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Long Bone Fracture Detection of X-ray Images

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ABSTRACT: Nowadays the accident rates are increasing progressively or we can say it's increasing day by day. In India every day, we have 415 deaths in accidents, the highest in the world and bone fracture is a common problem because of many reasons. Moreover, we know that bone is unyielding, inflexible and strong part of our human body system. So it is very necessary that, bone fracture is taken in account soberly. In this work, we have proposed automatic system that classifies the bone is fractured or not and also it helps in decreasing task or burden of a surgeon by picking out the simple case. In this paper, we are also going to classify that which type of unhealthy of bone in an input x-ray figure. This can be done in three steps: they are pre-processing, feature extraction and the final step is classification. We are using MATLAB programming software for the implementation with far reaching of image processing mechanism environs.

KEYWORDS: Image sharpening, Neural Network, Pre-processing, Hough transform, Harris corner detection.

I. INTRODUCTION

In present days Image processing in medical sector, gaining a lot of popularity and it is widely accepting in healthcare industries because of its industrial cultivates and freeware discovery. It participate an important act in disorder analysis ameliorates patient care and assist in general practitioners while deciding the type of the treatment should be taken. Manual supervision and traditional structure of X-ray for unhealthy bone detection is monotonous and low progress. Sometimes a tired radiologist may fail to see crack in bone image among healthy ones. In such cases an automated system can help to screen x-ray images for doubtful cases and alarm doctors. For any such critical cases depending on doctors or experts may cause unbearable mistakes. We know that in the world our country is at a high risk of bone fractures. According to the study of survey in the Indian Journal of Medical Research shows that 69% of people aged from 38 to 68 in Delhi bear from continuous bone loss and face high risk of unhealthy bones. Hence we came up with an idea of system detecting bone fracture of x-ray images. We can define fracture in simple words. Fracture is break or disruption in the continuity of bone or we can also say that it is a disruption of the normal architecture of the bone. There are so many types of bone fracture and they are mainly described as: open fracture, closed fracture, partial fracture, complete fracture, stable and displaced and furthermore, these are intern classified into many other types based on fracture pattern.

II. RELATEDWORK

In [1] authors preoperative planning of bone fractures using information from CT scans increases the probability of obtaining satisfactory results, since specialists are provided with additional information before surgery. The reduction of complex bone fractures requires solving a 3D puzzle in order to place each fragment into its correct position. Computer- assisted solutions may aid in this process by identifying the number of fragments and their location, by calculating the fracture zones or even by computing the correct position of each fragment. In [2] author used OpenCV library combined with Canny Edge Detection method to detect the bone fracture. Canny Edge Detection method is an optimal edge detection algorithm on determining the end of a line with changeable threshold

and less error rate. The simulation results have shown how canny edge detection can help determine location of fractures in x-ray images. In [3] deep learning and, in particular, the convolution neural network (CNN), has achieved results comparable to those of humans in bone fracture classification. Adopting a correct generalization, we are reasonably sure that a computer-aided diagnosis (CAD) system, correctly designed to assist doctors, would save a considerable amount of time and would limit the number of wrong diagnoses. In [4] author used Canny method produces perfect information from the bone image. The main aim of this research is to detect human lower leg bone fracture from X-Ray images. The proposed system has three steps, namely, pre-processing, segmentation, and fracture detection. In feature extraction step, this paper uses Hough transform technique for line detection in the image. Feature extraction is the main task of the system. The results from various experiments show that the proposed system is very accurate and efficient. In [5] The research design involves data collection, pre-processing, segmentation, feature extraction, classification and evaluation of the proposed method. The sample dataset were x-ray images collected from the Department of Radiology, National Orthopaedic Hospital, Igbobi-Lagos, Nigeria as well as Open Access Medical Image Repositories. The image pre-processing involves the conversion of images in RGB format to grayscale, sharpening and smoothing using Unsharp Masking Tool. The segmentation of the pre-processed image was carried out by adopting the Entropy method in the first stage and Canny edge method in the second stage while feature extraction was performed using Hough Transformation. Detection and classification of fracture image employed a combination of two algorithms; K-Nearest Neighbour (KNN) and Support Vector Machine (SVM) for detecting fracture locations.

III. PROPOSED ALGORITHM

A. Proposed System Algorithm:
- Selecting input x-ray image.
- Feeding system with x-ray images.
- Applying image processing methods.
- Extracting features from the feeded image.
- Classification based on the features.
- Result: identifying which type of bone fracture.

