REPORT

ON

Detecting Hand Bone Fractures in X-Ray Images

Submitted to

NMAM INSTITUTE OF TECHNOLOGY, NITTE

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In partial fulfillment of the requirements for the award of the

Degree of Bachelor of Engineering
in
Computer Science and Engineering

by

SHIBANI BHANDARY	**4NM16CS138**
SHRILATHA	**4NM16CS144**
SHRIVIDYA	**4NM16CS145**
SUNAINA S SHETTY	**4NM16CS155**

Under the guidance of

Mr. Ramesha Shettigar

Asst. Professor
Dept. of CSE, NMAMIT, NITTE

NITTE EDUCATION TRUST | N.M.A.M. INSTITUTE OF TECHNOLOGY
(An Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi)
Nitte – 574 110, Karnataka, India

CERTIFICATE

Certified that the project work entitled **Detecting hand bone fractures in X-ray images** is a bonafide work carried out by Shibani Bhandary (4NM16CS138) , Shrilatha (4NM16CS144) , Shrividya (4NM16CS145) , Sunaina S Shetty (4NM16CS155) in partial fulfillment for the award of Degree of Bachelor of Engineering in Computer Science and Engineering of the Visvesvaraya Technological University, Belagavi during the year 2019-20. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

Name & Signature of Guide **Signature of HOD** **Signature of the Principal**

Mr. Ramesha Shettigar,
Asst. Prof Gd II

External Viva

Name of the Examiners	Signature with Date
1. Ramesha Shettigar	3/10/19
2. Raghurendra K R	K.R. 3/10/19

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Shibani Bhandary (4NM16CS138)

Shrilatha (4NM16CS144)

Shrividya (4NM16CS145)

Sunaina S Shetty (4NM16CS155)

ABSTRACT

Computer aided diagnosis is a hot research field. Systems with the ability to provide a highly accurate diagnosis using little resources are highly desirable. One type of such systems depend on medical images to provide instantaneous diagnosis based on some discriminative features extracted from the images after processing them for noise removal and enhancement. The bone fracture is a common problem in human beings occurs due to high pressure is applied on bone or simple accident and also due to osteoporosis and bone cancer. Therefore the accurate diagnosis of bone fracture is important aspects in medical field. X-ray images are used for bone fracture analysis. The aim is to develop an image processing based efficient system for a quick and accurate classification of bone fractures based on the information gained from the x-ray images. Images of the fractured bone are obtained from hospital and processing techniques like pre-processing, segmentation, edge detection and feature extraction methods are adopted. The processed images will be further classified into fractured and non-fractured bone and compare the accuracy of different methods.

CONTENT

CHAPTER 1

INTRODUCTION

Bones are the solid organs in the human body protecting many vital organs such as brain, heart, lungs etc. The human body contains 206 bones with various shapes and structures. In this project we focus on short and sesamoid bones of the hand. Due to limitations in dataset collection, we focus on two parts of hand bones: metacarpals and phalanges, and ignore carpal bones. Bones can suffer fractures in spite of their rigidity. In this project, we will consider the problem of detecting fractures in hand bones without paying attention to the type of fracture.

X-ray images are among the most common ways to detect problems in bones as well as other organs of the human body. The output image is a shadow-like image. Although CT and MRI images give better quality images for body organs than x-ray images, the latter are faster cheaper, enjoy wider availability and are easier to use with few limitations. Moreover, the level of quality of x-ray images is enough for the purpose of bone fracture detection. The aim is to propose an efficient system for a quick and accurate diagnosis of hand bone fractures based on the information gained from the x-ray images.

CHAPTER 2

LITERATURE SURVEY

For our Literature Survey we have taken four research papers for our study:

- Automatic Fracture Detection in Bone Images by G Narayanaswamy and Bindu A Thomas explains about how to detect fracture automatically in long bones (Tibia bones) images of any modalities and the detection process is carried out in three steps, namely preprocessing, segmentation and bone fracture. Pre-processing is carried to reduce the salt and pepper noise while preserving the edges and sharpness of the image. This type of noise is generally caused by a failure in capture or transmission that is appearing in the image as light and black dots. Segmentation has got two steps, the first step separates the bone structure from the bone image and the second step, identifies the diaphysis region from the segmented bone structure. During Fracture Detection a Hough Transform is used to detect the fracture in a bone image. Followed by the edge detection. The limitation of this method is, in CT and some cases of X-ray images very difficult to find the area of fracture. In future work, it is fully implemented to CT images with multiple fractures in a bone and also classifies the type of fracture in a bone images.

