**BONE OSTEOPOROSIS DETECTOR USING IMAGE PROCESSING**

**ABSTRACT:**

Osteoarthritis is a major cause of disability in the adult population. As a progressive degenerative joint disorder, OA is characterized by cartilage damage, changes in the subchondral bone, osteophyte formation, muscle weakness, and inflammation of the synovium tissue and tendon. Although OA has long been viewed as a primary disorder of articular cartilage, subchondral bone is attracting increasing attention. It is commonly reported to play a vital role in the pathogenesis of OA. Subchondral bone sclerosis, together with progressive cartilage degradation, is widely considered as a hallmark of OA. Despite the increase in bone volume fraction, subchondral bone is hypomineralized, due to abnormal bone remodeling. Some histopathological changes in the subchondral bone have also been detected, including microdamage, bone marrow edema-like lesions and bone cysts. This review summarizes basic features of the osteochondral junction, which comprises subchondral bone and articular cartilage. Importantly, we discuss risk factors influencing subchondral bone integrity. We also focus on the microarchitectural and histopathological changes of subchondral bone in OA, and provide an overview of their potential contribution to the progression of OA. A fuzzy extraction model for the pathogenesis of OA is proposed.

**CHAPTER - 1**

**INTRODUCTION**

Osteoarthritis (OA) is a common leading cause of pain and disability in the aging population. As a slowly progressive degenerative joint disorder, OA is characterized by cartilage damage, changes in the subchondral bone, osteophyte formation, muscle weakness, and inflammation of the synovium tissue and tendon.

Although OA has long been considered as a primary disorder of articular cartilage, the contribution of subchondral bone to the physiopathology of OA is arousing interest. Subchondral bone deterioration is commonly associated with articular cartilage defects, and subchondral bone sclerosis, together with progressive cartilage degradation, is widely considered as a hallmark of OA. Despite the increase in the number of trabeculae and bone volume, subchondral bone is hypo mineralized and of inferior quality, as a consequence of abnormal local high bone turnover. Some histopathological changes in the subchondral bone have also been detected, including microdamage, bone marrow edema-like lesions and bone cysts.

In this review, we summarize basic features of a functional joint unit comprised of subchondral bone and articular cartilage. We also discuss factors that influence the integrity of subchondral bone. Importantly, we focus on the micro architectural and histopathological changes of subchondral bone in OA, and provide an overview of their potential contribution to the progression of OA.

**CHAPTER - 2**

**SYSTEM STUDY**

**EXISTING SYSTEM**

Osteoporosis is an asymptomatic bone condition that affects a large proportion of the elderly population around the world, resulting in increased bone fragility and increased risk of fracture. Previous studies had shown that the vibroacoustic response of bone can indicate the quality of the bone condition. Therefore, the aim of the authors’ project is to develop a new method to exploit this phenomenon to improve detection of osteoporosis in individuals. In this paper a method is described that uses a reflex hammer to exert testing stimuli on a patient’s tibia and an electronic stethoscope to acquire the impulse responses. The signals are processed as mel frequency cepstrum coefficients and passed through an artificial neural network to determine the likelihood of osteoporosis from the tibia’s impulse responses. Following some discussions of the mechanism and procedure, this paper details the signal acquisition using the stethoscope and the subsequent signal processing and the statistical machine learning algorithm. Pilot testing with 12 patients achieved over 80% sensitivity with a false positive rate below 30% and accuracies in the region of 70%. An extended dataset of 110 patients achieved an error rate of 30% with some room for improvement in the algorithm. By using common clinical apparatus and strategic machine learning, this method might be suitable as a large population screening test for the early diagnosis of osteoporosis, thus avoiding secondary complications.

