Bone Fracture Detection Using Deep Convolutional Neural Network

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Abstract : Bone fracture can be detected by the doctors based on their experience. Due to the growth in the artificial Intelligence we are training the system using DCNN to detect the bone fracture in the early stage. In this input MRI Bone images will be given to median filter for pre-processing. Ridge edge detection will be done next to do boundary region detection of the image ROI detection and Hough transform will process for which region of the image looks abnormal. Once it done regions will be tuned with skeleton detection. After this we perform GLCM feature extraction to calculate the feature parameters of the image. This feature values will be given an input to the classification block. Here we using CNN deep learning for the classification and finally fracture image and the area is identified and marked. Using MATLAB we can check the working of the algorithm.

Introduction

The main cause of bone fracture is trauma or stress in the bone, overuse of the bone and diseases that makes the bones weak. There are 10 lakhs and more patients every year in India suffering from bone fracture which may be easily treated or complicated.

There are different types of fractures like closed fracture here the broken bone will not come out of the skin, open fracture here the broken bone will come out of the skin, greenstick fracture which will occur in children a small crack in the bone, hair line fracture normally occur in the foot, complicated fracture which may damage the veins of nerves, comminuted fracture here the bone is split into small pieces, avulsion fracture in the knee or shoulder joints and compression fracture for old people suffering from osteoporosis. By using the machine learning for analysing these problems the output will be accurate. The treatment given at the right time according to the problem analysed at the early stage will save them from future risks. There are different types of machine learning techniques used nowadays in the medical field for early detection of the problems.

Literature survey

1) Title: Bone Fracture Detection Using Deep Supervised Learning from Radiological Images: A Paradigm Shift

Author name: Tanushree Meena, Sudipta Roy

Year : 2022

Work: In this paper it is mentioned that the artificial intelligence (AI) and, deep learning (DL) are receiving attention to help the radiologists in detecting the bone fracture . Deep learning can be widely used in medical image analysis. Also the risks and complications in the DL-based method, and the future of DL in bone imaging is discussed

2) Title: Classification and Detection of Bone Fracture Using Machine Learning

Author name: Swapna, Renuka Malge

Year : 2022

Work: In this paper, an artificial classification system is developed for recognizing and categorizing the bone fractures. Two steps are followed in this method. The images are processed in the first step for detecting the shape and position. In the second step classification is done using back propagation neural network training And finally it was tested on many images and the results are good.

3) Title: Efficient bone fracture Detection and Classification Using Machine Learning Approaches

Author name: Tabassum Nahid Sultana, Asma Parveen

Year: 2022

Work: In this paper leg and hand bone fracture detection and classification is performed using different techniques like k-nearest neighbor (KNN), Support Vector Machine (SVM), Artificial Neural Network (ANN), and Convolutional Neural Network (CNN) classifiers. Here Automatic fracture detection is performed for patients in long distance and thus it helps for early detection and treatment if needed.

4) Title: Bone Fracture Detection and Classification using Deep Learning Approach

Author name: D. P. Yadav, Sandeep Rathor

Year : 2020

Work**:** In this paper the Deep Neural Network (DNN) is used and the classification accuracy is 84.7% for normal bone and 86% for bone with fracture.

5) Title: Artificial Intelligence Application in Bone Fracture Detection

Author name: Ahmed AlGhaithi, Sultan Al Maskari

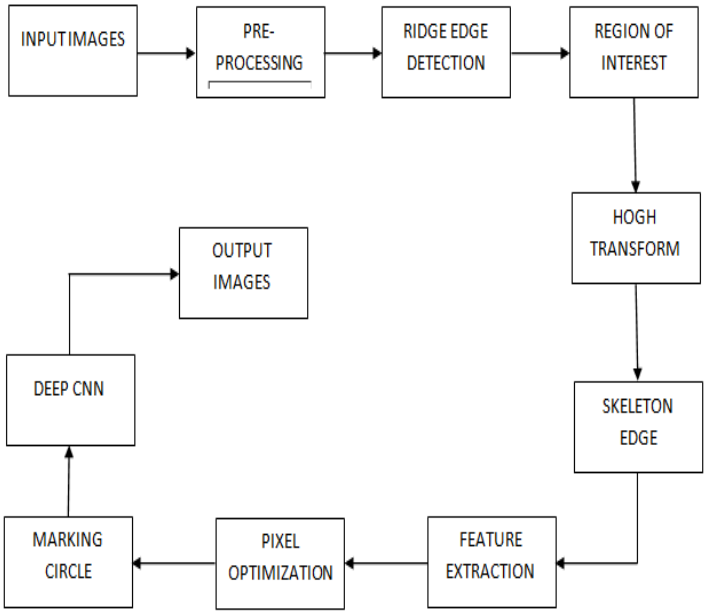
Year: 2021

Work: In this paper AI developments in fracture imaging applications are divided into the types of fracture detection, classification, segmentation, and non interpretive tasks are discussed. Also the challenges are discussed.

System Overview

IMAGE PRE-PROCESSING

It is the first step and it will remove the unwanted signal using filter and also it will enhance some of the needed signal for further processing.



