Bone Fracture Detection using CNN and SVM

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***Abstract* - Identification of faults/cracks through computer-based techniques is a growing trend these days. Any highly responsive system can be characterized by two key features: quick detection and being highly accurate, by leveraging modern techniques and by efficient utilization of resources.**

Bone fracture is the result of an excess external force which is beyond the threshold of the bone. Canny Edge detection is an image processing method used to detect the bone fracture through efficient use of automated fracture detection and it overwhelms the noise removal problem. Nowadays there are several methodologies available for edge detection like: Canny, Log, Prewitt, and Robert. However, these techniques are not useful to detect minor details during analysis due to its inability to perform multiresolution analysis. The other key problem of these techniques is that even though they work fine with high resolution and high-quality images they cannot work as well with noisy images because of their inherent lack of ability to differentiate between edges and the noise components.

The method we are proposing overcomes over these problems using CNN algorithm. The results from the simulations we observed that the proposed method is a better option to perform edge detection at aggregate scales. The method proposed has also proved to be robust enough to extract the necessary information and do the processing needed and handle noise better than the currently available edge detectors.

INTRODUCTION

Bone fracture is a common problem even in most developed countries and therefore the number of bone fractures is increasing rapidly. A bone fracture can occur because of any easy accident or pressure. So, quick and accurate diagnoses are often crucial to the success of any prescribed treatment.

In practice, doctors and radiologists rely on X-ray images to work out whether a fracture has occurred or not and therefore the precise nature of the fracture. Manual inspection of X-rays for fracture detection may be a tedious and time-consuming process. A radiologist may not notice a fractured image among healthy ones. The CAD system can be used to help to screen X-ray images for suspicious cases and alarm the doctors. Depending on the radiology experts alone for such a critical matter has been the only option till now, the idea of an automatic diagnosis system has always been an appealing one.

Image processing and machine learning-based studies are getting used in several areas like face recognition, fingerprint recognition, tumor detection, and segmentation. Different Machine Learning algorithms are used for classification tasks in these areas. Some of the commonly used ML algorithms are LDA, SVM, Artificial Neural Networks (ANN), KNearest Neighbor (KNN), and Deep learning algorithms. The selection of input features is very important in any classification task, using ML algorithms.

Problem with existing system

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CNN & SVM

Convolutional neural networks use classification and image recognition in order to detect objects. It is made up of neurons who have learnable weights and biases. Each neuron receives numerous number of inputs and then it takes a weighted sum over them, where it passes it through an activation function and responds back with an output. The primary use of CNNs is to classify images, cluster them by similarities, and then perform object recognition

Support Vector Machine may be a supervised ml algorithm which may be used for both classification or regression challenges. However, it is mostly used in classification problems. In the SVM algorithm, we plot each data item as some extent in n-dimensional space with the worth of every feature being the worth of a specific coordinate. Then, classification is performed by finding the hyper-plane which differentiates the 2 classes.

VGG 16.

VGG 16 is a Convolutional Neural Network proposed in the paper "Very Deep Convolutional Networks for Large-Scale Image Recognition" we have used a pretrained model in comparison to making our own model because of the accuracy it provides we tried creating our own model but didn't have the computational resources required for it.

RESNET50.

ResNet, short for Residual Networks, may be a classic neural network used as a backbone for several computer vision tasks. This model was the winner of the ImageNet challenge in 2015. The fundamental breakthrough with ResNet was it allowed us to coach extremely deep neural networks with 150+layers successfully.

FEATURES OF THE PROJECT

Fracture detection

- The program processes the image and finds if there are any fractures present in the said image.
- The program uses CNN algorithm for the feature extraction which is better than the algorithms we compared to as noisy images can also give highly accurate results using the Convolutional Neural Network.
- SVM classifier- Support Vector Machine Classifier is a linear classifier which performs non linear classification easily with the Kernel trick.
- This project can also print the F1 score which helps us compare different models accuracy.

LITERATURE SURVEY

1] Deshmukh, Snehal., Zalte, Shivani., Vaidya, Shantanu. and Tangade, Parag. (2015), ―Bone Fracture Detection Using Image Processing in Matlab‖, International Journal of Advent Research in Computer and Electronics:

"An efficient algorithm is proposed for bone fracture based on thresholding and fuzzy cmean segmentation and morphological operators. In the base paper [1], the fractured portion is selected manually to overcome this drawback, the proposed method detects the bone fracture automatically. The result shows that the proposed method of fracture detection is better. The results show that algorithm is 89.6% accurate and efficient."

