BONE FRACTURE DETECTION USING CNN ALGORITHM

Major Project submitted in partial fulfillment of the requirement for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

Under the esteemed guidance of

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We, SRITAM NANDA, V. VINAY KUMAR and E. ROHITH KUMAR and bearing the Roll No's: and **16R11A0570, 16R11A0594** and **17R11A0507** hereby declare that the project report entitled **"BONE FRACTURE DETECTION USING CNN ALGORITHM"** is done under the guidance of **Dr .G. SOMA SEKHAR**, **Associate Professor (CSE Department)**, Department of Computer Science and Engineering, Geethanjali College of Engineering and Technology, is submitted in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology in Computer Science and Engineering.**

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CONTENTS

ABSTRACT

Diagnosis through computer-based techniques is nowadays is tremendously growing. Highly efficient system that incorporates modern techniques and fewer resources is required to speed up the diagnosis process and also to increase the level of accuracy. Fracture in a bone occurs when the external force exercised upon the bone is more than what the bone can tolerate. Canny Edge detection is an algorithm which is an image processing methodology to detect the bone fracture and it is efficient use of automated fracture detection and overcome the noise removal problem. There are many methods available for edge detection like Sobel, Canny, Log, Prewitt and Robert, these methods have certain drawbacks like, multiresolution analysis cannot be done, so there may be difficulties to detect minor details. Secondly these methods works fine with high quality images, but are not good enough for noisy images as, they cannot distinguish edges and noise components. The proposed method comes over these problems is using CNN algorithm & the results are compared with one of the best classical edge detector. The simulation results shows that the proposed method has been proved an efficient method for performing edge detection at multiple scales, even in the presence of noise also, that can extract information and perform required processing even at much smaller parts of an image and handle noisy images more efficiently as compared to classical edge detectors.

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Bones are the rigid organs in the human body which protects important organs such as the brain, heart, lungs and other internal organs. The anthropoid body has 206 bones with various shapes, size, and artifact. Bone fracture is a very common problem in human beings. Bone fractures can occur due to accident or any other case in which high pressure is applied to the bones. There are different types of bone fracture that can occur namely oblique, compound, comminuted, spiral, green stick, and transverse. Different types of surgical imaging tools are available to detective work various types of abnormalities such as electromagnetic radiation, computed tomography (ct), magnetic resonance imaging (MRI), ultrasound, etc. x-rays and ct are most frequently used in fracture diagnosing because it is the fastest and easiest way for the doctors to study the Maurice of bones and joints. Doctors usually use x-ray images to determine whether an injury exists, and the location of the fracture.

X-ray medical imaging plays a vital role in diagnosis of bone fracture in human body. The X-ray image helps the medical practitioners in decision making and effective management of injuries. In order to improve diagnosis results, the stored digital images are further analyzed using medical image processing. The most common ailment of the human bone is fracture. There are many types of bone fractures such as normal, transverse, comminuted, oblique, spiral, segmented, avulsed, impacted, torus and greenstick. Generally for X-ray image segmentation of bone fractures, a number of edge detection algorithms like sobel, prewitt, Roberts and canny were used. Jaskirat kaur et al. compares image segmentation of X-ray image using various edge detection techniques and found that best segmentation results were obtained using canny edge detection. Subodh kumar et al performed X-ray image segmentation using sobel edge detection method. Satanage et al has applied different edge detection methods on X-ray images and observed that the conventional edge detection methods also provide best segmentation results. Edge detection segments an image by detecting edges among different regions. Thus, edges are characterized by abrupt changes in intensity. Classical methods of edge detection involve convolving the image with an operator, a 2-D filter like Robert, Prewitt, canny. But they all fail to detect edges in noisy images and at multiresolution. Therefore our aim is to propose an edge detection method that perform multistage edge detection and can handle noisy images efficiently. The proposed method is bone fracture detection using CNN algorithm.

The proposed method is a novel method that leverages images edge detection using CNN algorithm. Applying the median filter, it improves the quality of an image. There is no reduction in contrast. We don't need to do to each and every image in dataset. Only for noised images. The median filter is a nonlinear digital filtering technique, often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain Conditions, it preserves edges while removing noise (but see discussion below), also having applications in signal processing.

Using neural networks it will have two different operations and it will check with the database and if it is matched it will go to the further process called segmentation in that it calculates the area of damaged part and it shows the result analysis. It gives the accuracy and sensitivity according to the affected area.

The Graphical user interface developed provides the user with a synergistic environment. The GUI is designed keeping in mind that the end user need not know anything about the coding section. Using GUI, we can perform any calculation, communicate with any other UI components, plot graph, create tables, etc. MATLAB GUI made it easy to process the provided images. The process involved importing the image and converting it into the grayscale image. The user then selects the particular region that is affected and is converted into black and white for detection analysis. Finally the area under analysis is measured and final analysis is provided.

CHAPTER 2

LITERATURE SURVEY

The IOF, WHO suggest that problems of bone can increase as the population grows rapidly in next decades [1]. The manual investigation process of bone x-ray can be automated so that it can help clinicians, orthopedic surgeons, radiologists and assure patient for proper diagnosis.

2.1 Literature review:

Many people suffer from bone fractures worldwide. The international Osteoporosis Foundation [1] reported that, worldwide, woman has 30%-40% lifetime risk of getting osteoporotic fractures while men have a lower risk of 13%. Osteoporosis occurs in a condition when bone losses minerals, such as Calcium and Phosphate [2]. The number of hip fractures could rise from 1.7 million worldwide in 1990 to 6.3 million by 2050.

Image preprocessing is the first step of any system like ours since its only source of information is medical images. Works useful for this step are discussed next. Specifically, the focus here is on removing different types of noise such as Gaussian, salt and pepper, etc. In [34], the authors present a filtering algorithm for Gaussian noise removal. After estimating the amount of noise corruption from the noise corrupted image, the authors replace the center pixel by the mean value of the sum of the surrounding pixels based on a threshold value. Compared to other filtering algorithms such as mean, alpha-trimmed mean, Wiener, K-means, bilateral and trilateral, this algorithm gives lower Mean Absolute Error (MAE) and higher Peak Signal-to-Noise Ratio (PSNR). In [3], the authors propose an extension of the K-fill algorithm to remove salt and pepper noise based on the number of black or white pixels in a 3×3 window. In [12], the authors propose an iterative algorithm based on the Expectation Maximization (EM) approach for noise removal. Assuming that the observations are corrupted by the noise modeled as a sum of two random processes: a Poisson and a Gaussian, this approach allows them to jointly estimate the scale parameter of the Poisson component and the mean and variance of the Gaussian one. Finally, in [38], the authors address the problem of image enhancement and speckle reduction using filtering techniques. Using histogram analysis, they compare different filters: Wiener, average and median filters, and show that the Wiener filter is a better technique for speckle reduction without fully eliminating the image edges.

Standard edge detection techniques such as Canny [5], Sobel and Laplacian represent an obvious first choice for this step. Below, we discuss other relevant techniques. In [33], the authors use the Contour let transform algorithm for edge detection, and compare it against other edge detection algorithms.