**PROPOSED SYSTEM**

Digital image processing comprises varieties of applications, where some of these used in medical image processing include convolution, edge detection as well as contrast enhancement. Efficient edge detection depends on choosing the threshold; the choice of threshold directly determines the results of edge detection. In this paper, Sobel edge detection operator and its enhanced algorithm are first discussed in terms of optimal thresholding in C language under Linux platform. It is implemented a competent execution time for this new enhanced algorithm to detect edges for human knee osteoarthritis images in different critical situations. The proposed method is able to exhibit discernible view of salient features of most osteoarthritis images with approximately 50% better execution time compare to classical Sobel method. Also, it is shown that the algorithm is very effective in case of noisy and blurs images.

**CHAPTER – 3**

**SYSTEM REQUIREMENTS**

**GENERAL**

These are the requirements for doing the project. Without using these tools and software’s we can’t do the project. So we have two requirements to do the project. They are

1. Hardware Requirements.

2. Software Requirements.

**HARDWARE REQUIREMENTS**

The hardware requirements may serve as the basis for a contract for the implementation of the system and should therefore be a complete and consistent specification of the whole system. They are used by software engineers as the starting point for the system design. It shows what the system does and not how it should be implemented.

Processor : Intel Pentium IV

Processor Speed : 1.4 GHz

Memory (RAM) : Default

Hard disk : Default

Monitor : Default

**SOFTWARE REQUIREMENTS**

The software requirements document is the specification of the system. It should include both a definition and a specification of requirements. It is a set of what the system should do rather than how it should do it. The software requirements provide a basis for creating the software requirements specification. It is useful in estimating cost, planning team activities, performing tasks and tracking the team’s and tracking the team’s progress throughout the development activity.

Operating System : Ubuntu10.04

Simulator Tool : MATLAB / SIMULINK

Protocol Design : AD HOC / PI

Platform : Independent

**CHAPTER – 3**

**LITERATURE SURVEY**

# 1. AN EFFICIENT GRAPH-CUT SEGMENTATION FOR KNEE BONE OSTEOARTHRITIS MEDICAL IMAGES

**AUTHORS:** [Sufyan Y. Ababneh](https://ieeexplore.ieee.org/author/37586636000); [Metin N. Gurcan](https://ieeexplore.ieee.org/author/37285359300)

**ABSTRACT:** The segmentation of bones in the knee region is one of the first essential steps to perform further analysis, classification and osteoarthritis imaging biomarkers discovery. In this paper, an efficient graph-cut based segmentation algorithm is proposed. One of the challenges in current graph-cut schemes is properly distinguishing between regions of interest (ROI) and background regions with features very similar to those of the ROI. Since obtaining a very discriminative cost function is not always feasible, many algorithms require user interaction to provide an extensive number of seed points. In this paper, a new approach is proposed which uses efficient content-based features to achieve segmentation without the need for any user interaction. Experimental results on actual knee MR images demonstrate the effectiveness of the proposed scheme with an average accuracy of 95% using the Zijdenbos similarity index.

# 2. AN ADEPT EDGE DETECTION ALGORITHM FOR HUMAN KNEE OSTEOARTHRITIS IMAGES

**AUTHOR:** [Syed Zahurul](https://ieeexplore.ieee.org/author/37392692900); [Syed Zahidul](https://ieeexplore.ieee.org/author/37392693600); [Razali Jidin](https://ieeexplore.ieee.org/author/37282549200)

**ABSTRACT:** Digital image processing comprises varieties of applications, where some of these used in medical image processing include convolution, edge detection as well as contrast enhancement. Efficient edge detection depends on choosing the threshold; the choice of threshold directly determines the results of edge detection. In this paper, Sobel edge detection operator and its enhanced algorithm are first discussed in terms of optimal thresholding in C language under Linux platform. It is implemented a competent execution time for this new enhanced algorithm to detect edges for human knee osteoarthritis images in different critical situations. The proposed method is able to exhibit discernible view of salient features of most osteoarthritis images with approximately 50% better execution time compare to classical Sobel method. Also, it is shown that the algorithm is very effective in case of noisy and blurs images.