- GLCM based Adaptive Crossed Reconstructed (ACR) k-mean Clustering Hand Bone Segmentation by Hum Yan Chai, Lai Khin Wee, Tan Tian Swee and Sheikh Hussain explains how to segment the bone from the soft tissue area using radiograph in the following steps, namely band division, k means clustering, texture analysis and crossed reconstruction. In band division we first divide the picture into vertical bands and then further divide each band horizontally. In k means clustering, the pixels of each region are k-means clustered with the feature of pixel's intensity followed by performing the GLCM texture analysis. Eventually, the different sections will be reconstructed based on the texture analysis result. By dividing the images into multiple regions and reconstructed again based on texture analysis, the bone can be segmented from soft tissue region more effectively compared to global segmentation. However the result is not optimized due to the reason that there are a lot of parameters that can be altered to obtain better result at the price of computational performance.

- Detection of bone fractures using image processing methods by Anu T C, Mallikarjunaswamy M.S. and Rajesh Raman explains detection of bone fractures using x-ray images. The process is carried out in five steps namely pre-processing, noise removal, edge detection, segmentation and feature extraction. Pre-processing techniques such as RGB to grayscale conversion are applied to remove the noise from the image by using the median filter. This is followed by noise removal. Noise is the unwanted pixels in the image that degrade the quality of the image. Salt and pepper is one of the common noise found in x-ray images. It can be removed by applying mathematical transformation on the images. It preserves the edges while removing noise. Edge Detection reduces the number of pixels and save the structure of the image by determining the boundaries of objects in the image. The edge detector used is sobel edge detector. Segmentation divides the given image into regions homogenous with respect to certain features as colour, intensity etc. After smoothing the image and detecting the edges of the hand bone proceed with extracting useful and discriminating features of the hand bone image thereby detecting the fracture. The main drawback is, in CT and some cases of X-ray images, it is very difficult to find the area of fracture. In future this method can be implemented to CT images and also classify the type of fracture is occurs.
- Combining Classifiers for Bone Fracture Detection in X-Ray Images by Vineta Lai Fun Lum,Wee Kheng Leow,Ying Chen,Tet Sen Howe,Meng Ai Png. This paper presents a study of probabilistic combination methods applied to the detection of bone fractures in x-ray images. Three types of texture features were extracted from each image namely Gabor orientation (GO), Markov Random Field(MRF) and Intensity Gradient Direction(IGD). Due to differences in gender and age, the same bone of different patients can differ in shape and size. To handle such differences, an adaptive sampling method was employed to sample the features. The number of sampling points is inversely proportional to the number of pixels required in a sampling area to accurately extract the features. Gini-SVM was used for classification tests. Suppose we have N classifiers based on different feature vectors. These classifiers can be combined using the rules like Max Rule, Min Rule, Product Rule, Sum Rule and Majority Vote Rule. It can be concluded that the OR rule has the best overall performance of high accuracy and sensitivity.

CHAPTER 3

PROBLEM DEFINITION

Every year, millions of people break bones in their hands. Because we are so dependent on our hands even a small loss of function can result in a lifelong disability. A hand fracture is a break in one of the bones in the hand. This includes this small of the fingers (phalanges) and the long bones within the palm (metacarpals). A broken hand can be caused by a fall, crush injury, twisting injury, or through direct contact in sports. In most cases, a hand fracture will heal well with non-surgical treatment. Depending on the type and location of the fracture, this may include wearing caste, splint or buddy straps for a period of time. For more serious fracture or for fractures that do not line up properly, however, surgery may be required to realign the broken pieces of bones.

X-rays provide images of dense structures such as bone. Your doctor may order one or more x-rays to help identify the location and extent of the fracture. X-ray show phalanx and metacarpal fracture. Although CT and MRI images give better quality images for body organs than x-ray images, the latter are faster cheaper, enjoy wider availability and are easier to use with few limitations. Moreover, the level of quality of x-ray images is enough for the purpose of bone fracture detection.

Quick and accurate diagnosis can be crucial for the success of any prescribed treatment. Depending on human experts alone for such a critical matter have caused intolerable errors. Hence, the idea of automating the diagnosis procedure has always been an appealing one. As with other computer aided diagnosis systems, the motivations for building this system are

1. Reducing human errors (it is well known that the performance of humans experts can drop below acceptable levels if they are distracted, stressed, overworked, emotionally unbalanced etc.)
2. Reducing the time or effort associated with training and hiring physicians.

