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Automatic Bone Fracture Detection for Medical Applications

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Abstract: Bone cracks are the serious condition that people face often. In some medical applications, sensitivity in detection medical problems and the accuracy of detection are often in conflict. Detecting bone cracks by computer helps doctor to examine closely and it improves accuracy and timeliness. Hence developed such frame work which detects bone crack by image processing technique. Nowadays image processing techniques are very helpful in analyzing the image for various purposes. In this project we used image of a cracked bone as input to the frame work. This frame work algorithm includes the few steps: pre-processing, Segmentation and ROI search and detection. Features like length and pixel areas of the portions are utilized to recognize break in X-ray beam picture. Calculation has been recreated on different X-beam pictures which demonstrate great outcomes to find crack in picture. Likewise, right now found that canny edge detection works obviously better than some other edge recognition for portioning the cracked part.

Keywords: Edge detection, Image pre-processing, Image segmentation, Hough transform

I. INTRODUCTION

The Digital Image Processing is growing tremendously and becoming an essential part of medical field due to its enhancement in technology and as well as cheaper microprocessor. It plays a key role in manipulation of image, and extracting as much knowledge as possible from the Image with the help of different algorithms. Fracture occurs when a heavy-force expend against a bone is stronger than the bone can structurally withstand. Several hair line & minor fractures may get un-noticed in the X-ray image by the Doctor. In such cases Digital Image Processing helps doctor to determine those errors by providing clear and crystal view of the image to the doctor. So this proposed approach used image processing as a significant tool to detect those minor fractures efficiently.

II. OBJECTIVE

The main objective of this project is to classify the fractured and un-fractured bone for which image processing techniques is used which involve pre-processing, feature extraction and classification. The median and average filter is used to get the noise free image and then Logarithmic operator is used for image Enhancement whose factor is evaluated empirically. In the result snapshot we can see the original image and detected fracture in second image. Few intermediate results, canny edge detection, segmented areas, through huff transform parameter space and recognized peak points in the graph as the fracture took place are to be done.

III. EXISTING METHOD

In existing method, Automatic bone fracture detection has been done using image processing which involves the usage of average and median filter in order to remove noise in images. And after preprocessing image segmentation has been done by using filters like sobel, prewitt filters. In sobel filter, cleared edge detection can be obtained. After using those filters machine learning algorithms have been used like SVM (Support Vector Machine). This algorithm has been used for Classification and regression problems. In this project, the aim is to classify fractured portion of a bone from non-fractured part. So in this a hyperplane will be there across two classifiers. Then calculation of borders near to the hyperplane is detected. The margin is calculated by,

$$\frac{1}{||w'||} + \frac{1}{||w'||} = \frac{2}{||w'||}$$

where w' is a non-linear optimization task solved by Karush-Kuhn-Tucker (KKT) conditions, using Langrange multiples. And finally support vectors are obtained. Instead of machine learning, deep learning approach also has been done. In deep learning there is an approach of CNN (Convolution Neural Networks). It has been more efficient for detection the classification in images. Here to the input we apply Kernel or filter and feature mapping will be done for

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each pixel and corresponding value will be mapped in feature map. The above procedure is repeated until all the pixels are mapped in feature map. After the process of convolution pooling is done to reduce the dimensions and we will obtain less pixels. After pooling and convolution output is enlarged and connected layers are obtained. Later accuracy curves are observed which involves training loss. By using this approach of datasets for machine learning and deep learning algorithms Automatic bone fracture has been detected.