# 3. DEEP 3D CONVOLUTIONAL NETWORKS TO SEGMENT BONES AFFECTED BY SEVERE OSTEOARTHRITIS IN CT SCANS FOR PSI-BASED KNEE SURGICAL PLANNING

**AUTHOR:** [Davide Marzorati](https://ieeexplore.ieee.org/author/37087032012); [Mattia Sarti](https://ieeexplore.ieee.org/author/37088548871); [Luca Mainardi](https://ieeexplore.ieee.org/author/37323982600); [Alfonso Manzotti](https://ieeexplore.ieee.org/author/37086636321);

**ABSTRACT** Segmentation of bony structures in CT scans is a crucial step in knee arthroplasty based on personalized surgical instruments (PSI). As a matter of fact, the success of the surgery depends on the quality of the matching between the patient-specific resection jigs, manufactured exploiting the patient bony surfaces attained by segmentation, and true patient surfaces. Severe pathological conditions as chronic osteoarthritis, deteriorating the cartilages, narrowing the intra-articular spaces and leading to bone impingement, complicate the segmentation making the recognition of bony boundaries sub-optimal for traditional semi-automated methods and often extremely difficult even for expert radiologists. Deep convolutional neural networks (CNNs) have been investigated in the last years towards automatic labeling of diagnostic images, especially harnessing the encoding-decoding U-Net architecture. In this article, we implemented deep CNNs to encompass the concurrent segmentation of the distal femur and the proximal tibia in CT images and evaluate how segmentation uncertainty may impact on the surgical planning. A retrospective set of 200 knee CT scans of patients was used to train the network and test the segmentation performances. Tests on a subset of 20 scans provided median dice, sensitivity and positive predictive value indices greater than 96% for both shapes, with median 3D reconstruction error in the range of 0.5mm. Median 3D errors on both PSI femoral and tibial contact areas and surgical cut alignments were less than 2mm and 2°, respectively, which can be considered clinically acceptable. These results substantiate that deep CNN architectures can disclose the opportunity of segmenting bone shapes in CT scans for PSI-based surgical planning with promising accuracy. However, we observed that segmentation scores alone cannot be taken as representative of the 3D errors at the contact areas of the PSI. Therefore when comparing segmentation algorithms of PSI-based surgic...

# 4. CARTILAGE-DEFECT ASSESSMENT BY MEASURING THICKNESS OF KNEE MRI: DATA FROM THE OSTEOARTHRITIS INITIATIVE

**AUTHOR:** [Yong-woo Lee](https://ieeexplore.ieee.org/author/37085653121); [Bui Toan](https://ieeexplore.ieee.org/author/37086731146); [Chunsoo Ahn](https://ieeexplore.ieee.org/author/37086733193); [Jitae Shin](https://ieeexplore.ieee.org/author/37400263300)

**ABSTRACT:** In this paper, we present a knee cartilage assessment technique to differentiate those in different osteoarthritis grades. We construct atlas for each grade and each atlas represents an average size of cartilage thickness. We build the atlas using manual segmentation of patellar cartilage following groupwise registration. We assign thickness value at the voxels in bone-cartilage interface in ahead. The thickness atlas is used for t-test to see how our method is accurate. T-test result shows our method finds significant difference between osteoarthritis grade 0 and 4 with p less than 0.001.

# 5. AN AUTOMATED CONTENT-BASED SEGMENTATION FRAMEWORK: APPLICATION TO MR IMAGES OF KNEE FOR OSTEOARTHRITIS RESEARCH

# AUTHOR: [Sufyan Y. Ababneh](https://ieeexplore.ieee.org/author/37586636000); [Metin N. Gurcan](https://ieeexplore.ieee.org/author/37285359300)

**ABSTRACT:** To effectively diagnose and monitor the treatment of diseases such as osteoarthritis, the segmentation, processing and analysis of mass volumes of medical images is gaining high importance. In this paper, a new fully automated content-based segmentation framework is proposed. The framework is designed to be compatible with a wide variety of segmentation techniques. To this end, a novel content-based two-pass block discovery mechanism is proposed to provide full automation for image segmentation. The proposed framework uses both training and local image data and disjoint block-wise image scanning to achieve ROI and background block discovery. The detected object and background blocks are then used to initialize and support the segmentation process. The effectiveness of the proposed framework is demonstrated by performing automatic segmentation of the femur and tibia bones in knee osteoarthritis MR images with 96% accuracy. Experimental results are provided which show the effectiveness of the proposed framework.