In this paper, a novel morphology gradient based image segmentation algorithm is proposed to detect the radius bone fracture edges. The image processing results as depicted in show that bone structure and fracture edges are detected more accurately using proposed image segmentation method compared with other edge detection techniques like sobel, prewitt and canny. Here, the morphological gradient image clearly highlights the sharp gray level transition occurring in the fracture region. Since the canny edge detection method is applied to the morphology gradient image, an appropriate lower and upper threshold value needs to be provided manually. The same algorithm can be extended to other type of bone fracture detection with slight modification.

2.2 Canny survey:

Qian Xu, Srinivas Varadarajan, Chaitali Chakrabarti, Fellow, IEEE, and Lina J. Karam, Fellow, IEEE “A Distributed Canny Edge Detector: Algorithm and FPGA Implementation” The Canny edge detector is one of the most widely used edge detection algorithms due to its superior performance. It is more intensive as compared to other edge detecting algorithms, but it also has a higher latency because it is based on frame-level statistics. In this paper, we propose a mechanism to implement the Canny algorithm at the block level without any loss in edge detection performance compared with the original frame-level Canny algorithm. Directly applying the original Canny algorithm at the block-level leads to excessive edges in smooth regions and to loss of significant edges in high-detailed regions since the original Canny computes the high and low thresholds based on the frame-level statistics. To solve this problem, we present a distributed Canny edge detection algorithm that adaptively computes the edge detection thresholds based on the block type and the local distribution of the gradients in the image block. It is capable of supporting fast edge detection of images and videos with high resolutions, including full-HD since the latency is now a function of the block size instead of the frame size.

2.3 Proposed Method

2.3.1 CNN Algorithm

Convolution neural networks with many layers have recently been shown to achieve excellent results on many high-level tasks such as image classification, object detection and more recently also semantic segmentation. Particularly for semantic segmentation, a two stage procedure is often employed. Hereby, convolution networks are trained to provide good local pixel-wise features for the second step being traditionally a more global graphical model. Alexander G. Schwing and Raquel Urtasun unifies this two-stage process into a single joint training algorithm. They demonstrate their method on the semantic image segmentation task and show encouraging results on the challenging PASCAL VOC 2012 dataset. Anastasios Doulamis, Nikolaos Doulamis, Klimis Ntalianis, and Stefanos Kollias proposed an unsupervised video object (VO) segmentation and tracking algorithm based on an adaptable neural-network architecture. The proposed scheme comprises: 1) a VO tracking module and 2) an initial VO estimation module. Object tracking is handled as a classification problem and implemented through an adaptive network classifier, which provides better results compared to conventional motion-based tracking algorithms.

Network adaptation is accomplished through an efficient and cost effective weight updating algorithm, providing a minimum degradation of the previous network knowledge and taking into account the current content conditions. A retraining set is constructed and used for this purpose based on initial VO estimation results. Two different scenarios are investigated. The first concerns extraction of human entities in video conferencing applications, while the second exploits depth information to identify generic VOs in stereoscopic video sequences. Human face body detection based on Gaussian distributions is accomplished in the first scenario, while segmentation fusion is obtained using color and depth information in the second scenario. A decision mechanism is also incorporated to detect time instances for weight updating. Experimental results and comparisons indicate the good performance of the proposed scheme even in sequences with complicated content (object bending, occlusion).

The international Osteoporosis Foundation reported that, worldwide, woman has a 30% - 40% lifetime risk of getting osteoporotic fractures while men have a lower risk of 13%. The number of hip fractures could rise from 1.7 million worldwide in 1990 to 6.3 million by 2050. The most dramatic increase is expected to occur in Asia during the next decades. World Health Organization confirms that osteoporosis is second only to cardiovascular diseases as a leading health care problem.

Medical Author, Benjamin C Wedro, MD, FAAEM, state that diagnosis of a fracture includes a history and physical examination. X-rays are often taken. Occasionally, CT or MRI is used to find an occult or hidden fracture or provide more information regarding the damage to the bone and adjacent tissues [8], [9], [10]. To find hidden fracture a more accurate visualization is needed so that diagnosis can be done properly. The children fracture is so hard to visualize.

The GLCM for fracture and non-fracture bone is computed and analysis is made. Features of Homogeneity, contrast, energy, correlation are calculated to classify the fractured bone. 30 images of femur fractures have been tested; the result shows that the CAD system can differentiate the x-ray bone into fractured and non-fractured femur. The accuracy of developed algorithm obtained from the system is 86.67% which promises an efficient method to recognize bone fracture automatically. Dennis Wen-Hsiang Yap et al., proposes detection of femur fractures by texture analysis of trabeculae patterns of bone. Gabor filter was used to extract texture patterns. Test results show that it is more accurate than an existing method based on neck-shaft angle. Two classifiers are used to classify the test samples: Bayesian and Support Vector Machine (SVM). 432 femur images were obtained from a hospital, and were divided randomly into 324 training and 108 testing images. The results were Fracture detection rate is 76.9% and classification accuracy is 94.4%. Vineta Lai Fun Lum et al., state that in medical applications, sensitivity in detecting medical problems and accuracy of detection are often in conflict. A single classifier usually cannot achieve both high sensitivity and accuracy at the same time. Methods of combining classifiers have been proposed in the literature. This paper presents a study of probabilistic combination methods applied to the detection of bone fractures in x-ray images. Test results show that the effectiveness of a method in improving both accuracy and sensitivity depends on the nature of the method as well as the proportion of positive samples. 432 consecutive femur images were obtained from a local public hospital, and were divided randomly into 324 training and 108 testing images. The percentage of fractured cases in the training and testing sets were kept approximately the same (12%). In the training set, 39 femurs were fractured, and in the testing set, 12 were fractured. 145 consecutive wrist images were obtained from the same hospital, and divided randomly into 71 training and 74 testing images. The percentage of fractured cases in the training and testing sets were also kept approximately the same (30%). In the training set, radius bones were fractured in the testing set.

CHAPTER 3

SOFTWARE REQUIREMENT

3.1 Matlab:

It is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include:

- Math and computation Algorithm.
- Development Modeling, simulation, and prototyping.
- Data analysis, exploration, and visualization.
- Scientific and engineering graphics.
- Application development, including graphical user interface building.

MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar no interactive language such as C or FORTRAN.

MATLAB has evolved over a period of years with input from many users. In university environments, it is the standard instructional tool for introductory and advanced courses in mathematics, engineering, and science. In industry, MATLAB is the tool of choice for high-productivity research, development, and analysis.

MATLAB features a family of application-specific solutions called toolboxes. Very important to most users of MATLAB, toolboxes allow you to learn and apply specialized technology. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others.

MATLAB provides a large number of standard elementary mathematical functions, including abs, sqrt, exp, and sin. Taking the square root or logarithm of a negative number is not an error; the appropriate complex result is produced automatically. MATLAB also provides many more advanced mathematical functions, including Bessel and gamma functions.

MATLAB apps are self-contained MATLAB programs with GUI front ends that automate a task or calculation. The GUI typically contains controls such as menus, toolbars, buttons, and sliders.