2] Edward V, Cephas Paul. and Hepzibah S, Hilda. (2015), ―A Robust Approach For Detection of the type of Fracture from XRay Images‖, International Journal of Advanced Research in Computer and Communication Engineering,

"The X-ray images that are acquired consist of both fractured and non-fractured images. On these images, first pre-processing techniques such as enhancing the images using filtering techniques such as Lucy Richardson filter, blind deconvolution filter and median filter to remove gaussian noise and salt and pepper noise. In the second step edge detection is performed using Canny Edge detection algorithm. Next, the segmentation is performed on the image by k-means clustering algorithm. Finally, the feature extraction is done for the image using GLCM feature extraction algorithm and classified using Region of Interest (ROI) algorithm"

3] O. Bandyopadhyay, A. Biswas, and B. B. Bhattacharya, "Classification of long-bone fractures based on digital-geometric analysis of X-ray images," Pattern Recognit. Image Anal., vol. 26, no. 4, pp. 742–757, 2016.

"A comprehensive study is imparted here covering fracture diagnosis with the aim to assist investigators in developing models that automatically detect fractures in human bones. The paper is presented in five folds. Firstly, we discuss the data preparation stage. Second, we present various image-processing techniques used for fracture detection. Third, we analyze conventional and deep learning-based techniques for diagnosing bone fractures. Fourth, we make comparative analysis of existing techniques. Fifth, we discuss different issues and challenges faced by researchers while dealing with fracture detection."

4] U. Andayani et al., "Identification tibia and fibula bone fracture location using scanline algorithm," J. Phys. Conf. Ser., vol. 978, p. 012043, 2018.

"The tibia and fibula are two separated-long bones in the lower leg, closely linked at the knee and ankle.

Tibia/fibula fracture often happen when there is too much force applied to the bone that it can withstand. One of the way to identify the location of tibia/fibula fracture is to read X-ray image manually. Visual examination requires more time and allows for errors in identification due to the noise in image. In addition, reading X-ray needs highlighting background to make the objects in X-ray image appear more clearly. Therefore, a method is required to help radiologist to identify the location of tibia/fibula fracture. We propose some image-processing techniques for processing cruris image and Scan line algorithm for the identification of fracture location. The result shows that our proposed method is able to identify it and reach up to 87.5% of accuracy."

5] M. Khan, S. P. S. M. A. Sirdeshmukh, and K. Javed, "Evaluation of bone fracture in animal model using bio-electrical impedance analysis," Perspect. Sci., vol. 8, pp. 567–569, 2016.

"X-ray and CT involve high level of radiation exposer (particularly when multiple examinations are done) which is very harmful especially for children and pregnant women, and it is costly as well. The electrical impedance measurement is a non-invasive and simple quantitative technique for evaluation of bone fracture healing (Hirashima et al., 2009, Yoshida et al., 2010). It has also been used very frequently for measuring physical properties and structure of substance in industries. Furthermore, it has been used for biological systems to measure body fat percentage, blood volume, movements of upper and lower limbs, etc. (Miyatani et al., 2001)."

6] McDonagh, John, and G. Tzimiropoulos, Joint face detection and alignment with a deformable Hough transform model, European Conference on Computer Vision, Springer International Publishing (2016).

"We propose a method for joint face detection and alignment in unconstrained images and videos. Historically, these problems have been addressed disjointly in literature with the overall performance of the whole pipeline having been scantily assessed. We show that a pipeline built by combining state-of-the-art methods for both tasks produces unsatisfactory overall performance. To address this limitation, we propose an approach that addresses both tasks, which we call Deformable Hough Transform Model (DHTM). In particular, we make the following contributions: (a) Rather than scanning the image with discriminatively trained filters, we propose to employ cascaded regression in a sliding window fashion to fit a facial deformable model over the whole image/video. (b) We propose to capitalize on the large basin of attraction of cascaded regression to set up a Hough-Transform voting scheme for detecting faces and filtering out irrelevant background. (c) We report state-of-the-art performance on the most challenging and widely-used data sets for face detection, alignment and tracking."

FLOWCHART

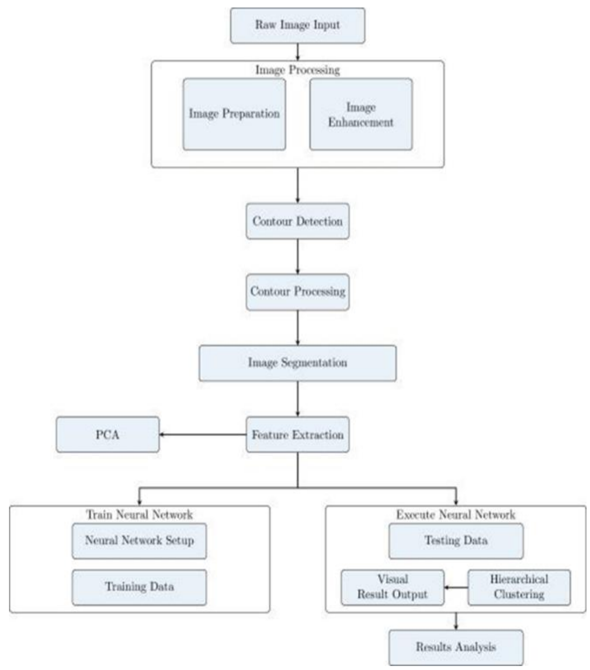


FIG 1.1

This flowchart shows the sequential flow of the steps from the input image to the preprocessing stage which is then followed by contour detection & processing and then feature extraction using CNN and SVM to then train the neural network and execute it.