**CHAPTER – 4**

**SYSTEM STUDY**

**FLOW CHART:**

**ALGORITHM:**

The input layer represents the input membership functions for the fuzzy rules, with sufficient input causing a rule in the hidden layer to fire. The weights between the layers represent the fuzzy sets, with membership in each set determined by the relative weights – these can be altered using particular training algorithms as per a normal neural system. Transfer functions are usually continuous and pass real values through the network to the output layer to be interpreted as degrees of membership in fuzzy sets based on the firing of fuzzy rules in the hidden layer.

Fuzzy neural networks combine the strengths of both neural networks and FL, making them a very powerful hybrid tool. They allow the integration of expert knowledge into the system, and are considered inherently more understandable because of their use of human-like fuzzy inference.

The accuracy of the prediction models was evaluated by their performance in the unseen test data, which were not used for the training. The results is evident that, irrespective of vessel type, the performance of the neuro-fuzzy and ANN models is better than that of the linear regression model. The [mean absolute error](https://www.sciencedirect.com/topics/engineering/mean-absolute-error) of prediction for both the ANN and neuro-fuzzy models is less than 5% for ring yarns and around 2% or even less for rotor yarns. In contrast, the regression model exhibits a mean absolute error of prediction higher than 5% and 2% for ring and rotor yarns, respectively. Moreover, the maximum error of prediction of the regression model is also much higher than those of the ANN and neuro-fuzzy models. The reason behind the superior accuracy of the ANN and neuro-fuzzy models may be attributed to their aptness to handle the nonlinear relationship prevailing between fibre and yarn properties. In the case of ring spun yarns, the performance of the neuro-fuzzy system (R = 0.802, mean absolute error = 4.72%) seems to be better than that of the ANN model (R = 0.738, mean absolute error = 4.92%) whereas it is the reverse in the case of [rotor spun yarns](https://www.sciencedirect.com/topics/engineering/rotor-spun-yarn). However, it must be considered that only three input parameters were used in the neuro-fuzzy model as against eight in the ANN and regression models. In spite of this difference, the prediction accuracy of the neuro-fuzzy model is comparable with or even better than that of the ANN model. Adequate training of an increased number of fuzzy rules may lead to much better performance of the neuro-fuzzy model. However, training of an increased number of fuzzy rules using a limited amount of data may actually undermine the performance of the neuro-fuzzy system, and therefore a tradeoff is needed when selecting the number of input variables and the number of membership functions for each variable.

Fuzzy sets are also often used in neural networks—neurofuzzy networks—in which the first layer represents normal input variables, the last layer represents normal output variables, and the hidden layers represent fuzzy rules. The connection weights are fuzzy. The antecedent and consequent of a fuzzy rule are encoded directly into the initial weight of the neural network. Each neuron represents a fuzzy membership function, while each link represents the weight of the fuzzy rule. Membership functions express the prior linguistic rules and may be of any shape. If the membership function is a Gaussian, it may have the same variance as a receptive field unit:

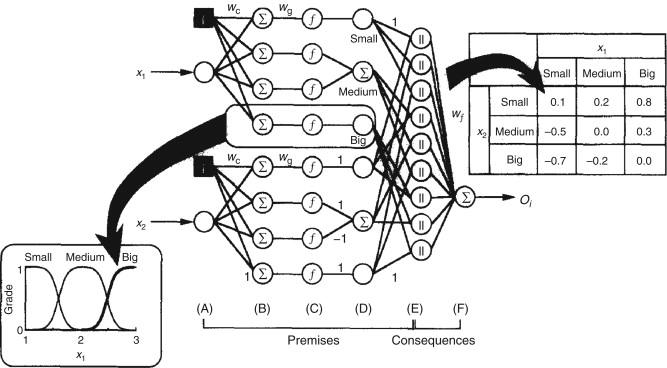
(11.7)y=μx=e−(x−c2/2σ2)

where c = center (mean) of membership function and σ = width (variance) of membership function.

The set of fuzzy rules and their membership functions constitute a knowledge base. The fuzzy sets are converted as fuzzy connection weights with learning implemented by the neural network. The neural network uses gradient descent to tune the membership function parameters that define its shape (width and central position); that is, it alters the fuzzy symbolic representation. The FNN may be defined by the function:

(11.8)yi=fWgx=∑j=1nwijg∑k=1mwjkxk+wj0+wi0

where W = weight vector of weights connecting jth hidden unit to inputs and ith output to hidden units, g(⋅) = sigmoidal transfer function, and xk = inputs.



**CHAPTER - 5**

**SOFTWARE DESCRIPTION**

**MATLAB INTRODUCTION:**

The name MATLAB stands for MATrix LABoratory. MATLAB was written originally to provide easy access to matrix software developed by the LINPACK (linear system package) and EISPACK (Eigen system package) projects. MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming environment. MATLAB has many advantages compared to conventional computer languages (e.g., C, FORTRAN) for solving technical problems. MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. Specific applications are collected in packages referred to as toolbox. There are tool boxes for signal processing, symbolic computation, control theory, simulation, optimization, and several other fields of applied science and engineering.

## MATLAB's POWER OF COMPUTAIONALMATHMATICS

MATLAB is used in every facet of computational mathematics. Following are some commonly used mathematical calculations where it is used most commonly:

* + - Dealing with Matrices andArrays
    - 2-D and 3-D Plotting andgraphics
    - LinearAlgebra
    - AlgebraicEquations
    - Non-linear Functions
    - Statistics
    - DataAnalysis
    - Calculus and Differential Equations NumericalCalculations
    - Integration
    - Transforms
    - CurveFitting
    - Various other specialfunctions

## FEATURES OFMATLAB

### Following are the basic features of MATLAB

It is a high-level language for numerical computation, visualizationandapplication development.

* + - It also provides an interactive environment for iterative exploration, design and problem solving.
    - It provides vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration and solving ordinary differential equations.
    - It provides built-in graphics for visualizing data and tools for creating customplots.
    - MATLAB's programming interface gives development tools for improving code quality, maintainability, and maximizingperformance.
    - It provides tools for building applications with custom graphicalinterfaces.
    - It provides functions for integrating MATLAB based algorithms with external applications and languages such as C, Java, .NET and Microsoft Excel.

## 

## USES OFMATLAB

MATLAB is widely used as a computational tool in science and engineering encompassing the fields of physics, chemistry, math and all engineering streams. It is used in a range of applicationsincluding:

* + - signal processing andCommunications
    - image and video Processing
    - controlsystems
    - test andmeasurement
    - computationalfinance
    - computationalbiology

## UNDERTANDING THE MATLABENVIRONMENT

MATLAB development IDE can be launched from the icon created on the desktop. The main working window in MATLAB is called the desktop. When MATLAB is started, the desktop appears in its default layout.



Fig.4.5.1. MATLAB desktop environment The desktop has the following panels:

**Current Folder** - This panel allows you to access the project folders and files.



Fig.4.5.2. current folder

**Command Window** - This is the main area where commands can be entered at the command line. It is indicated by the command prompt (>>).