Many MATLAB products, such as Curve Fitting Toolbox, Signal Processing Toolbox and Control System Toolbox include apps with custom user interfaces.

3.2 GUI (Graphical user interface):

A graphical user interface (GUI) is a user interface built with graphical objects, such as buttons, text fields, sliders, and menus. In general, these objects already have meanings to most computer users. For example, when you move a slider, a value changes; when you press an OK button, your settings are applied and the dialog box is dismissed. Of course, to leverage this built-in familiarity, you must be consistent in how you use the various GUI-building components.

Applications that provide GUIs are generally easier to learn and use since the person using the application does not need to know what commands are available or how they work. The action that results from a particular user action can be made clear by the design of the interface.

The sections that follow describe how to create GUIs with MATLAB. This includes laying out the components, programming them to do specific things in response to user actions, and saving and launching the GUI; in other words, the mechanics of creating GUIs. This documentation does not attempt to cover the "art" of good user interface design, which is an entire field unto itself. Topics covered in this section include:

Creating GUIs with GUIDE

MATLAB implements GUIs as figure windows containing various styles of uicontrol objects. You must program each object to perform the intended action when activated by the user of the GUI. In addition, you must be able to save and launch your GUI. All of these tasks are simplified by GUIDE, MATLAB's graphical user interface development environment.

GUI Development Environment

The process of implementing a GUI involves two basic tasks:

- Laying out the GUI components.
- Programming the GUI components

GUIDE primarily is a set of layout tools. However, GUIDE also generates an M-file that contains code to handle the initialization and launching of the GUI. This M-file provides a framework for the implementation of the callbacks - the functions that execute when users activate components in the GUI.

The Implementation of a GUI

While it is possible to write an M-file that contains all the commands to lay out a GUI, it is easier to use GUIDE to lay out the components interactively and to generate two files that save and launch the GUI:

A FIG-file - contains a complete description of the GUI figure and all of its children (uicontrols and axes), as well as the values of all object properties.

An M-file - contains the functions that launch and control the GUI and the callbacks, which are defined as sub functions. This M-file is referred to as the application M-file in this documentation. Note that the application M-file does not contain the code that lays out the uicontrols; this information is saved in the FIG-file.

The following diagram fig3.1 illustrates the parts of a GUI implementation.

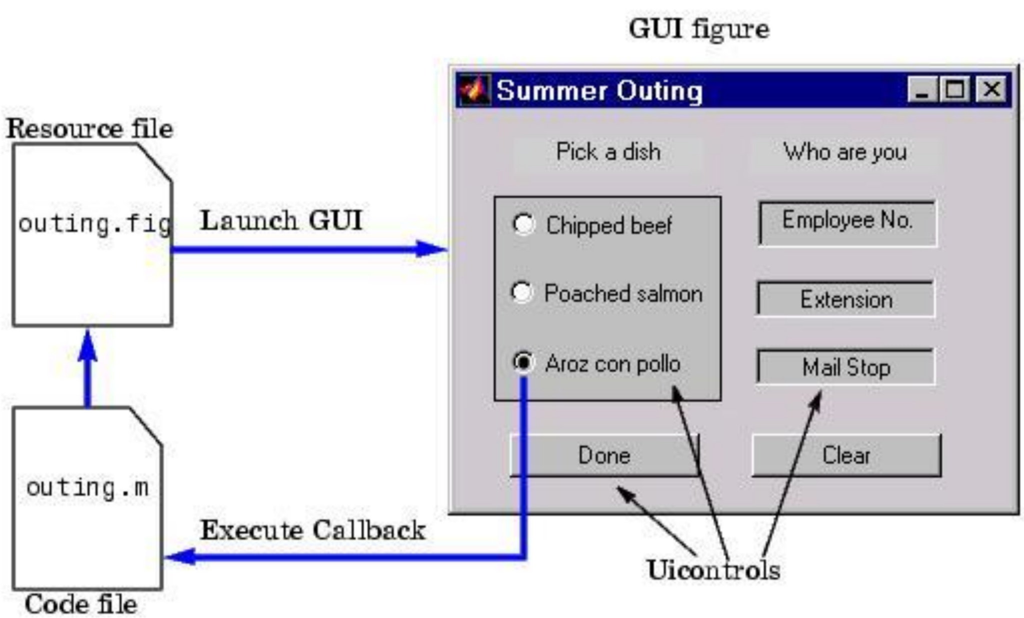


FIG 3.1 GUI Implementation

CHAPTER 4

INTRODUCTION TO DIGITAL IMAGE PROCESSING

4.1 Image Processing

Image processing was first used in the early 1920s in a paper industry where images were coded for a submarine cable transfer & reconstructed by a telegraph printer at the receiving point. In the mid to late 1920s, there had been improvements in the system. In 1964, image processing was used to improve the images of the moon taken by the Ranger 7 space probe. Such techniques were used in the other space missions as well. In the 1970s, image processing began to be used in the fields of medical science. In 1979, Allan M. Cormack and Godfrey N. Hounsfield jointly received The Nobel Prize for the invention of computer assisted tomography. Nowadays digital image processing is getting more and more attention because of the focus on two principal areas:

- Improvements in the image information for human interpretation
- Processing of image for autonomous perception

Visual representation of any two or three dimensional scene is called an image. To be precise, image is an array or a matrix where pixels (image elements) are arranged in a columns and rows. It can be considered as a two dimensional function $f(x, y)$ where x, y are two spatial coordinates that represents the intensity or the gray level of the image at that point. Where there is image, image processing is involved. Image processing is one of the most widely used & rapidly growing technologies. It is the process of analyzing and manipulating a digitized image for quality enhancement or to extract any information from it. Image processing basically follows these steps:

- Importing image via image acquisition tools
- Analyzing and manipulation of image
- Output can be an image or report based on image analysis

Two types of methods are used for image processing named: Analogue and Digital Image processing. Analogue image processing can be used for hard copies like printouts and photographs since analogue are required for human viewing. Digital image processing involves manipulation of images in digitized way using a computer or other devices. There are three phases images go through for digital image processing:

- Low-level image processing.
- Mid-level image processing.
- High-level image processing.

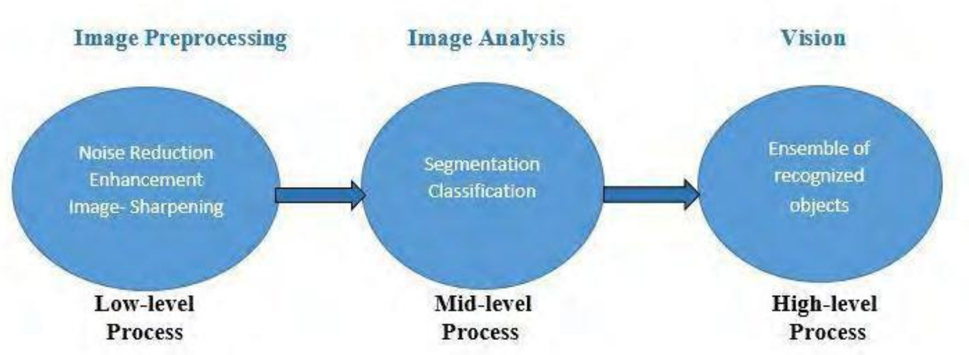


Fig. 4.1 Phases of Digital Image Processing

4.2 Biomedical Image Processing

Over the last few decades biomedical image processing has been advanced dramatically. Biomedical images are the core of where medical science is at. It refers to the images of human body which helps in better understanding of human biological systems. It can refer to microscopic images of cell, blood vessels or can be images of complete organs, organ systems and body parts. Technological advancement in this field has been providing doctors with the tools that are needed for the most accurate diagnosis & treatment. Biomedical imaging mainly consists of X-Rays, Contrast Agents, Ultrasound, CT, and MRI etc.

