sum Average		**Conclusion:-** The author proposed a method for automated femur bone fracture detection using GLCM computerized techniques. Classify the absence and presence of bone fracture based on the obtained parameter value from GLCM value. **Gaps:-** The Smoothing method is not used and no classifier is used.

N.Umadevi et al.[5]	**Preprocessing Methods:-** Poisson Unbiased Risk Estimate (PURE) Wavelet Shrinkage Method **Segmentation Methods:-** Multi-wavelet transformation is used and then Active Contour Segmentation and region growing algorithm is used			Optimized Hough transform	**Conclusion:-** The experimental results prove that the proposed algorithm has the significant gain in terms of segmentation accuracy and speed. **Future Works:-** This algorithm will be combined with a fracture detection algorithm to detect and locate the region of fracture. **Gaps:-** Smoothing and the Edge Detection Method is not used.
N.Umadevi et al.[6]	**Preprocessing Methods:-** Hybrid Denoising Method (Independent component analysis with wavelets) **Segmentation Methods:-** Active Contour Model, Region Growing algorithm, extract the diaphysis region		**GLCM Features:-** Contrast, Energy, Entropy, Mean, Variance, Correlation, Standard Deviation, Markov Random Field, Gabor Orientation, Homogeneity, Intensity gradient direction **Classifier:-** SVM, K-Nearest Neighbor(KNN), Black Propagation Artificial Neural Network(BPNN)	Fast Hough Transformation, Accuracy, Precision, Recall, F-Measure	**Conclusion:-** The experimental Results shows that the ensemble model that combines BPNN, SVM & KNN with both texture and shape features the significant improvement in terms of accuracy, precision, recall, and F-Measure. **Future Works: -** In future, the Dynamic selection of classifiers and dynamic fusion algorithms are to be considered. **Gaps:-** The Edge Detection and smoothing methods is not used.
Authors Name	**Pre-processing & Segmentation Methods**	**Edge Detection Method & Smoothing**	**GLCM Features & Classifier**	**Feature Extraction**	**Conclusion/ Gaps/ Future work**
P.Santhoshini et al.[7]	**Preprocessing Methods:-** Hough Filter **Segmentation Methods:-** using threshold	**Edge Detection Method:-** Canny edge		BMD,BMC, Area	**Conclusion:-** This paper presents an efficient method to diagnose the osteoporosis by measuring the bone mineral density of segmented femur bone parts and also compare the bone mineral density obtained from the DEXA scan. **Gaps:-** Smoothing methods is not used.
Ismail Hmeidi et al.[8]	**Preprocessing Methods:-**	**Edge Detection Method:-**	**GLCM Features:-**	Wavelets and Curvelets	**Conclusion:-** In this paper, the proposed

	Median Filter	Sobel Edge detector	Entropy, Contrast, Cor-relation, Homogeneity **Classifier:-** Decision Tree, Naïve Bayes, Neural Network, Bagging, Boosting, Meta classifier	Features	system automatically detects fractures in hand bones using x-ray images. The system performed incredibly well with 91.8% accuracy. **Future Works:-** For improvements such as experimenting with the larger dataset and different feature sets. **Gaps:-** The Segmentation method is not used.
LAI KHIN WEE et al.[9]	**Preprocessing Methods:-** Median Filter **Segmentation Methods:-** K-Means based shaft segmentation	**Edge Detection Method:-** Laplacian Edge detector	**GLCM Features:-** Energy, Mean Contrast, Variance, Entropy, Correlation, Homogeneity, Dissimilarity		**Conclusion:-** The author's classify the absence and presence of bone fracture based on the obtained parameter value from GLCM value. The accuracy of the developed algorithm is achieved at least 86.67% which promises an efficient method to recognize bone fracture automatically.
Charles Cockrell et al.[10]	**Preprocessing Methods:-** 2-D Gaussian Filter **Segmentation Methods:-** Registered Active Shape Model	**Edge Detection Method:-** Canny Edge Detection **Other methods:-** 1.) adaptive window creation 2.) 2 D SWT Application 3.) Masking 4.) Boundary Tracing		Accuracy, Specificity, Sensitivity	**Conclusion:-** The results show that the proposed method is capable of detecting fractures in pelvic bones accurately. **Future Work:-** The future works focus on the quantitative measurement of fracture on the basis of a larger dataset, for example, horizontal displacement. **Gaps: -** Smoothing method is not used.