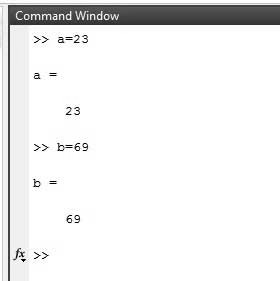


Fig.4.5..3. command window

**Workspace** - The workspace shows all the variables created and/or imported from files.

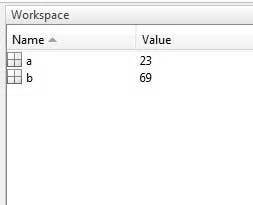


Fig.4.5.4.workspace

**Command History** - This panel shows or rerun commands that are entered at the command line.

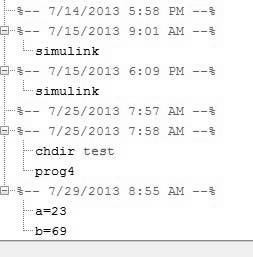


Fig.4.5.5 command history

## COMMONLY USED OPERATORS AND SPATIALCHARATERS

MATLAB supports the following commonly used operators and special characters:

|  |  |
| --- | --- |
| **Operator** | **Purpose** |
| **+** | Plus; addition operator. |
| **-** | Minus, subtraction operator. |
| **\*** | Scalar and matrix  multiplication operator. |
| .\* | Array and multiplication  operator. |
| ^ | Scalar and matrix  exponentiation operator. |
| .^ | Array exponentiation  operator. |

|  |  |
| --- | --- |
| \ | Left-division operator. |
| / | Right-division operator. |
| .\ | Array left-division  operator. |
| ./ | Array right-division  operator. |

Table.4.5.6 MATLAB used operators and special characters.

## COMMANDS

MATLAB is an interactive program for numerical computation and data visualization. You can enter a command by typing it at the MATLAB prompt '>>' on the Command Window.

### Commanda for managing a session

MATLAB provides various commands for managing a session. The following table provides all

|  |  |
| --- | --- |
| **Commands** | **Purpose** |
| Clc | Clear command window |
| Clear | Removes variables from memory |
| Exist | Checks for existence of file or  variable. |
| Global | Declare variables to be global. |
| Help | Searches for help topics. |
| Look for | Searches help entries for a  keyword. |
| Quit | Stops MATLAB. |
| Who | Lists current variable. |
| Whos | Lists current variables (Long  Display). |

Table.4.7.1 commands for managing a session

### INPUT AND OUTPUTCOMMAND

MATLAB provides the following input and output related commands

|  |  |
| --- | --- |
| **Command** | **Purpose** |
| Disp | Displays content for an array or  string. |
| Fscanf | Read formatted data from a  file. |
| Format | Control screen-display format. |
| Fprintf | Performs formatted write to  screen or a file. |
| Input | Displays prompts and waits for  input. |
| ; | Suppresses screen printing. |

Table.4.8 input and output commands

## MFILES

MATLAB allows writing two kinds of program files:

### Scripts:

script files are program files with .m extension. In these files, you write series of commands, which you want to execute together. Scripts do not accept inputs and do not return any outputs. They operate on data in the workspace.

### Functions:

functions files are also program files with .m extension. Functions can accept inputs and return outputs. Internal variables are local to the function.

### Creating and Running Script File:

To create scripts files, you need to use a text editor. You can open the MATLAB editor in two ways:

* Using the commandprompt
* Using theIDE

You can directly type edit and then the filename (with .m extension).

Edit or

edit<file name>

## DATA TYPES AVAILABLE INMATLAB

MATLAB provides 15 fundamental data types. Every data type stores data that is in the form of a matrix or array. The size of this matrix or array is a minimum of 0-by-0 and this can grow up to a matrix or array of any size.