X-Rays:

It all began with the discovery of X-rays by Wilhelm Roentgen in 1895.Although diagnosis with this technology was difficult due the similarity between the densities of adjacent soft tissues within the body. It was an interesting diagnosis technique for bones or any foreign objects in the body but was not correct method for the soft tissue pathologies.

Contrast Agents:

Between 1906 and 1912, application of pharmaceutical contrast agents which helped to visualize organs and blood vessels was a vast development in radiography. Administration of harmless contrast agents orally or via vascular injection allowed the visualization of blood vessels, digestive and gastrointestinal systems, bile ducts and gall bladder for the very first time. By 1960's, this technique was responsible for new radiological application: angiography which is used for visualizing inside or lumen of a blood vessel both arteries and veins.

Ultrasound:

In the 1960's, the principles of Sonar (developed extensively during the Second World War) were applied to diagnostic imaging. Ultrasound is a type of sound that is above human hearing range. Ultrasound scanner transmits high frequency sound waves that penetrate into the body, bounce off the organs, and then the return sound wave vibrates transducer which turns it into electronic pulses that transforms the pulses into images. The ultrasound technology was first clinically used inthe1970s.

Computed Tomography (CT) :

Godfrey Hounsfield and Allan Cormack were awarded Nobel Prize in Medicine for inventing computed tomography (CT) in 1972. CT scan refers to the computer processed X-rays (taken from different angles) which can produce tomographic images of specific areas of a scanned object. It provides better insight of body without cutting it.

Magnetic Resonance Imaging (MRI):

Magnetic Resonance Imaging was first used in 1970's and continued evolving throughout the years. Over 1980's it has become common in medical imaging. MR imaging is based on the well-known NMR phenomenon.

CHAPTER 5

METHODOLOGY

Methodology is the type of algorithm that being used to develop a system. The proposed methodology is the analysis for image features extract using steps.

1. Apply preprocessing techniques (remove noises).
2. Apply dwt algorithm to find the edges.
3. Use NN Network for classification algorithm and their parameter to classify the image.
4. Extract the features using Fuzzy clustering for fracture detection and structural analysis
5. Output is the result.

5.1 Block Diagram:

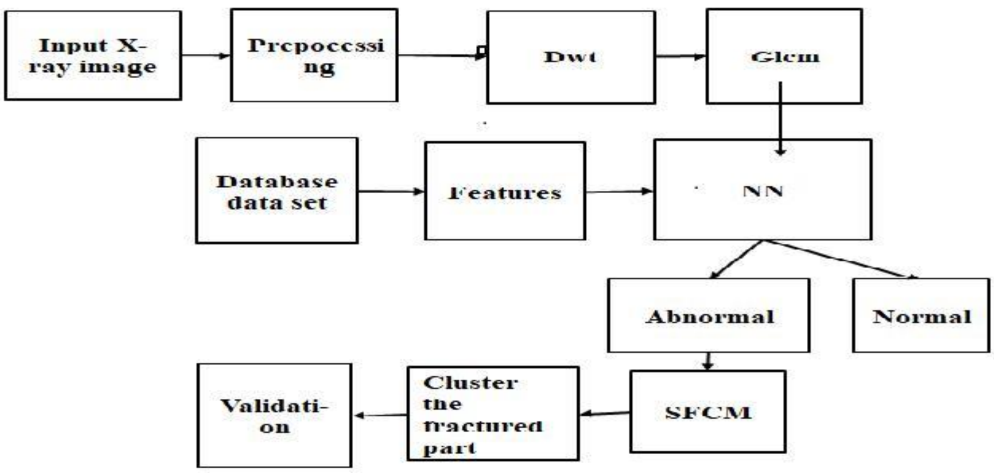


Fig 5.1–Bone Fracture Detection System

The bone fracture system consists of five main processing modules fig 5.1, which are the preprocessing module, Dwt module, NN module, clustering, bone classification module. The first processing module of the system will prompt the user to select an X-ray image. Subsequently, the x-ray is done with some preprocessing stage in order to remove the noise from the image. The applied to a DWT algorithm which divides into 4 channels in each channel is able to detect the edges. Extraction of features of an X-ray image.

In the classification phase, after the DWT process applied to a NN module which compares with database images and gives the two different stages they are normal and abnormal. If the bone is affected then it shows the abnormal phase and undergoes into segmentation process otherwise it shows not affected.

If the bone is fractured it under goes into SFCM clustering. From those four clusters select one image which gives the affected area. And shows the result whether the bone is fractured or not.

5.2 PREPROCESSING

5.2.1 Data Acquisition:

The imread function supports four general syntaxes. The imread function also supports several other format-specific syntaxes.

A = imread(filename,fmt)

The above instruction reads a grayscale or color image from the file specified by the string filename, where the string format specifies the format of the file. If the file is not in the current directory or in a directory in the MATLAB path, specify the full pathname of the location on your system. For a list of all the possible values for font, see Supported Formats. The imread instruction returns the image data in the array A. If the file contains a grayscale image, A is a two-dimensional (M-by-N) array. If the file contains a color image, A is a three-dimensional (M-by-N-by-3) array. The class of the returned array depends on the data type used by the file format. See Class Support for more information. For most file formats, the color image data returned uses the RGB color space.

[X,map] = imread(filename,fmt)

The above instruction reads the indexed image in filename into X and its associated color map into map. The color map values are rescaled to the range [0,1].

5.2.2 RGB to Gray

The RGB to Gray converts the true color image RGB to the grayscale intensity image. In photography, computing, and colorimetric, a **grayscale** or **grayscale** image is one in which the value of each pixel is a single sample representing only an amount of light, that is, it carries only intensity information. Images of this sort, also known as black-and-white or monochrome, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest.

Grayscale images are distinct from one-bit bi-tonal black-and-white images, which in the context of computer imaging are images with only two colors, black and white (also called bi-level or binary images). Grayscale images have many shades of gray in between. Grayscale images can be the result of measuring the intensity of light at each pixel according to a particular weighted combination of frequencies (or wavelengths), and in such cases they are monochromatic proper when only a single frequency (in practice, a narrow band of frequencies) is captured. The frequencies can in principle be from anywhere in the electromagnetic spectrum (e.g. infrared, visible light, ultraviolet, etc.).

A colorimetric (or more specifically photometric) grayscale image is an image that has a defined grayscale color space, which maps the stored numeric sample values to the achromatic channel of a standard color space, which itself is based on measured properties of human vision.