Authors Name	**Pre-processing &Segmentation Methods**	**Edge Detection Method & Smoothing**	**GLCM Features &Classifier**	**Feature Extraction**	**Conclusion/ Gaps/ Future work**
R.Aishwariya et al.[11]	**Preprocessing Methods:-** Using a Novel Edge **Segmentation Methods:-** Active Contour Model and Geodesic Active Contour	**Edge Detection Method:-** Canny Edge Detection **Smoothing :-** Use the Edge map and law Texture before the canny edge detection		Accuracy, Sensitivity, Specificity	**Conclusion:-** The results of detecting the object boundaries in the noisy images show that the proposed technique canny edge detection is better. **Gaps:-** GLCM Features and Classifier is not used.

R.JAYASREE et al.[12]	**Preprocessing Methods:-** Gaussian or Median Filter	**Edge Detection Method:-** Laplacian Edge Detector	**GLCM Features:-** Energy, Contrast **Classifier:-** Fisher's Linear Discriminant analysis	Gabor Feature Extraction,	**Conclusion:-** From this method the author's Classify the absence and presence of bone fracture based on the obtained parameter value from GLCM value. Findings show that the system is able to provide consistent and reproducible result. **Gaps:-** The Segmentation method is not used.
Shoon Lei Win et al.[13]	**Preprocessing Methods:-** Median Filter to denoise and Gaussian filter to sharpen the image **Segmentation Methods:-** Watershed Segmentation	**Edge Detection Method:-** Canny Edge Detection **Smoothing:-** Modified Histogram Clustering	Morphological Operations (Dilation and erosion)	Hue, Value ,Saturation	**Conclusion:-** The proposed tumor detection able to accurately detect & system achieved an error rate of 8%. The preliminary results demonstrate how a simple machine learning classifier with a set of simple image-based features can result in high classification accuracy.
Prafull Sharma et al.[14]	**Segmentation Methods:-** Watershed Segmentation &Otsu's Segmentation	**Edge Detection Method:-** Edge detection Operation Discrete Step Algorithm	Morphological Operations		**Conclusion:-** The discrete step algorithm provides a quick and efficient method to analyze the abnormalities and problems with bone structures. It gives an easy step by step approach to X-Ray image segmentation, which gives better bone segmentation results **Gaps:-** The image cannot be denoising.

V CONCLUSIONS

This paper surveyed various segmentation models that segment the bone structure and fractured region from an x-ray image. The steps used to extract the bone fracture from the x-ray image are Edge detection algorithms, pre-processing, feature extraction and SVM classifier in a serial fashion. Measure the performance of proposed algorithm in terms of metrics such as efficiency and elapsing time. For the future improvement implements another segmentation method to improve the fracture detection and also use another classifier.

VI REFERENCES

[1].Mahendran, S.K. and Baboo, S. S. (2011). "An enhanced tibia fracture detection tool using image processing and classification fusion techniques in X-ray Images". Global Journal of Computer Science and Technology, Vol.11, Issue.14, pp.23-28.

[2].Chokkalingam, SP. and Komathy, K. (2014). "Intelligent Assistive Methods for Diagnosis of Rheumatoid Arthritis Using Histogram Smoothing and Feature Extraction of Bone Images". World Academy of Science, Engineering and Technology International Journal of Computer Information Systems and Control Engineering, Vol. 8, Issue .5, pp.834-843.

[3].AL-Ayyoub, Mahmoud. and AL- Zghool, Duha. (2013). "Determining the Type of Long Bone Fractures in X-Ray Images". WSEAS Transactions on Information Science and Applications, Vol.10, Issue.8, pp. 261-270.