The following table shows the most commonly used data types in MATLAB:

|  |  |
| --- | --- |
| **Datatype** | **Description** |
| Int8 | 8-bit signed integer |
| Unit8 | 8-bit unsigned integer |
| Int16 | 16-bit signed integer |
| Unit16 | 16-bit unsigned integer |
| Int32 | 32-bit signed integer |
| unit32 | 32-bit unsigned integer |
| Int64 | 64-bit signed integer |
| Unit64 | 64-bit unsigned integer |
| Single | Single precision numerical data |
| Double | Double precision numerical data |
| Logical | Logical variables are  1or0,represent true &false respectively |
| Char | Character data(strings are stored |

|  |  |
| --- | --- |
|  | as vector of characters) |
| Call array | Array of indexed calls, each capable of storing array of a  different dimension and datatype |
| Structure | C-like structure each structure having named fields capable of storing an array of a different  dimention and datatype |
| Function handle | Pointer to a function |
| User classes | Object constructed from a user- defined  class |
| Java classes | Object constructed from a java  class |

Table.4.10. data types in MATLAB.

**CODINGS:**

clc; % Clear the command window.

warning off;

workspace; % Make sure the workspace panel is showing.

format long g;

format compact;

fontSize = 10;

%i/p image get in section

% Select an image from the 'Disease Dataset' folder by opening the folder

[filename,pathname] = uigetfile({'\*.\*';'\*.bmp';'\*.tif';'\*.jpg';'\*.png'},'Pick a Disease Affected image');

rgbImage = imread([pathname,filename]);

disp('IMAGE LOADED');

pause(1);

%preprocessing

i=rgbImage;

pause(2);

gray=i;

% gray = rgb2gray(rgbImage);

J = histeq(gray);

disp('PRE PROCESSING STARTS');

pause(1);

figure;

imshow(rgbImage);

title('Original Image');

figure;

imshow(J);

title('Enhanced Image');

figure;

imshowpair(gray,J,'montage');

title('Enhanced Pair Image');

axis on;

figure;

subplot(1,2,1);

imhist(gray,64);

title('Original Image Histogram');

axis on;

disp('STRUCTURAL DATA ANALYSIS');

pause(1);

thresh = multithresh(gray,2);

seg\_I = imquantize(gray,thresh);

RGB = label2rgb(seg\_I);

grey1 = rgb2gray(RGB);

subplot(1,2,2);

imhist(grey1,64);

title('Enhanced Image Histogram');

figure;

imshow(RGB);

title('RGB Segmented Image');

axis off

figure

subplot(331)

imshow(i)

title('Original Image')

I1=i;% I1=rgb2gray(i);

subplot(332)

imshow(I1)

title('Grayscale image')

A = adapthisteq(I1,'clipLimit',0.02,'Distribution','rayleigh');

subplot(333)

imshow(A)

title('Contrast Enhanced image')

subplot(334)

I3 = threshold(A);

imshow(I3);

title('Thresholded image')

subplot(335)

I4=threshold(I1);

imshow(I4)

title('contrast segment image')

subplot(336)

imshow(RGB);

title('RGB SEGMENTED IMAGE');

%segmentation

% Get the dimensions of the image. numberOfColorBands should be = 3.

I = imresize(rgbImage,[500 700]);

greenc = I1; % Extract Green Channel

ginv = imcomplement (greenc); % Complement the Green Channel

adahist = adapthisteq(ginv); % Adaptive Histogram Equalization

se = strel('ball',8,8); % Structuring Element

gopen = imopen(adahist,se); % Morphological Open

godisk = adahist - gopen; % Remove Optic Disk

medfilt = medfilt2(godisk); %2D Median Filter

background = imopen(medfilt,strel('disk',15));% imopen function

I2 = medfilt - background; % Remove Background

I3 = imadjust(I2); % Image Adjustment

level = graythresh(I3); % Gray Threshold

bw = im2bw(I3,level); % Binarization

bw = bwareaopen(bw, 30); % Morphological Open

% figure,imshow(bw);

wname = 'sym4';

[CA,CH,CV,CD] = dwt2(bw,wname,'mode','per');

figure,imshow(CA),title('LINE B/W');

b = bwboundaries(bw);