If the original color image has no defined color space, or if the grayscale image is not intended to have the same human-perceived achromatic intensity as the color image, then there is no unique mapping from such a color image to a grayscale image.

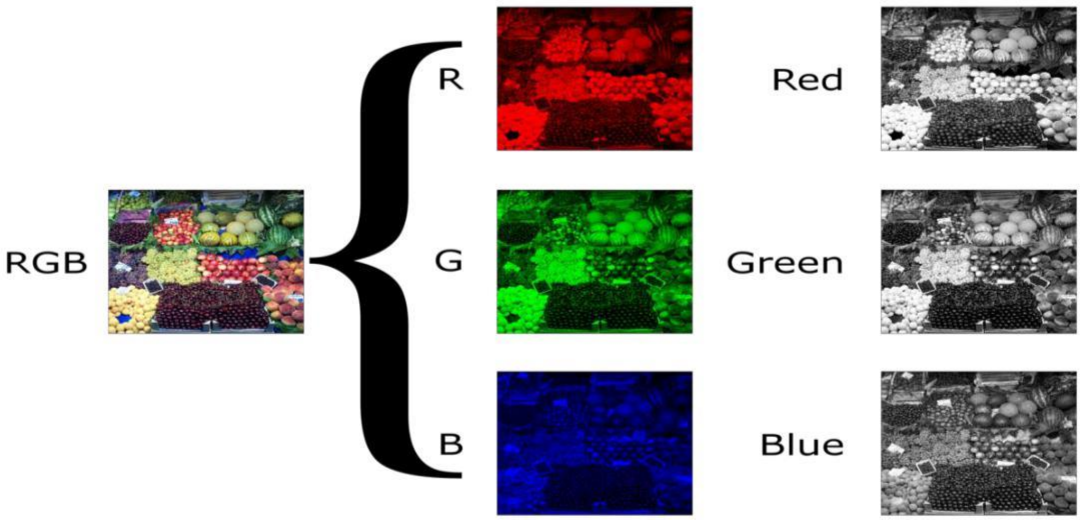


Fig 5.2 - RGB to Gray Images

5.2.3 Median filter

Applying the median filter it improves the quality of an image. There is no reduction in contrast. We don't need to do to each and every image in dataset. Only for noised images. The median filter is a nonlinear digital filtering technique, often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise (but see discussion below), also having applications in signal processing shown in fig 5.3.

Fig 5.3 Median Filter

5.3 DWT Algorithm

In numerical analysis and functional analysis, a discrete wavelet transform (DWT) is any wavelet transform for which the wavelets are discretely sampled. As with other wavelet transforms, a key advantage it has over Fourier transforms is temporal resolution: it captures both frequency and location information (location in time).

Discrete wavelet transform algorithm

There are several types of implementation of the DWT algorithm. The oldest and most known one is the Malaat (pyramidal) algorithm. In this algorithm two filters - smoothing and non-smoothing one are constructed from the wavelet coefficients and those filters are recurrently used to obtain data for all the scales. If the total number of data D=2^N is used and signal length is L, first D/2 data at scale L/2^(N-1) are computed, than (D/2)/2 data at scale L/2^(N-2), ... etc up to finally obtaining 2 data at scale L/2. The result of this algorithm is an array of the same length as the input one, where the data are usually sorted from the largest scales to the smallest ones.

Similarly, the inverse DWT can reconstruct the original signal from the wavelet spectrum. Note that the wavelet that is used as a base for decomposition cannot be changed if we want to reconstruct the original signal, e. g. by using Haar wavelet we obtain a wavelet spectrum; it can be used for signal reconstruction using the same (Haar) wavelet.

WORKFLOW

STEP 1

The discrete wavelet transform (DWT) is an implementation of the wavelet transform using a discrete set of the wavelet scales and translations obeying some defined rules.

STEP 2

In other words, this transform decomposes the signal into mutually orthogonal set of wavelets, which is the main difference from the continuous wavelet transform (CWT), or its implementation for the discrete time series sometimes called discrete-time continuous wavelet transform (DT-CWT).In other words, this transform decomposes the signal into mutually orthogonal set of wavelets, which is the main difference from the continuous wavelet transform (CWT), or its implementation for the discrete time series sometimes called discrete-time continuous wavelet transform (DT-CWT).

STEP 3

The wavelet can be constructed from a scaling function which describes its scaling properties. The restriction that the scaling functions must be orthogonal to its discrete translations implies some mathematical conditions on them which are mentioned everywhere e. g. the dilation equation

$$\phi(x) = \sum_{k=-\infty}^{\infty} a_k \phi(Sx - k).$$

STEP 4

where S is a scaling factor (usually chosen as 2). Moreover, the area between the function must be normalized and scaling function must be orthogonal to its integer translates

STEP 5

After introducing some more conditions (as the restrictions above soes not produce unique solution) we can obtain results of all this equations, e. g. finite set of coefficients a_k which define the scaling function and also the wavelet. The wavelet is obtained from the scaling function as

$$\psi(x) = \sum_{k=-\infty}^{\infty} (-1)^k a_{N-1-k} \psi(2x - k)$$

STEP 6

Where N is an even integer. The set of wavelets than forms an orthonormal basis which we use to decompose signal. Note that usually only few of the coefficients a_k are nonzero which simplifies the calculations.

5.4 GLCM Feature:

Entropy:-Hence, for each texture feature, we obtain a co-occurrence matrix. These co-occurrence matrices represent the spatial distribution and the dependence of the grey levels within a local area. Each ***(i,j)*** th entry in the matrices, represents the probability of going from one pixel with a grey level of '***i***' to another with a grey level of '***j***' under a predefined distance and angle. From these matrices, sets of statistical measures are computed, called feature vectors.

Energy: It is a gray-scale image texture measure of homogeneity changing, reflecting the distribution of image gray-scale uniformity of weight and texture..

E=∑∑p(x, y) ^2 P(x, y) is the GLCM

Contrast: Contrast is the main diagonal near the moment of inertia, which measure the value of the matrix is distributed and images of local changes in number, reflecting the image clarity and texture of shadow depth.

I=∑∑(x-y)^2 p(x,y)

Entropy: It measures image texture randomness, when the space co-occurrence matrix for all values is equal, it achieved the minimum value.

S=∑∑p(x, y) log p (x, y)

Correlation Coefficient: Measures the joint probability occurrence of the specified pixel pairs.

C=∑∑((x- μx)(y-μy)p(x , y)/$\sigma_x\sigma_y$))

Homogeneity: Measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.

H = ∑∑ (p(x , y)/(1 + [x-y])))

5.5 FEATURE EXTRACTION

The acquired data is first subjected to a pre processing step. Besides filtering for noise removal, this step also processes the signal for achieving invariance to selected inspection parameters. For instance, in the case of inspection data acquired at different inspection frequencies the signals are first transformed to an equivalent signal at a reference value of the inspection frequency parameter. Similarly, the overall classification performance of the system can be rendered invariant to other selected parameters. In the second step, discriminatory features in the signal are extracted. Feature extraction serves to reduce the length of the data vector by eliminating redundancy in the signal and compressing the relevant information into a feature vector of significantly lower dimension. The Discrete Wavelet Transform (DWT) is particularly effective at extracting features at multiple resolution levels in ultrasonic signals which are inherently non-stationary in nature. A second set of features based on Principal Component Analysis (PCA) also calculates the statistical properties of a set of neighboring A-scans. The rationale underlying this approach is that the irregular nature of the IGSCC causes the variance of signals in the crack region to be vastly different from the variance of reflections obtained from a counter bore region. The PCA exploits this information to discriminate between cracks and counter bores.