B. Description of Proposed Algorithm:

Step1. Input X-Ray Image:
          The first step is image acquisition or input x-ray image in image processing in the working system. Hence, system totally hangs on x-ray images to detect lengthy bone fractureIn image insertion step the x-ray images are retrieved from some sort of hardware resources. JPG and PNG format images are used in this system because it is easier to process using image processing methods. However the modern x-ray screening equipments support JPG and DICOM format. So it is not necessary to convert image from one format to another.

Step 2: Preprocessing
To adjust image or resizing image we are using imadjust method. Image enhancing method is applied as pre-process or post-process part. To do this we need to convert the RGB image into grayscale image. The fundamental theory of Unsharp masking (USM) is negative image to create original image, then remove the blurred part of image from the native image itself. As the result in final stage we are adding the subtracted result to the native input x-ray image. And then we will get the processed image by the calculation or equation (1).
          Sharpened = input image $+$ (input image $-$ blurred) $\times$ amount   ....   (1)
          Then Unsharp masking method is applied on the resulted grayscale image to highlight, blurred, enhanced or smooth image patterns or attributes for exhibition and exploration and get the edge intensification in given picture. Flow diagram of pre-processing is as shown below:
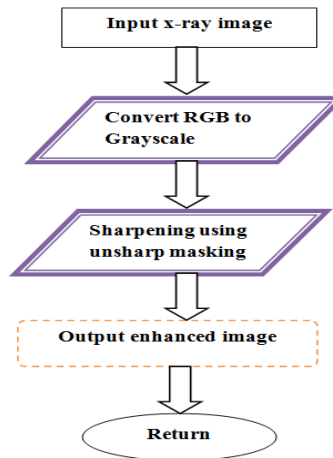
Figure 4: pre-processing flow diagram.

Step 3: Feature extraction:

In feature extraction step we have used sharpened image for extracting the features from the image. Here we are using two algorithms to perform feature extraction step. The algorithms are Hough transform and Harris corner detection. Using the statistical MATLAB commands the other properties are taken out. Those are: Mean, Standard Deviation, Variance, Smoothness and Kurtosis, skewness, inverse difference moment, contrast, homogeneity, correlation, energy and entropy.
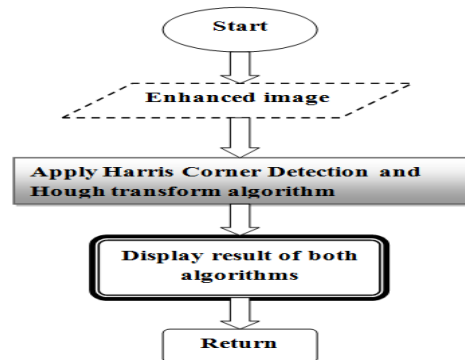
Figure 5: Feature extraction flow chart.

Step 4: Classification

In classification step we are going to train the NN algorithm with extracted features in the previous step. Using these features NN is used to identify the class of the input image. Fractured detection can be divided into two categories: they are classification-based and transform-based. In this work we are using classification- based. Training and testing: as the inputs parameters for training or testing are same but for different purpose, the pre-processing and feature extraction is common to both. For training the type of network with its set parameters such as layers, training function, output function etc, chosen. The weights are obtained by training the NN with the set of training images. In case of testing the network that is built during the training is taken and input features from the test set/case image is

fed and simulated to get the results. In addition to the described steps, the accuracy and performance of the neural networks are calculated for varying input parameters and presented graphically.

The networks types chosen and the commands used are as follows:

- net = patternnet(hiddenLayerSize);

This function generates RBF AWGN network with specified hidden layers for neurons.

- [net,tr] = train(net,inputs,targets);

The training function used to train the network for specific inputs and targets so that the weight matrix is adjusted accordingly.

- net = feedforwardnet(hiddenLayerSize);

This function generates feedforward network with specified hidden layers, (default 10).

Training procedure:

1. We should begin with classes and the labelled datasets.
2. Target variables are labelled properly after the feature sets found.
3. Finding the feature sets for further images one by one.
4. Saving the property sets once we are done with reading every image in the dataset.
5. Select the algorithm that we decided to implement NN type.
6. Final step is to train the classifier NN with the target values of inputx-ray.