IV. PROPOSED SYSTEM

In proposed work, Automatic bone fracture detection has been done in much effective manner thereby reducing the complexity of code and followed an easier approach by the usage of single application alone. In this three stages of steps has been done .At first, image preprocessing has been done .In preprocessing three techniques has been done namely erosion, dilation and noise removal filter. Erosion has been done mainly for removal of pixels. Dilation has been done for removal of pixels. We have used average and median filter for noise removal. Next is image segmentation. In image segmentation technique, three types of edge detectors are there. View of sobel, prewitt and canny filter has been shown in the output separately. Sobel will be used for detecting only the edges but canny will be more efficient in showing the outline of the fractured bone. So canny edge detector has been done. Third technique which is been used is Hough transform. Hough is mainly used for detecting any of the curves in the outline of the bone fracture obtained by canny edge detector. In hough transform, the aligned points from the output of the Canny edge filter has been aligned as lines. From the equation of line, the lines which has two points has an intersection across the single point. Similarly for so many points, so many lines will go across those points. So each point on the canny edge detector ,the corresponding lines gets matched with the points and forms a portion i.e. the area of bone fracture gets discovered. In the project after the detection of fractured portion it needs to be in styled format by means of red curves showing the fractured part. For that GUI code is required to create dialogue box showing “bone fractured is detected” and if the fracture is not there in the x-ray input image it showing “bone fracture is not detected”.

V.METHODOLOGY

In this work the software we have used is MATLAB using Image processing technique Bones can endure breaks paying little brain to their firm nature. Bone breaks can happen in view of a straight forward fiasco or some other situation wherein a high weight is related on the bones. There are different sorts of bone parts: direct, corner to corner, compound, drove, winding, green-stick. X-beam pictures (or Radiographs) are among the most for the most part saw approaches to manage perceiving issues in bones likewise as different organs of the human body. This image is a shadow-like picture. Dismissing the way that CT and MRI pictures give better quality pictures for body organs than x-shaft pictures, the last are quicker increasingly reasonable, recognize continuously expansive accessibility and are less mentioning to use with couple of restrictions. The process involves image preprocessing, image segmentation, and huff transform.

(A) IMAGE PRE-PROCESSING

This stage is typically significant for upgrading the information and picture information for additional handling in light of the fact that there at time of picture catch there are a few motivations to make picture information tainted. In nearness of a clamor it turns out to be especially hard to remove the right data or prompts the various aftereffects of ensuing stages. the primary methodology for picture upgrade are clamor evacuation, modifying picture brilliance and shading modification.

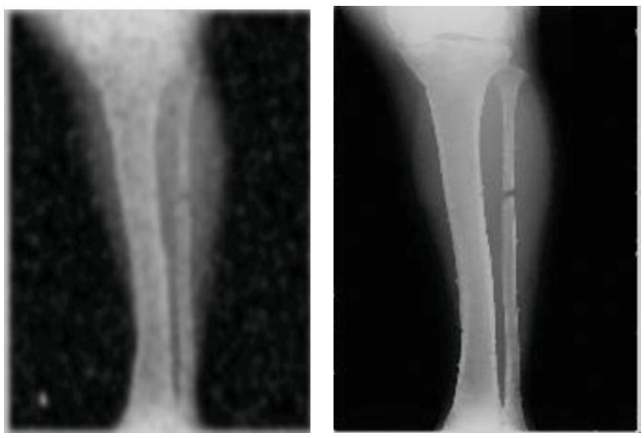

Fig. 1 Original image and pre-processed image

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Clamor can be characterized as undesirable pixel that influences the nature of the picture. There are various sorts of clamor, for example, poison, Gaussian, Salt and pepper, and so on. Gaussian commotion is the most well-known kinds of clamor that can be found in X-beam pictures. This sort of commotion is for the most part brought about by the sensor and hardware of a scanner or advanced camera. Along these lines, the framework decides to utilize Gaussian channel to decrease the commotion while saving the edge and smooth of the picture. The Gaussian smoothing channel is a generally excellent channel for expelling commotion draw from an ordinary circulation.

(B) IMAGE SEGMENTATION

Image segmentation is the crucial advance to investigate picture and concentrate information from them. It is an activity of portioning a picture into an assortment of associated sets of pixels. The principle reason for segmentation process is to get more data in the area of enthusiasm for a picture which helps in comment of the item scene. There are three primary methodologies of image segmentation are area approach, limit approach and edge approach. Right now, edge-based division is utilized which is increasingly appropriate for bone picture. Edge detection is one of the most broadly utilized methodology in applications that require finding features in a picture. An acclaimed shrewd edge identifier is utilized for finding the limits of portions which outflanks than sobel, prewitt and canny edge detector. .