5.6 NEURAL NETWORK

In machine learning and related fields, artificial neural networks (ANNs) are computational models inspired by biological neural networks (the central nervous systems of animals, in particular the brain) and are used to estimate or approximate functions that can depend on a large number of inputs and are generally unknown. Artificial neural networks are generally presented as systems of interconnected "neurons" which can compute values from inputs, and are capable of machine learning as well as pattern recognition thanks to their adaptive nature.

For example, a neural network for handwriting recognition is defined by a set of input neurons which may be activated by the pixels of an input image. After being weighted and transformed by a function (determined by the network's designer), the activations of these neurons are then passed on to other neurons. This process is repeated until finally, an output neuron is activated. This determines which character was read. Like other machine learning methods - systems that learn from data - neural networks have been used to solve a wide variety of tasks that are hard to solve using ordinary rule-based programming, including computer vision and speech recognition.Which is shown in below figure 5.4.

Neural networks are a kind of black box where data is entered and the network “figures out” the necessary juxtapositions required drawing a reasonably accurate conclusion; the operations are organized into a multilayered feed forward network with four layers:

- Input layer
- Hidden layer
- Pattern layer/Summation layer
- Output layer

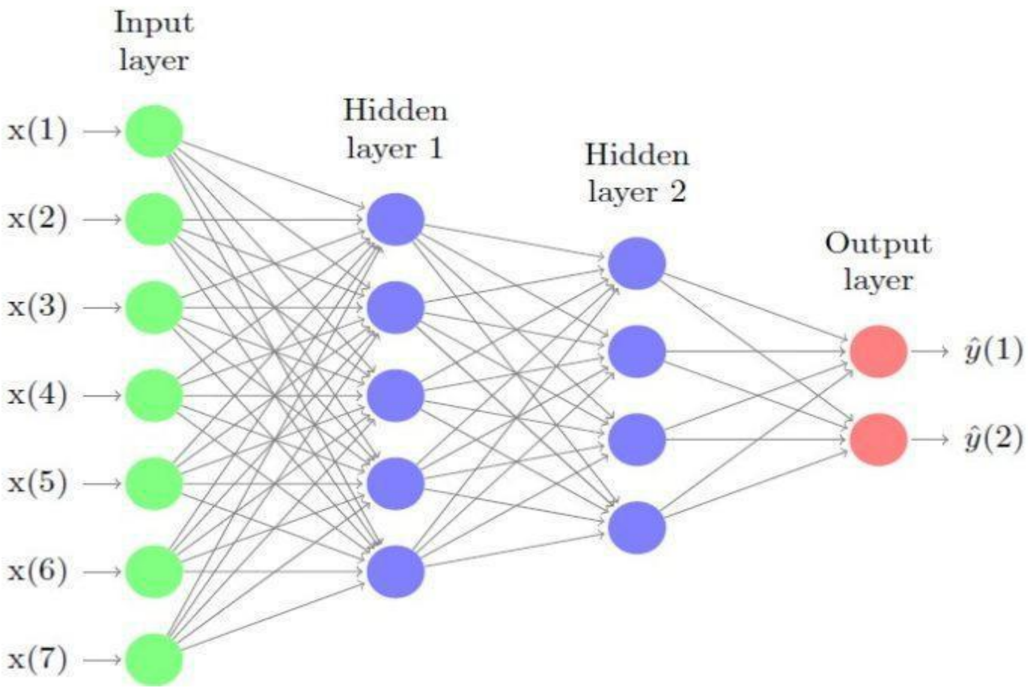


Fig 5.4 CNN classification

5.7 TRAINING AND CLASSIFICATION

In this work, Convolution Neural Network is used for learning how to segment images. Convolution Neural Networks (CNN) extract features directly from pixel images with minimal preprocessing. It can even able to recognize a pattern which has not been presented before, provided it resembles one of the training patterns. After learning (from ground-truth image), CNN automatically generate a good affinity graph from raw database images. This affinity graph can be then paired with any standard partitioning algorithm, such as N-cut, connected component to achieve improved segmentation.Which is shown in below fig 5.5.

