**Automatic detection and labelling of**

**long bone fractures**

Guided by

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**Abstract:**

**Automated fracture detection and labelling is an essential part of a computer-aided tele-medicine system. We have proposed a unified technique for the detection and evaluation of fractures in long-bone DICOM image. We first segments the bone region of an input DICOM image and then generates the bone-contour using an adaptive thresholding approach. Next, it performs unsupervised correction of bone-contour discontinuities that might have been generated because of segmentation errors, and finally detects the presence of fracture in the bone. Moreover, the method can also localize the line-of-break for easy visualization of the fracture, identify its orientation, and assess the extent of damage in the bone. Several concepts from digital geometry such as relaxed straightness and concavity index are utilized to correct contour imperfections, and to detect fracture locations and label it.**

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**INTRODUCTION:**

**Bones are the solid organs in the human body protecting many important organs such as brain, heart, lungs and other internal organs. The human body has 206 bones with various shapes, size and structures. The largest bones are the femur bones, and the smallest bones are the auditory ossicles. Bone fracture is a common problem in human beings. Bone fractures can occur due to accident or any other case in which high pressure is applied on the bones. There are different types of bone fracture occurs are oblique, compound, comminuted, spiral, greenstick and transverse. There are different types of medical imaging tools are available to detecting different types of abnormalities such as X-ray, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), ultrasound etc. X-rays and CT are most frequently used in fracture diagnosis because it is the fastest and easiest way for the doctors to study the injuries of bones and joints. Doctors usually uses x-ray images to determine whether a fracture exists, and the location of the fracture.The database is DICOM images. In modern hospitals, medical images are stored in the standard DICOM (Digital Imaging and Communications in Medicine) format which includes text into the images. Any attempt to retrieve and display these images must go through PACS (Picture Archives and Communication System) hardware.**

**Chapter 1**

* 1. **Block Diagram :**

**1.2. Modules :**

1. Bone Region Segmentation from an X-ray Image

2. Contour Generation Using Adaptive Thresholding

3. Contour Correction Using Relaxed Digital Straight

Line segments

4. Fracture detection using concavity index

5. Labelling the detected fractures in the long bone

**1.3. Functioning :**

In the X-ray images of bones, the bone parts appear along with the surrounding tissues and muscles. It is necessary that the bone segment is separated before we go for the detection and labelling of the fractures present in them. So, Bone Region Segmentation is done first to separate the bone segment from the neighbouring tissues and muscles. There are several approaches for producing the segmentation of the bone region. But algorithms

applied to normal images for segmentation like Edge-detection approach or k-means clustering fails for digital X-ray images because of the presence of

flesh-shadow and black background surrounding the bone segment. Using these approaches may result in over-segmentation or under-segmentation which is not

feasible. So, we have adopted Entropy-based approach for bone segmentation, which will give better results compared to the normal methods.

After segmenting the bone region, exact bone contour is drawn for automated fracture detection and labelling.Generating the bone contour will help in setting the Region of Interest to the bone region and it is a crucial step in

making the successive steps of fracture detection to be much simpler. We have adopted Adaptive thresholding approach for generating the bone contour from the earlier segmented bone images.A bone fracture may cause a disconnected or uneven bone contour. Hence, any discontinuity in the contour that appears due to segmentation or contour generation error can mislead the fracture detection process. In order to overcome the error detection, we have adopted an approach for contour correction using relaxed digital straight line segments. This method assumes that any discontinuity in the bone contour will appear as two disconnected RDSS and this feature of RDSS can be used to correct the discontinuity in the generated contour.Fracture detection is done using concavity indices. This is done by analyzing the changes in the concavity indices of the pixels present in the bone contour. This method

assumes that the concavity index of the neighbouring pixels will remain the same over a straight long contour and it changes when the curve turns in any direction and this can used for detecting the fractures.