Eventually, this system can be integrated within the software of the x-ray imaging devices to enable users to produce a quick and highly accurate diagnosis while generating the image.

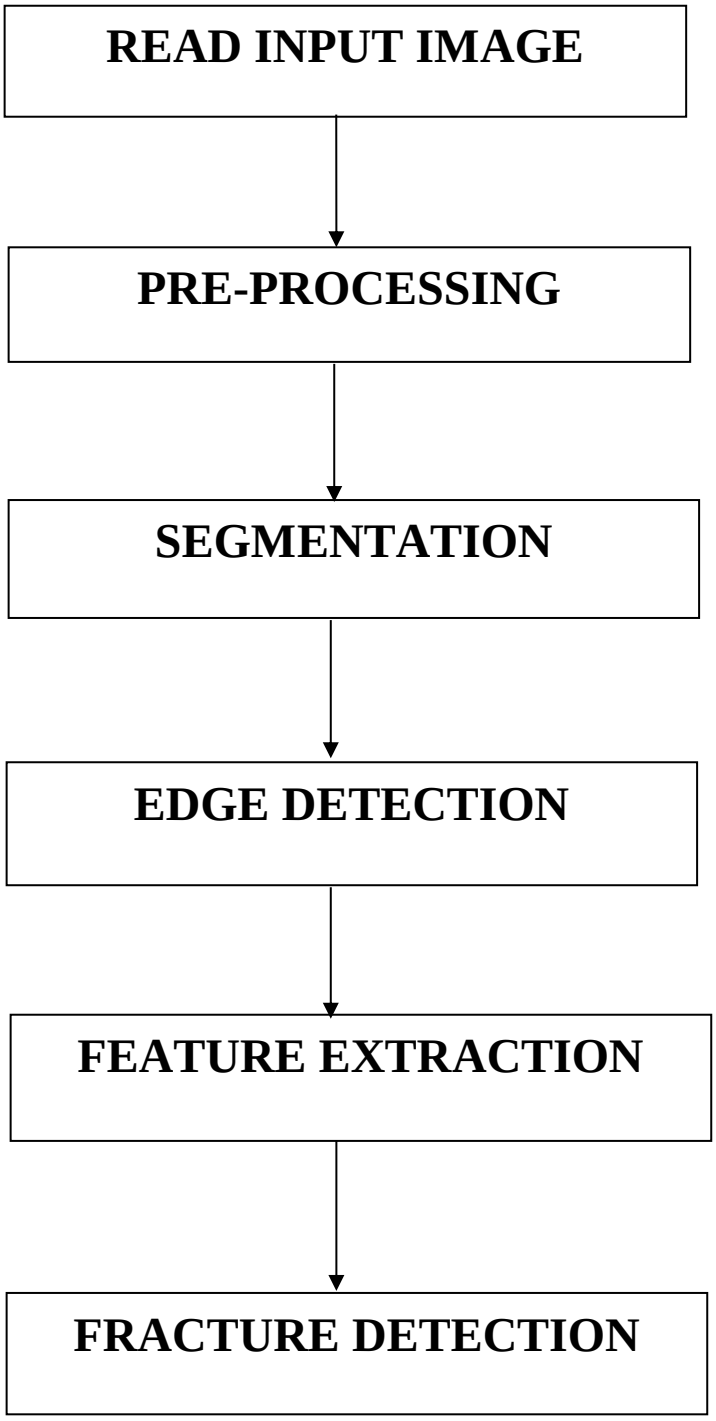
CHAPTER 4

SYSTEM REQUIREMENTS SPECIFICATION

- Operating System: Windows (32 or 64 bit)
    - 8GB RAM Monitor resolution should be minimum 1280*800
- Platform: Python

CHAPTER 5

SYSTEM DESIGN



Read Input Image: X-ray image is input for the process. These X-ray images show the parts of your body in different shades of black and white.

Pre-Processing: Captured images contain various types of noise due to which it is difficult to detect fracture. Salt and pepper noise is one of the noise present in x-ray images which is caused by failure in capture or transmission that is appearing in image as light and black dots. It is removed using Median filter. Median Filter preserves the edge and sharpness of images while removing noise.

Segmentation: After pre-processing the images we segment the bones from soft tissue area. It is the operation of partitioning an image into a collection of connected sets of pixels. It helps to sub divide the image in various portions so that we can study the bone structure for the fracture detection.

Edge Detection: It is the method of identifying points in a digital image at which the image brightness changes sharply or more formally, has discontinuities. It works by detecting discontinuity in brightness. It helps in data extraction.