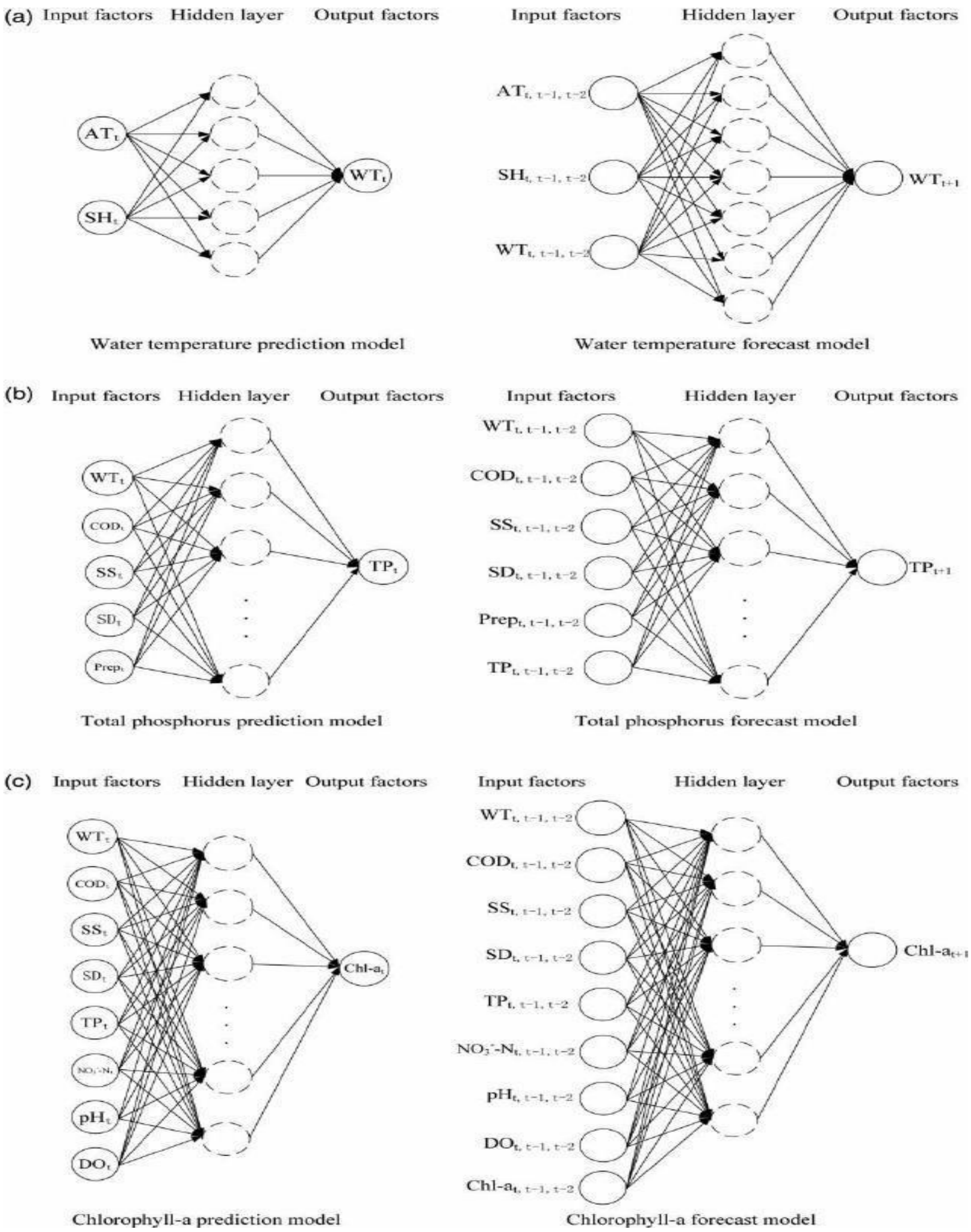


Fig 5.5 Training and classification of NN

5.8 CLUSTERING

In general, image pixels in immediate neighborhoods most probably have either the same or close grayscale levels. In this case, these pixels will belong to the same cluster with a high probability that may cause uncertainty in determining the exact object boundaries. Spatial fuzzy c-means algorithm handles this problem through using the spatial relationships among neighbor pixels. The algorithmic description of the spatial fuzzy c-means algorithm is exactly the same as that of fuzzy c-means algorithm. The standard fuzzy C-means (FCM) algorithm does not fully utilize the spatial information for image segmentation and is sensitive to noise especially in the presence of intensity in homogeneity in magnetic resonance imaging (MRI) images. The underlying reason is that a single fuzzy membership function in FCM algorithm cannot properly represent pattern associations to all clusters. we present a spatial fuzzy C-means (SFCM) algorithm for the segmentation of MRI images. The algorithm utilizes spatial information from the neighborhood of each pixel under consideration and is realized by defining a probability function. A new membership function is introduced using this spatial information to generate local membership values for each pixel. Finally, new clustering centers and weighted joint membership functions are presented based on the local and global membership functions. The resulting SFCM algorithm solves the problem of sensitivity to noise and intensity in homogeneity in MRI data and thereby improves the segmentation results. The experimental results on several simulated and real-patient MRI bone images show that the SFCM algorithm has superior performance on image segmentation when compared to some FCM-based algorithms.

CHAPTER-6

EXPERIMENTAL RESULTS AND DISCUSSION

From the visual comparison of experimental results, it can be observed that classical edge detectors like canny edge detectors and proposed method. In case of a canny edge detector, the bone structure is detected accurately without noise but fails to detect the fracture edges. The developed bone fracture detection system is tested for a different dataset of X-ray images and observed that the system works with accurate of 78%. And gives the stage, type, and area. Our proposed based bone fracture segmentation algorithm accurately detects the bone structure and fracture edges. And tells whether the bone is fractured or not as shown in fig 6.1.

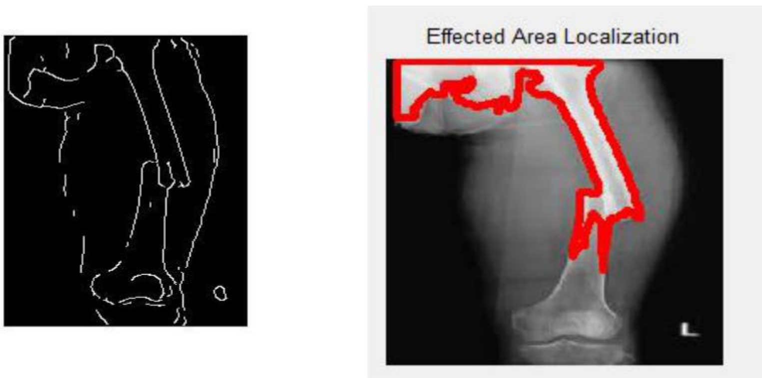


Fig 6.1.Comparison of existing canny edge and proposed CNN based method

SCREENSHOT OF THE OUTPUT

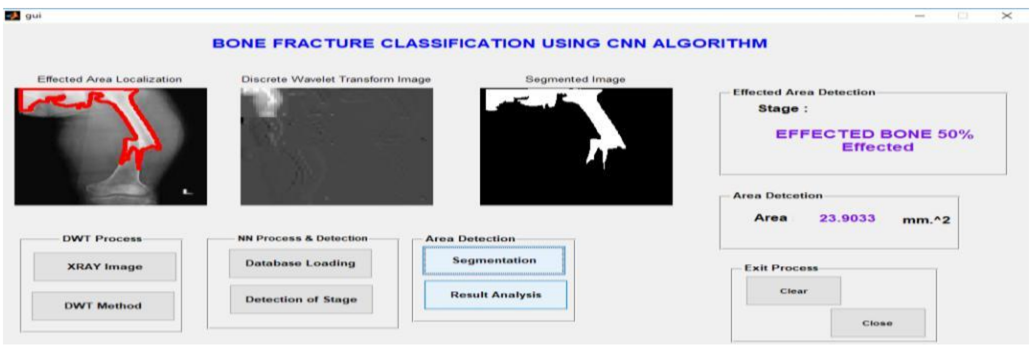


Fig 6.2 GUI Image

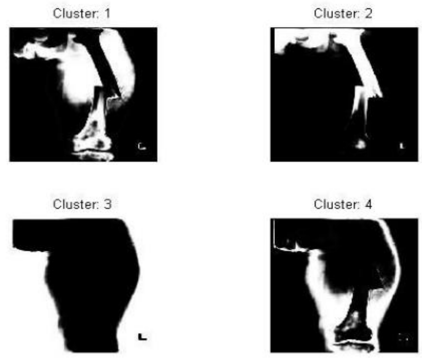
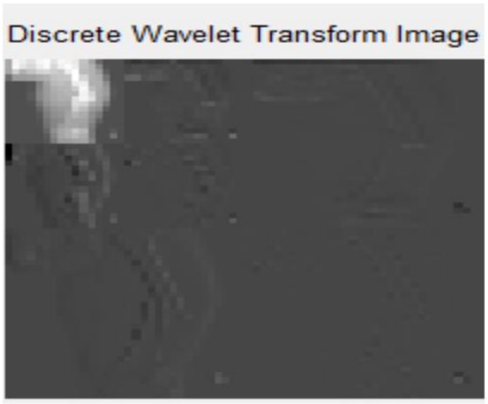