% axes(handles.axes5);

% I = imresize(I,[500 752]);

figure,imshow(I);

title('LINE TRACE');

hold on

for k = 1:numel(b)

plot(b{k}(:,2), b{k}(:,1), 'b', 'Linewidth', 1)

end

g=I1;

rsz = imresize(g,[500 700]);

a=adapthisteq(rsz);

o=strel('ball',8,8);

s=imopen(a,o);

se=a-s;

ad=adapthisteq(se);

im=imadjust(ad,[],[],6);

ad1=adapthisteq(im);

bw=im2bw(ad1,0.1);

ar = bwarea(bw);

ar = round(ar);

wname = 'sym4';

[CA,CH,CV,CD] = dwt2(bw,wname,'mode','per');

figure, imshow(CA);

title('AFFECT PARTS');

hold on;

%data extracting

disp('DATA EXTRACTING');

pause(1);

gray=rgb2gray(RGB);

m = mean(gray,2); % Computing the average face image m = (1/P)\*sum(Tj's) (j = 1 : P)

AA=min(max(m));

D=mean(mean(abs(gray)));

E = entropy(gray);

Std = std2(gray);

figure;

plot(m);

xlabel('NUMBER OF INSTANCE');

ylabel('VALUE OF INSTANCE');

title('INPUT IMAGE MEAN VALUE');

disp('DEVIATION');

disp(D);

disp('MAXIMUM PIXEL IMAGE DATA ');

disp(AA);

disp('ENTROPY');

disp(E);

disp('STANDARD DEVIATION');

disp(Std);

figure;

bar(1,D,'r');

hold on

bar(2,AA,'g');

hold on

bar(3,E,'y');

hold on

bar(4,Std,'m');

hold off

legend ('DEVIATION','MAXIMUM PIXEL','ENTROPY','STANDARD DEVIATION');

title('IMAGE ANALYSIS DATA');

odprz=imresize(rgbImage,[300 300]);

imwrite(odprz,'oq1.png');

pic1 = imread('oq1.png');

er=0;

[x,y,z] = size(pic1);

if(z==1)

;

else

pic1 = rgb2gray(pic1);

imwrite(pic1,'gray1.png')

end

bw1=im2bw(pic1,.6);

normal = 0;

affected = 0;

x=0;

y=0;

l=0;

m=0;

data1=xlsread('features');

distr='kernel';

X = double(data1(:,1:4));

Y = double(data1(:,5));

X1=X;

X2=Y;

P = X1';

T = X2';

net =neurofuzzy(P,T);

Y = sim(net,P);

for a = 1:1:256

for b = 1:1:256

if(bw1(a,b)==1)

affected =(affected+1);

else

normal = (normal+1);

end

end

end

disp('AFFECTED PIXEL POINTS:');

pause(1);

disp(affected);

disp('NORMAL PIXEL POINTS:');

pause(1);

disp(normal);

%decision tree unit

if(affected <= 290)

disp('INPUT IMAGE NORMAL');

pause(1);

msgbox('INPUT IMAGE NORMAL')

else

disp('osteoporosis OCCURED');

pause(1);

msgbox('osteoporosis OCCURED')

end

disp('PROCESS COMPLETED')

pause(1);

**SAMPLE IMAGE:**

****





**CHAPTER – 6**

**CONCLUSION & REFERENCE**

**CONCLUSION:**

In this work, an efficient, automatic method of classifying Osteoporosis has been done which is cost-effective and robust. The proposed method here was tested on diseased and non-diseased patients. Hence, this algorithm can be implemented to classify and detect the disease with increased accuracy which can be implemented at local hospitals to detect Osteoporosis.

**FUTURE WORK:**

* This research work will be extended to future where the disease is prod in elderly with a better approach
* Subsequent work is to be done for applying this in a standalone open-source software which will be all the way more beneficial for medical analysis for grading of osteoporosis with the availability of more datasets

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