Morphological process will be performed for adding some pixel using dilation process and removing some pixel using erosion process

RIDGE EDGE DETECTION

The ridge edge detection is performed to detect the sharp boundaries of the bone. Using this edge we can detect whether there is a fracture in the bone or it is a normal bone. In our project we are also performing other edge detection methods like sobel edge detection, prewitt edge detection and canny edge detection. All these edge detections are improved with intensity and finally the edge is detected.

HOUGH TRANSFORM

The Hough transform technique is mapped along with the ridge edge detection to detect the exact boundaries of the bone. Even if the image is damaged hough transform will find the exact boundary of the image.

SKELETON EDGE

The hough transform along with the skeleton edge detects the exact location of the fracture by thinning the boundary of the bone. .

PIXEL OPTIMIZATION

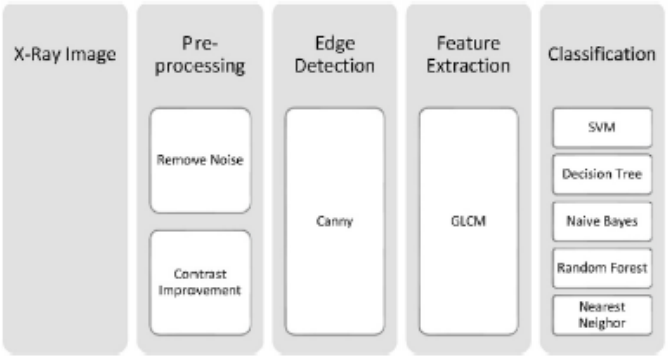
Pixel optimization along with masking circle will detect the fracture by finding the distance between the pixel location. Picture is formed by rows and columns and if the pixel location or spacing is too long then it will put dots and mark it as a fracture as the fracture is not a continuous line. Next step is feature extraction and it will convert the image into parameters like contrast, correlation, energy and homogeneity.

DEEP CNN

The parameter values are compared with the already trained data using Deep Convolutional Neural Network algorithm. After the comparison it will display the output as the fracture is detected or as No fracture is detected. In the deep learning the group of values are compared with the training data. In the matlab for displaying the neural network output Neural network tool box is available and if the datas are given then it will compare with the trained data and it will display the results. The output will be more accurate than the human eye. For building the artificial Intelligence systems, deep learning is a machine learning technique used. It is designed to perform large amount of complex data by sending to the multiple layers of neurons.

Existing System

In the existing system the bone fracture detection is performed in four different stages. In the first step preprocessing is performed to remove the noise. Here a filtering algorithm is used after converting the RGB to gray scale. In the second step edge detection is performed using Canny edge detection to detect the bone boundaries. In the third step feature extraction is performed using Gray Level Co-occurrence Matrix. Properties like contrast, correlation, homogeneity, energy and dissimilarity are noted. In the fourth step Classification is performed using Support Vector Machine and Random Forest and the comparison is performed with different algorithms.



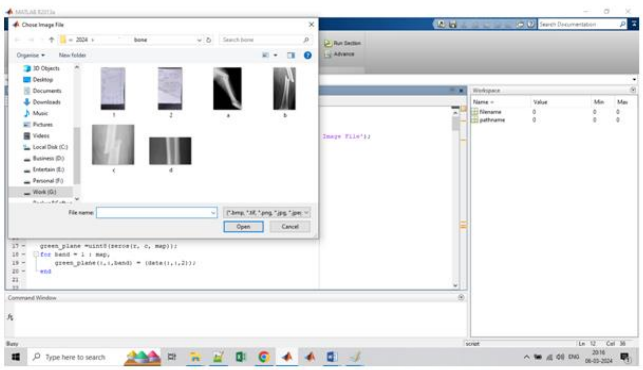
Proposed System

In the proposed system ridge edge detection method is used for detecting the boundaries of the image. The contrast and intensity is improved as it is based on pixel learning. Deep Convolutional Neural Network is used for classification. First the image is split into three planes namely R plane(Red), G plane(Green) and B plane(Blue) and we can process any one of the image. Then the image is performed preprocessing using median filter(filter coffiecients) to remove the noise, Morphological process is performed and then the Ridge Edge detection is used for accurate and exact detection of the bone boundary.

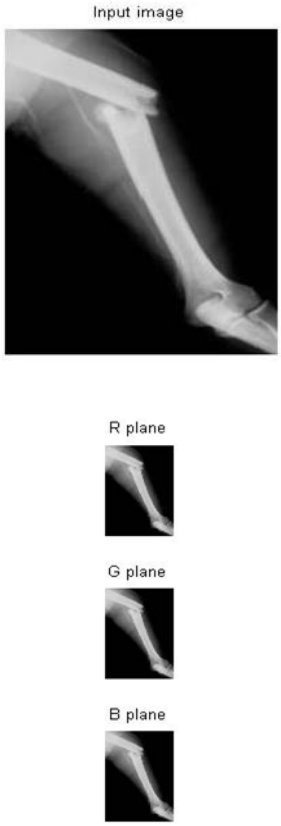
The particular Region of interest where there is abnormality is selected by which the complexity is reduced. The Hough transform is performed to detect the fracture where it will detect shapes like circles and ellipses. It can also able to detect the distorted image by changing the image space into parameter space. In the parameter space shapes can be easily detected. Then the image is given to find the exact location of the fracture using skeleton edge where the optimized output is found. As the image is filtered and undergone some of the process intensity will be reduced for improving the intensity the images in R,G and B plane are intensity enhanced as we can easily detect the fracture. Binarization is performed to improve the edge linearity. If there is no break in the edge then there is no abnormality or fracture is detected. The optimized edge is now calculated.