**Chapter 2**

**2.1. Literature survey :**

**1)Bandyopadhyay, O., Chanda, B., Bhattacharya, B.B.:**

**Entropy-based automatic segmentation of bones in digital X-ray images. In: Kuznetsov, S.O., Mandal, D.P.,Kundu, M.K., Pal, S.K. (eds.) PReMI 2011. LNCS, vol.6744, pp. 122–129. Springer, Heidelberg (2011)**

This paper proposes a new and efficient entropy-based segmentation approach, which instead of direct entropy thresholding, first produces an intermediate

image from the entropy matrix and then uses intensity-thresholding for segmenting the bone region in an X-ray image

**2) Bandyopadhyay, O., Biswas, A., Chanda, B.,Bhattacharya, B.B.: Bone contour tracing in digital X-ray images based on adaptive thresholding. In: Maji,P., Ghosh, A., Murty, M.N., Ghosh, K., Pal, S.K. (eds.)**

**PReMI 2013. LNCS, vol. 8251, pp. 465–473. Springer,**

**Heidelberg (2013)**

The proposed algorithm takes the segmented bone image (entropy-standard-deviation image) as input to adaptive thresholding method to generate the contour of bone part

**3) O. Bandyopadhyay, A. Biswas, B.B. Bhattacharya,**

**Long-bone fracture detection in digital X-ray images**

**based on concavity index, in: Proceedings,**

**International Workshop on Combinatorial Image**

**Analysis, vol. LNCS 8466, 2014, pp. 212–223.**

The paper can trace the bone contour in an X-ray image and can identify the fracture locations by utilizing a novel concept of concavity index of the contour. It further uses a new concept of relaxed digital straight line (RDSS)for restoring the false contour discontinuities that may arise due to segmentation or contouring error.

**4) Donnelley, M., Knowles, G., Hearn, T.: A CAD system for long-bone segmentation and fracture detection. In: Elmoataz, A., Lezoray, O., Nouboud, F.,Mammass, D. (eds.) ICISP 2008 2008. LNCS, vol. 5099, pp. 153–162. Springer, Heidelberg (2008)**

This paper have proposed a CAD system for the long-bone fracture detection which uses scale-space approach for edge detection, parameter approximation

using Hough transform, diathesis segmentation followed by fracture detection using gradient analysis.

**Chapter 3**

**3.1. Algorithms :**

**1. Segmentation using Entropy based approach:**

Local entropy represents the grayscale intensity variation in the neighbourhood of a pixel.

**Steps:**

● Compute the local entropy for each pixel of the input bone image.

● Multiply the value with the local standard deviation for that pixel (which will give the deviation in the local entropy value from the neighbouring pixels).

● Detect the pixels in the transition region of bone and surrounding tissues (pixels in the transition region will have more deviation compared to

other pixels).

● Generate the segmented bone image from the obtained pixels.

**2. Contour generation using adaptive thresholding:**

Adaptive threshold value of a pixel is obtained from the gray level values of four neighbouring pixels.

**Steps:**

**●** Select a pixel that is not visited yet and the intensity values of the neighbouring pixels are obtained.

● From the obtained intensity values, choose the one which is higher than the adaptive threshold value of the present.

● If a pixel is visited for the first time, add it to the visited list and proceed to its neighbouring pixels.

● Repeat the above steps until all

**3.2. IMPLEMENTATION DETAILS**

The application is implemented using MATLAB.

**MATLAB**

MATLAB is used for our project implementation .MATLAB is a multi-paradigm numerical computing environment and programming language.

It allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing

with programs written in other languages, including C, C++,Java, Fortran and

Python.Image Processing Toolbox provides a comprehensive set of reference-standard algorithms and workflow apps for image processing, analysis, visualization, and algorithm development. You can perform image segmentation, image enhancement, noise reduction,geometric transformations, image registration, and 3D image processing.

Image Processing Toolbox apps let you automate common image processing workflows. You can interactively segment image data, compare image registration techniques, and batch-process large data sets.Visualization functions and apps let you explore images, 3D volumes; adjust contrast; create histograms;manipulate regions of interest (ROIs).

**4. CONCLUSION**

Determining whether a radiographic study is normal or abnormal is a critical radiological task: a study interpreted as normal rules out disease and can

eliminate the need for patients to undergo further diagnostic procedures or interventions. The musculoskeletal abnormality detection task is particularly critical as more than 1.7 billion people are affected by musculoskeletal conditions worldwide. These conditions are the most common cause of severe, long-term pain and disability, with 30 million emergency department visits annually and increasing.

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