Feature Extraction: After smoothening the image and detecting the edges of hand bone, the proposed system proceeds with extracting useful and discriminating features of the hand bone image.

Fracture detection: It helps to detect which part of the bone is dislocated. Fracture Detection is done using a classifier. Classification is a step of data analysis to study a set of data and categorize them into a number of categories. Each category has its own characteristics. Based on feature extraction the classifiers classify the given image into fracture and non fractured image.

CHAPTER 6

IMPLEMENTATION

Data collection and labeling:

The dataset is a collection of 52 x-ray images. Out of these 20 images are non-fractured images and rest 32 are fractured images. Labeling is done based on type of fractures.

Noise Removal:

Main function in denoising an image is:

cv2.fastNIMeansDenoisingColored (P1,P2, float P3, float P4, int P5, int P6)

P1- Source Image Array

P2-Destination Image Array

P3-Size in pixels of the template patch that is used to compute weights

P4-Size in pixels of the window that is used to compute a weighted average for the given pixel

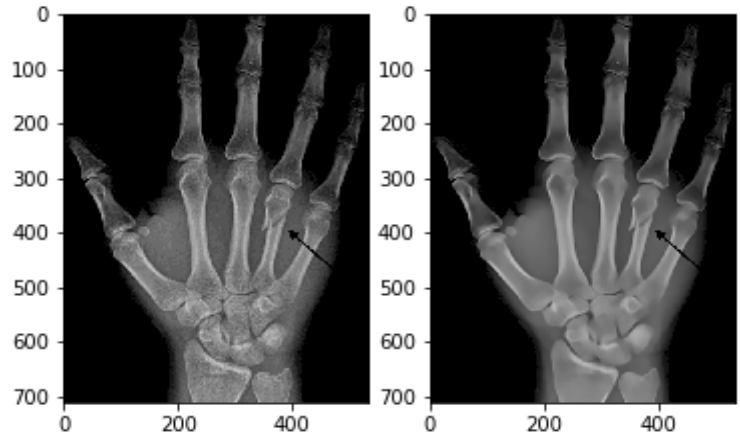
P5-Parameter regulating filter strength for luminance component

P6-Same as above but for colour components

Code:

```
# importing libraries
import numpy as np
import cv2
from matplotlib import pyplot as plt
# Reading image from folder where it is stored
img = cv2.imread('metacarp2.png',0)
imge = cv2.cvtColor(img, cv2.COLOR_GRAY2BGR)
# denoising of image saving it into dst image
dst = cv2.fastNlMeansDenoisingColored(imge, None, 10, 10, 7, 15)
# Plotting of source and destination image
plt.subplot(121), plt.imshow(imge)
plt.subplot(122), plt.imshow(dst)
plt.show()
```

Output: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CHAPTER 7

RESULTS AND DISCUSSION

We have broadly divided the entire system into 4 phases. As of now we've implemented 2 phases out of 4. As the part of first phase dataset collection and labeling is done. In the second phase, noise removal is implemented.

There are different types of noise present in an image. Salt and pepper noise is one of the common type of noise present in x-ray images. This is generally caused by failure in capture or transmission that is appearing in image as light and black dots. This noise is removed using median filter. Median filter removes both salt and pepper noise whereas other filters remove either of them. This preserves the edge while removing noise. The median filter is a non-linear digital filtering technique.

CHAPTER 8

CONCLUSIONS AND FUTURE WORK

This methodology is an effective and efficient way to detect hand bone fractures. Several techniques are tested for image pre-processing phase. We have implemented median filter technique to remove salt and pepper noise occurred while capturing images.

In future work, we aim to continue with next 2 phases which are edge detection and fracture detection. Edge detection can be implemented efficiently using Canny edge detection algorithm. Fracture detection is done using classification.

CHAPTER 9

REFERENCES

[1] Hum Yan Chai, Lai Khin Wee, Tan Tian Swee, Sheikh Hussain, GLCM based Adaptive Crossed Reconstruction k-mean Clustering Hand Bone Segmentation

[2] G Narayanaswamy and Bindu A Thomas, Automatic Fracture Detection in Bone Images

[3]Anu T C, Mallikarjunaswamy M.S., Rajesh Raman, Detection of bone fractures using image processing methods.

[4] Vineta Lai Fun Lum,Wee Kheng Leow,Ying Chen,Tet Sen Howe,Meng Ai Png. Combining Classifiers for Bone Fracture Detection in X-Ray Images