Testing procedure:

1. Read the images to be classified.
2. Find the property set or feature set.
3. Take the structure of neural network to be applied to the feature set of case image.
4. The result should be in the same formation as targets.

The output is obtained by simulating the neural network for input features:

Outputs = sim (net, new_inputs);

NN classifier is trained and tested with random set inputs in order to find the accuracy. The flow chart of classification is shown below:
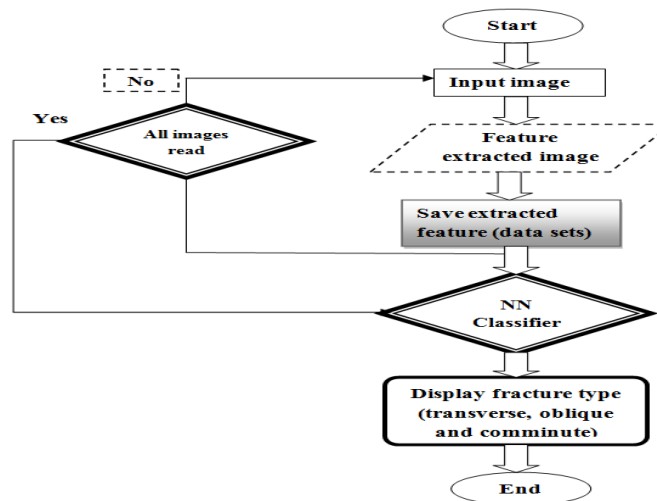

Figure 6: Classification flow chart

IV. **PSEUDO CODE**

Step 1: Image Acquisition.
Step 2: Convert RGB into gray scale image.

img = im2gray(RGB);

Adjust image with specific dimensions.

img = imresize(I,1.25);

Sharpening image

Sharpened = input image + (input image − blurred) × amount

Step 3: Feature Extraction:

Hough transform

rotI = imrotate (I, 0, 'crop');

BW = edge (rotI,'canny');

[H, T, R] = hough (BW)

Figure, Imshow (H, [], 'Xdata', 'T', 'Ydata', R);

lines = houghlines(BW, T, R, P, 'fILLgAP', 15, 'MinLength', 7);

Harris corner detection

Mean = mean2 (G);

Standard _Deviation = std2(G)

Entrophy = entrophy(G)

Step 4: Classification of type of fracture

net = patternnet(hiddenLayerSize);

[net,tr] = train(net,inputs,targets);

net = feedforwardnet(hiddenLayerSize);

V. RESULTS

Figure 7: Input images.
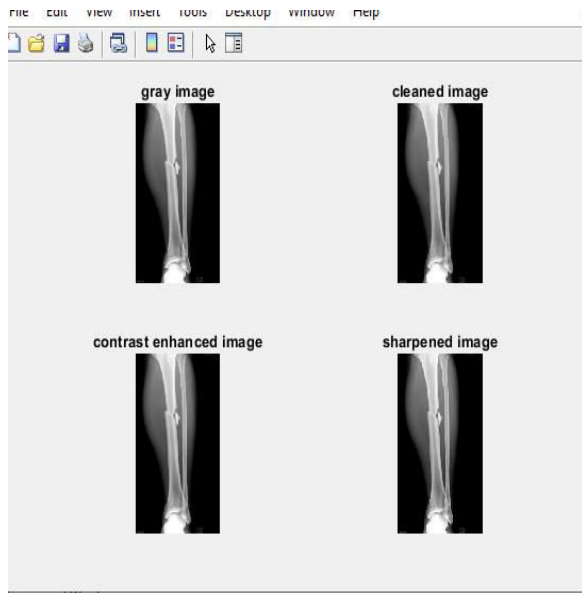
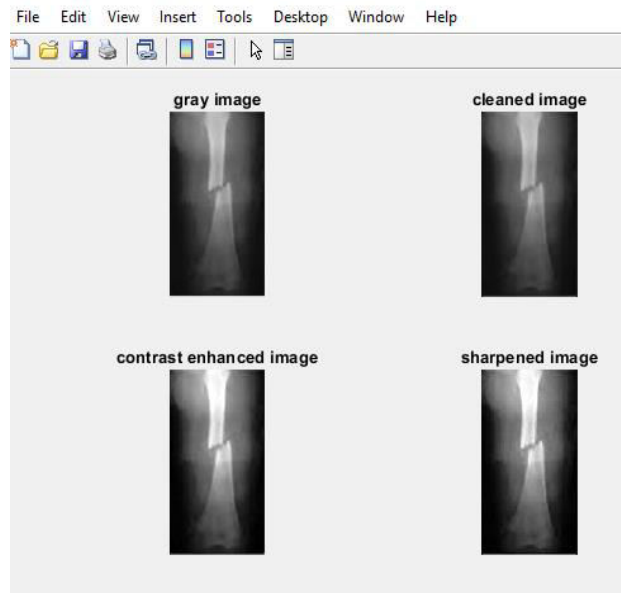Figure 8: Pre-processing of input image(c)
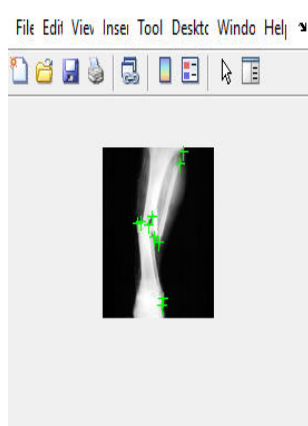