After this step the pixel optimization and masking circle is combined to update the abnormal area of the fracture by marking the dots where there are abnormal values by drawing a circle. Next step is to extract the features by changing the image into parameters where the numerical data can be obtained as contrast =0.093440, correlation= 0.987539, energy = 0.143128 and homogeneity = 0.957599. Finally the classification is done using Deep Convolution Neural network algorithm, where the current data derived and the previously trained data are compared and the results will be displayed as Fracture is detected or No fracture is detected. Using the Mat lab we can check whether the algorithm is working or any changes to be performed.

Output Results

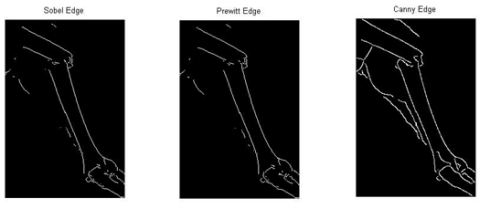


Main Menu

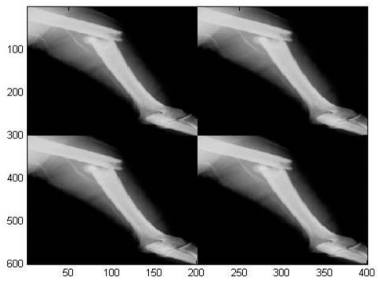


Plane Separation

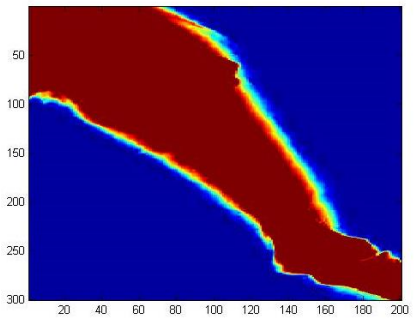
Morphological Analysis



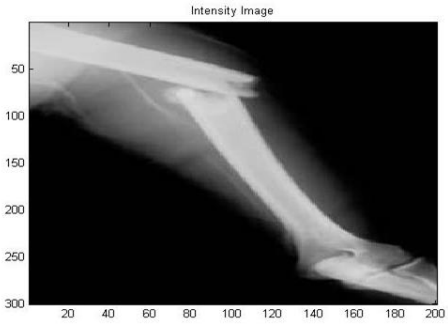
Different Edges



Region Edge Property



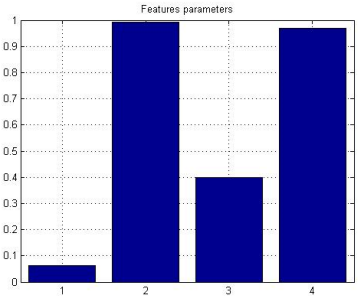
Transmission Property



Intensity Enhanced

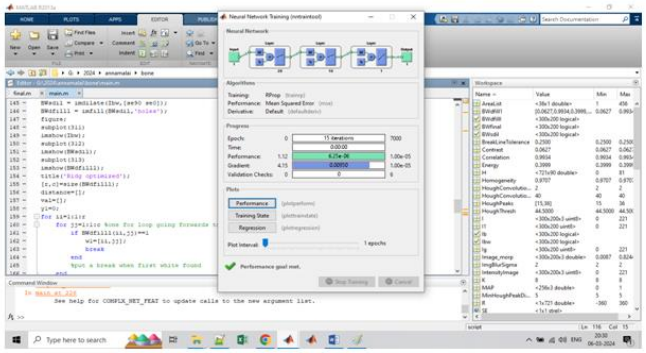
Binarization

Ridge Optimized



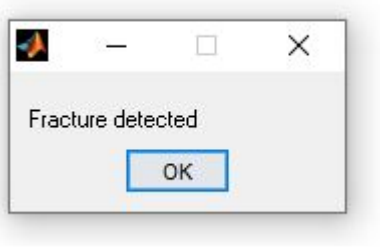
Feature Extraction

Contrast = 0.093440
Correlation = 0.987539
Energy = 0.143128
Homogeneity = 0.957599



Deep Classifier

Fracture Detection



Final Label

Conclusion

In our project we have used DCNN one of the popular machine learning algorithm to detect the bone fracture. We have developed a program in Matlab to verify the working of this algorithm. We can see the output for normal bone and fractured bone. If this program is loaded in a FPGA or DSP then the product can be used in the hospitals. It will be very useful for analyzing the MRI bone images.

References

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