Fig. 2 Edge detection using sobel filter

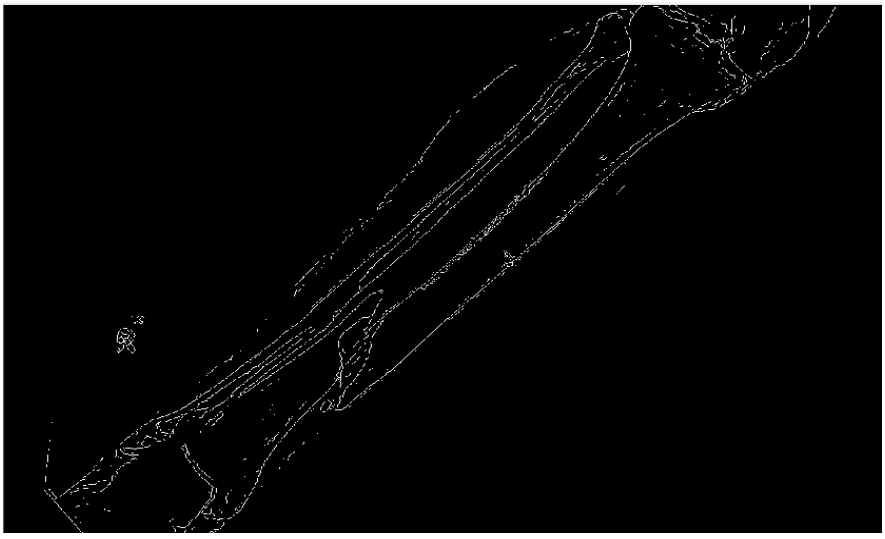

Fig. 3 Edge detection using prewitt filter

Canny edge detector: Canny edge operator is considered to be as superior edge detection operator among the available operators based on the experimental results. It detects faint edges more efficiently even in noisy. In this canny edge detection has been used.

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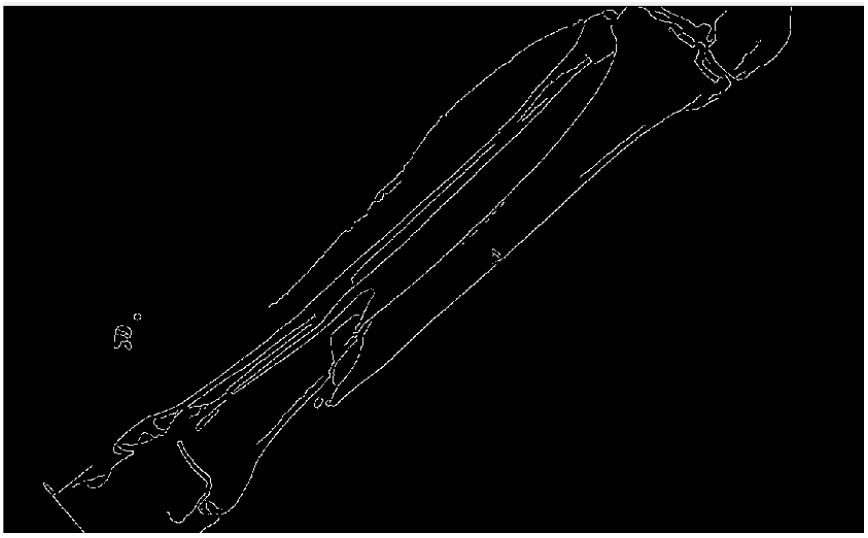