Figure 9: Pre-processing of input image (a)

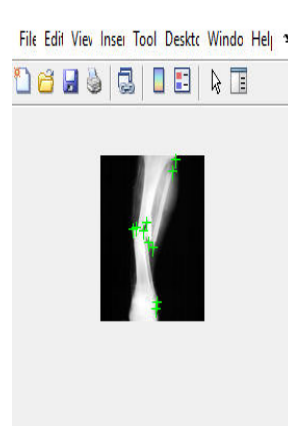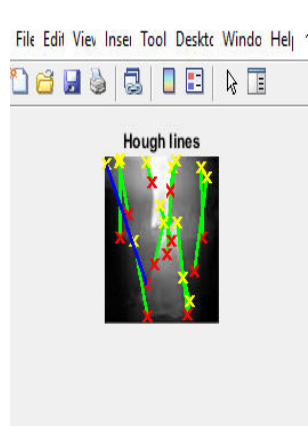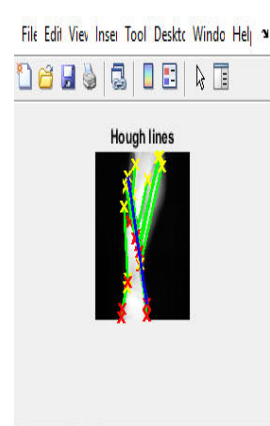

Figure 10: Feature extraction of input image
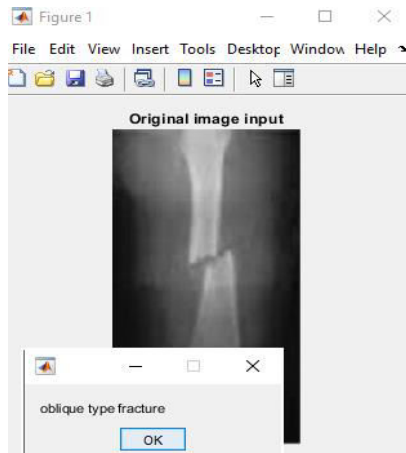

Figure 11: Feature Extraction of input image

Figure 11: oblique fracture

Figure 12: Comminute fracture

Figure 13: Transverse fracture

Confusion Matrix:

N=28	Community	Oblique	Transverse	Normal
Community	11	0	0	0
oblique	0	4	0	2
Transverse	0	0	5	0
Normal	0	0	0	6

N=28	Community	Oblique	Transverse	Normal
Community	10	1	0	0
oblique	0	4	2	0
Transverse	1	2	2	0
Normal	0	0	0	6

	ACCURACY	PRECISION	RECALL
RBF	92.8%	0.90	1
FF	78.5%	0.69	1

VI. CONCLUSION

The fracture detection remains to be the most cumbersome of the jobs as long as person is trying to validate it. Hence in the digital world where the expertise is readily available, one can click an image and confirm for self using the machine learning program. The same could be used in rural localities with bare medical equipments. So that next

process for further confirmation and treatment could be advised. The role of machine learning languages, such as neural networks in this field are as good as an expert who has witnessed those many cases that training database consists of. Opinion of human expertise may differ at times; the outcome of machine is nevertheless reliable. With the same input values, two neural networks are trained. Hence we get different accuracy results. When the network is trained with new input datasets, results would be up to the mark.

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