[4]. Vijaykumar, R. and Gireesh,G. (2013). "Quantative Analysis and fracture detection of pelvic bone x-ray images". 4th ICCCNT.

[5]. Umadevi, N. and Geethalakshmi,S.N. (2012). "Enhanced Segmentation Method for Bone Structure and Diaphysis Extraction from X-ray Images". International Journal of Computer Applications, Vol.37, Issue.3, pp.30-36.

[6]. Umadevi, N. and GeethaJakshmi, S.N. (2012). "Multiple Classification System for Fracture Detection in Human Bone X-Ray Images" .12th ICCCNT.
[7]. Santhoshini, P., Tamilselvi, R. and Sivakumar, R. (2013). "Automatic Segmentation of Femur Bone Features and Analysis of Osteoporosis". Lecture Notes on Software Engineering, Vol.1, Issue.2, pp.194-198.
[8].Al-Ayyoub, Mahmoud., Hmeidi,Ismail. and Rababah, Haya. (2013). "Detecting Hand Bone Fractures in X-Ray Images" .Journal of Multimedia Processing and Technologies, Vol.4, Issue.3, pp.155-168.
[9]. YAN CHAI, HUM ., WEE, LAI KHIN., SWEE, TAN TIAN . and HUSSAIN, SHEIKH. (2011). "Gray-Level Co-occurrence Matrix Bone Fracture Detection". WSEAS TRANSACTIONS on SYSTEMS, Vol.10, Issue.1, pp.7-16.
[10]. Wu, Jie., Davuluri, Pavani., R.Ward, Kevin., Cockrell, Charles., Hobson, Rosalyn. and Najarian, Kayvan. (2012). "Fracture Detection in Traumatic Pelvic CT Images". International Journal of Biomedical Imaging, pp.1-10
[11]. Aishwariya, R., Geetha, M.Kalaiselvi and Archana, M. "Computer Aided Fracture Detection of X-ray Images". IOSR Journal of computer Engineering, pp.44-51
[12]. Nivaeditha, Sai., Pavithra, V., Jayasree, R .and Tamilselvi, T. (2014). "Online Diagnosis of X-ray Image Using FLDA Image Processing Algorithm". Proceedings of 5th IRF International Conference, pp.76-80.
[13]. Azhari, Ed-Edily Mohd., Hatta, Muhd. Mudzakkir Mohd., Htike, Zaw Zaw. and Lei Win, Shoon. (2014). "Brain Tumor Detection and Localization in Magnetic Resonance Imaging". International Journal of Information Technology Convergence and Services (IJITCS), Vol.4, Issue.1, pp. 1-11.
[14].Sharma, Prafull. and Singh, Joshua Madhukar. (2013) "A Novel Approach towards X-Ray Bone Image Segmentation using Discrete Step Algorithm", International Journal of Emerging Trends & Technology in Computer Science, Vol.2, Issue.5, pp. 191-195.
[15]. V Edward, Cephas Paul. and S Hepzibah,Hilda.(2015). "A Robust Approach for Detection of the type of Fracture from X-Ray Images", International Journal of Advanced Research in Computer and Communication Engineering, Vol.4, Issue.3, pp.479-482.
[16].http://www.ivyroses.com/HumanBody/Skeletal/Fractures/Types-of-Fractures.php
[17].https://www.google.co.in/imgres?imgurl=https://smediacacheak0.pinimg.com/originals/55/69/0e/55690e6e850f7a53c10772f8a62ae259.jpg&imgrefurl=https://www.pinterest.com/murphyainec/vet/&h=900&w=600&tbnid=Ab3yU9HiCiVgM:&docid=VdjhXspOpJjbUM&itg=1&ei=rSj4VciVDZaTuAT076TgDQ&tbm=isch&ved=0CE0QMygYMBhqFQoTCIigtNWd-ccCFZYJjgod9DcJ3A
[18]http://www.researchgate.net/post/What_is_the_best_method_for_extraction_of_texture_of_an_image_by_using_GLCM_method