Fig. 4 Edge detection using canny filter

(C) HOUGH TRANSFORM

The Hough transform is a method which can be utilized to highlight a specific shape inside a picture. Since it shows that the ideal features can be indicated in some parametric structure, traditional Hough transform is normally utilized for the location of standard curves, for example, lines, circles, ovals, and so on. A generalized Hough transform can be utilized in applications where the basic simple feature(s) is beyond the realm of imagination. Because of the computational nature of the generalized Hough algorithm, we focus to the traditional Hough transform. Notwithstanding its space limitations, the traditional Hough transform holds numerous applications, as most produced parts include limits which can be depicted by customary curves. The advantage of traditional Hough transform is tolerant of holes in feature boundary descriptions and is generally unaffected by image noise.We can analytically describe a line segment in a number of forms. However, a convenient equation for describing a set of lines uses parametric or normal notion:

$$x\cos\theta + y\sin\theta = r$$

Where r is the length of a normal from the origin to this line and is the orientation of r with respect to the X-axis. For any point (x,y) on this line, r and are constant.

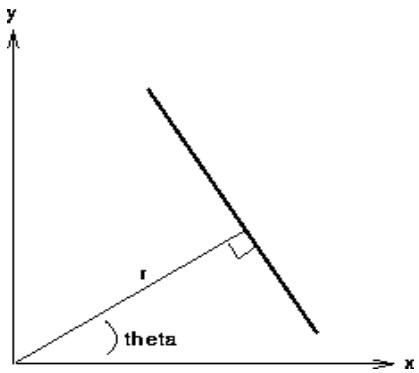

Fig. 5 Parametric description of a straight line

The Hough transform space is now defined in terms of the possible positions of the shape in the image, i.e. the possible ranges of In other words, the transformation is defined by:

$$(x - a)^2 + (y - b)^2 = r^2$$

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VI. RESULT

We have used certain methods to locate the bone fracture exactly. An x-ray image is taken as an input. First the image is converted into a gray image. After getting gray image certain pre-processing is required such as noise removal, image enhancement like image dilation and erosion. The filtered image is given to edge detection using canny filter. Canny filter is helpful in finding the edges more closely to the bone structure. Generally Hough transform is used to detect the straight lines in an image. In the edge detected image we apply Hough transform to detect the straight lines. If the bone gets broken the broken part appears as a curve or bends in an edge detected image instead of a straight line. With this logic behind we look for the curves in the image. The curve is detected by finding the maximum intensity points in an image. The maximum point is marked and its pixel location is also identified. With this we concluded the location of the bone crack in a pixel.The cracked part of the bone is circled by a red marker in the detected output. And the message box shows messages such as 'bone fracture detected' and 'Normal, no bone fracture'.

Fig.6 Output of the non-fractured bone

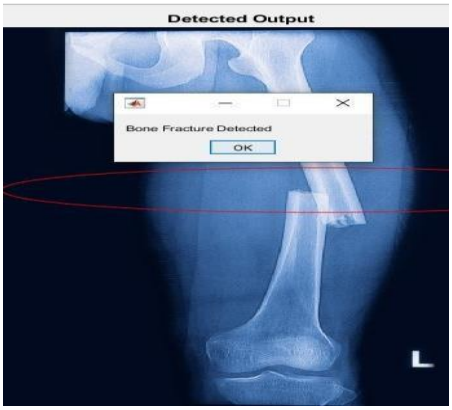

Fig.7 Output of the fractured bone

VII.CONCLUSION AND FUTURE WORK

Algorithm has been implemented using Matlab and its image processing toolbox. The cracks are identified with most accuracy. Experiment done on more images contains both fractured and non- fractured images. The results were accurate for both types of images. This is useful in medical applications that want to consume less time on detecting bone cracks. Automatic bone fracture detection will be very useful in detecting the bone crack part more accurate that will help the doctors to examine closely, identifies the crack is severe or not. In severe cases it serves time consuming to the severeness of the crack earlier. The doctor can examine and start the treatment earlier in case of severe one. It also helps the patients understand the seriousness of necessary treatments for severe cracks.

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