Fig 6.3 Filtered Image **Fig 6.4 Clustering**



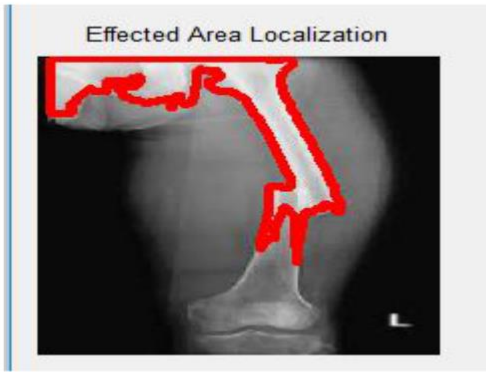


Fig 6.5 DWT Image **fig 6.6 Effected Image**

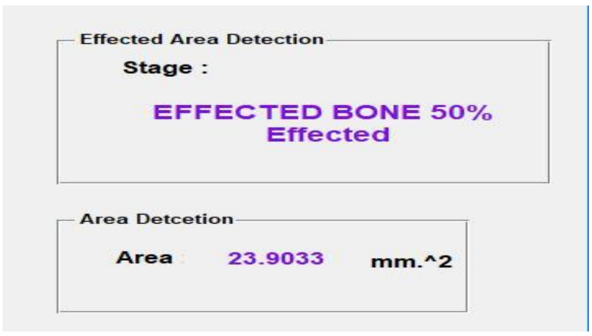


Fig 6.7: Stage, type and area of fractured

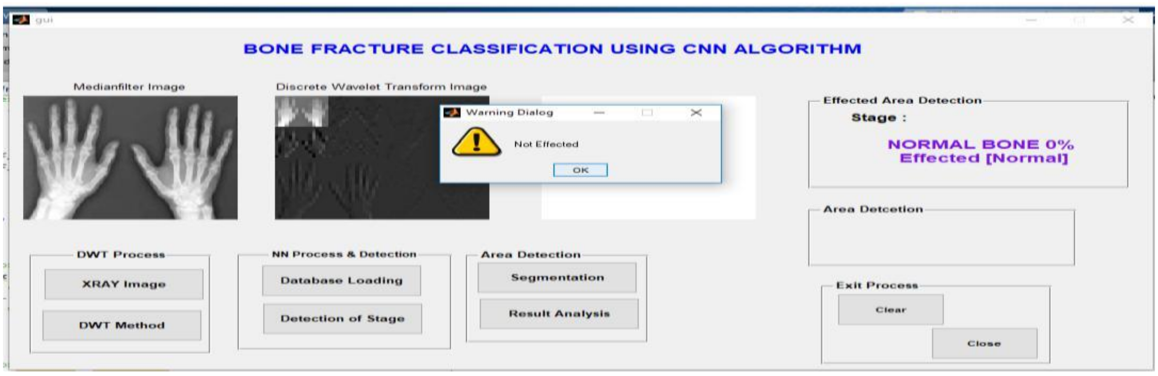


Fig 6.8: Not effected image

CHAPTER 7

CONCLUSION

The proposed method has made the use of wavelet transfer function to carry out multiresolution analysis of the input image and input image with noise. The edge detection has been performed on multiple resolutions of image, by 2DDWT, which can extract details from smaller parts and can carry out respective processing which is edge detection in the proposed method on any part of image. In proposed method edge detection has been performed at level1, level2 and level3 and corresponding outputs have been displayed. Later the edge maps obtained for different scales can be combined to get another segmented image.

A CNN based image segmentation algorithm is proposed to detect the bone fractured area using a GUI application that was developed. The Affected Area Localization show the bone structure and fracture edges are detected more accurately using proposed image segmentation method compared with other edge detection techniques like Sobel, Prewitt and canny. Here, the CNN based algorithm segmentation of an image clearly highlights the fractured area. Since the Dwt edge detection method is applied to the CNN algorithm, and with SFCM clustering it highlights the approximate fractured region and the impacted area percentage.

CHAPTER 8
ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- It is Automated fracture detection and it will ease the work of orthopedics**.**
- It gives better efficiency, sensitivity, accuracy.
- It detects multiple effected parts in the image.
- It automatically detects the important features without any human supervision.
- It solve the problems of sensitivity to noise and intensity in homogeneity in MRI data and improves the segmentation results.

DISADVANTAGES

- It is not 100% accurate.

CHAPTER 9
FUTURE SCOPE

A wavelet approach used to detect Fracture detection region on the X-Ray images. Multilevel wavelet is used to find the fracture from the x-ray bone images; it may detect only the fracture portion. There are some limitations that it finds the fracture only the horizontal images. In the future is used for the short bone x-ray images to detect the fracture and also in the hand, rib, hip, back bones etc. To overcome the limitation algorithm used on the vertical and diagonal image. This work can be further extended to, multiobjective image segmentation and use of quantum computing.

CHAPTER 10
REFERENCES

[1] Chokkalingam, SP. and Komathy, K. (2014). ―Intelligent Assistive Methods for Diagnosis of Rheumatoid Arthritis Using Histogram Smoothing and Feature Extraction of Bone Images‖. World Academy of Science, Engineering and Technology International Journal of Computer Information Systems and Control Engineering, Vol. 8, Issue .5, pp.834-843.

[2] Edward V, Cephas Paul. and Hepzibah S, Hilda. (2015) , ―A Robust Approach For Detection of the type of Fracture from X-Ray Images‖, International Journal of Advanced Research in Computer and Communication Engineering, Vol. 4, Issue No. 3, pp.479-482.

[3] 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 (IJARCE), pp. 15-19.

[4] Rathode, Hs. and Ali, Wahid. (2015), ―MRI Brain Image Quantification Using artificial neural networks – A Review Report‖, ISOI Journal of Engineering and Computer science, Vol. 1, Issue No. 1, pp. 48-55.

[5] Patel, Brijesh B., Shah, Brijesh N. and Shah, Vandana. (2013), ―Breast tumor representation & noise removal using Fuzzy c-mean algorithm and DWT‖, International Journal of Computer Trends and Technology (IJCTT), Vol. 4, Issue No.5, pp. 1111-1114.

[6] B.Swathika., K. Anandhanarayanan., B.Baskaran. And R.Govindaraj. (2015), ―Radius Bone Fracture Detection Using Morphological Gradient Based Image Segmentation Technique‖, International Journal of Computer Science and Information Technologies, Vol.6, Issue No.2, pp. 1616-1619.

[7] Aishwariya, R., Geetha, M.Kalaiselvi. and Archana, M. ―Computer- Aided Fracture Detection Of X-Ray Images‖, IOSR Journal of Computer Engineering, pp.44-51.

[8] Marshall, S.T. and Browner, B.D. (2012) [1st. Pub. 1956]. "Chapter 20: Emergency care of musculoskeletal injuries". In Courtney M. Townsend Jr. Sabiston textbook of surgery: the biological basis of modern surgical practice. Elsevier. pp. 480–520. ISBN 978-1-4377-1560 6. (Wikipedia)+

[9] https://homepages.inf.ed.ac.uk/rbf/HIPR2/median.htm

[10] https://en.wikipedia.org/wiki/Median_filter

[11]https://pubs.rsna.org/doi/abs/10.1148/ryai.2019180001?journalCode=ai

[12] https://en.wikipedia.org/wiki/Feature_extraction

[13] https://ieeexplore.ieee.org/document/7919713

[14]http://gwyddion.net/documentation/user-guide-en/wavelet-transform.html

[15] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6066766/