Block Diagram

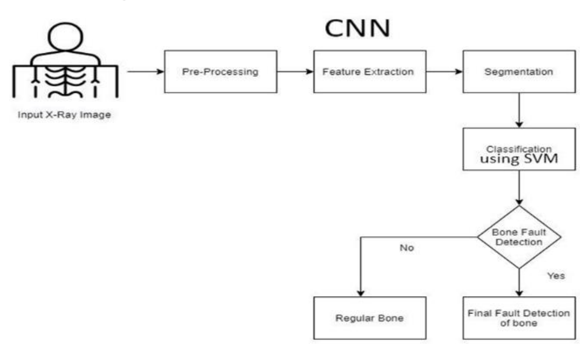


Fig2.1

Diagram shows how data is transferred from the input Xray image which is preprocessed then using CNN features are extracted, segmentation is done and then by using SVM classifier we get the final output.

DATA FLOW DIAGRAM

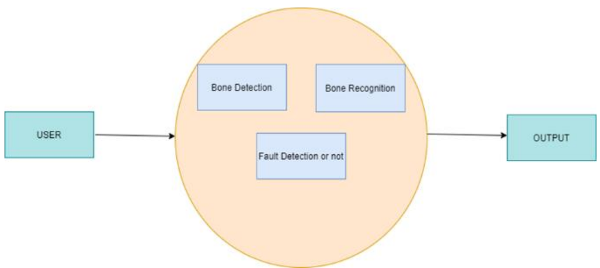


Fig 3.1-Shows input from user and actions performed on it before the output

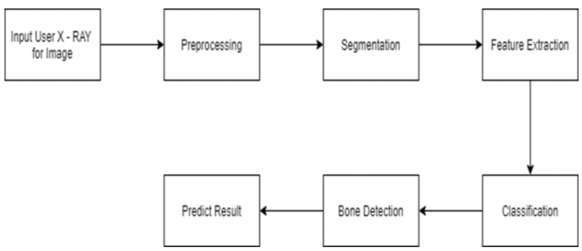


Fig 3.2- Shows the different stages of the program. Feature extraction using CNN and classification using SVM

ARCHITECTURE RESNET50

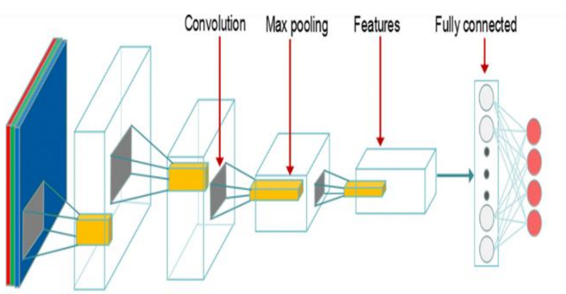
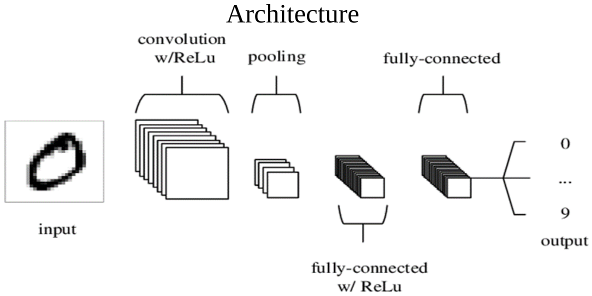


Fig.4.1-3D Representation of the Resnet50 Architecture



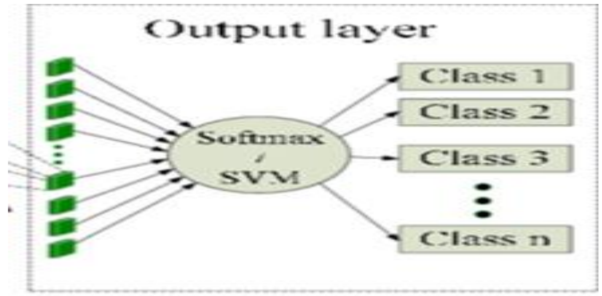


FIG4.2

Testing report with resnet50

	precision	recall	f1-score	support
negative	0.70	0.71	0.70	421
positive	0.70	0.69	0.69	416
accuracy			0.70	837
macro avg	0.70	0.70	0.70	837
weighted avg	0.70	0.70	0.70	837

FIG 4.3-This image shows the f1 score and the precision of the resent 50 with accuracy, macor and weighted average

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[5] U. Andayani et al., "Identification tibia and fibula bone fracture location using scanline algorithm," J. Phys. Conf. Ser., vol. 978, p. 012043, 2018.

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