A PROJECT *REPORT ON*

LIVER CANCER DETECTION USING IMAGE PROCESSING

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CERTIFICATE

This is to Certify that the project report entitled"**LIVER CANCER DETECTION USING IMAGE PROCESSING"** Submittedby **R.PAVANI SRI PRATYUSHA**(Y17EC1293),**V.SUREKHA**(Y17EC1318),**M.SOWJANYA**(Y17EC1267**V.C HAKRAARTHI**(Y16EC1305), to the Acharya Nagarjuna University, Guntur in partial fulfillment for the award of Degree of Bachelor of Technology in Electronics and Communication Engineering is a bonafide record of the project work carried out by them under my supervision during the year 2020-2021.

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ABSTRACT

The abnormal growth of cells in the liver causes liver cancer which is also known as hepatic cancer, where, Hepatocellular Carcinoma (HCC) is the most common type of liver cancer which makes up 75% of cases. The detection of this tumour is difficult and mostly found at advanced stage which causes life-threatening issues. Hence it is far essential to discover the tumour at an early stage. So the principle intention of this project is to detect liver cancer at earlier stage using image processing technique. Here the malignant liver tumours are detected from Computed Tomography (CT) images. The image undergoes enhancement using anisotropic diffusion filters and segmented by morphological operations which is simple and easy to work. This operation uses combination of two processes, dilation and erosion. The scope of this propounded technique is to highlight the tumour region present in the Computed Tomography.

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CHAPTER 1 INTRODUCTION

The formulation of the term cancer was in 460 - 370 BC. It is credited to the Greek Physician Hippocrates who is known as "FATHER OF MEDICINE". Billions of cells in our body divides each day to produce new cells. The newly formed cells occupies the space of dead cells. Basically, cells get together to form tissues, tissues get together to form organs. Hence, in some abnormal cases, cells divide more than the body needed and form as lumps or growths normally called as tumors.In this project we proposed simplemethod of cancer detection using image processing.

Digital image processing is the technique of using computers to process the image with the necessary algorithms. The software used here is MATLAB. Computed tomography image of liver cancer is employed to detect the tumor region. Detection of liver cancer involves three main steps. It includes preprocessing of image, processing of image and highlighting tumor region. Preprocessing of image involves image enhancement using anisotropic diffusion filter to remove noise and imperfections in image. During thresholding, there may be some chance of noise creation. This step plays an important role in detection of cancer, because a small deviation which may be caused due to imperfections or noise will leaves a major effect in detection process. After image enhancement, image is segmented for detection of tumor region in processing stage. For segmenting image, morphological operations are used. It includes dilation and erosion which is the basic process for completing the whole detection operation.

Morphological operations are simple and very easy to work because it operates on basic set theory and does not contain complex mathematical equations. The last step is to highlight the tumor region in the given image for easy and clear observation. For understanding the whole process obviously, the sub plotted image of all processed image is shown which includes original image, filtered image, tumor region, bordered tumor image and highlighted tumor region in original given ima

CHAPTER 2 LITERATURE REVIEW

Rong Zhu, et.al.,“Application of Improved Anisotropic diffusion Filter on Image Processing” proposed that anisotropic diffusion filter is the most commonly used method in removing noises. This paper describes the improved algorithm of anisotropic diffusion filter to remove salt and pepper noises of the images

[1] Ravi S, et.al.,“Morphological Operations for Image Processing: Understanding and its applications” described morphological operations are easy to apply and it works on the principle of set theory. The objective of using this type of operation is to remove the imperfections in the structures of the images

[2] Wassem Abdulrahman, et.al.,“Diagnosis of Liver Tumors Using Image Processing” aimed to identify the specific regions of liver area in the scanner images to abdominal area. This uses a new method for extraction the region of tumor in the CT.

[3] Amit Verma, et.al., “A Survey on Digital Image Processing Techniques for Tumor Detection” describes the image processing techniques for tumor detection. It gives the best result for detecting and classifying the tumor by comparing with the existing methods.

[4] et.al., “An Adaptive Anisotropic Diffusion Filter for Noise Reduction in MR Images” proposed The stepped forward anisotropic diffusion filter uses adaptive threshold selection. The proposed technique became carried out to real MR images and the outcomes are fantastic.

[5] Gabriel Ramos-Llordén, et.al.,“Anisotropic Diffusion Filter With Memory Based on Speckle Statistics for Ultrasound Images” recommend an anisotropic diffusion clear out with a probabilistic-pushed memory mechanism to triumph over the over-filtering problem by using following a tissue selective philosophy.

[6] Alireza Mazloumi Gavgani, et.al., “Noise reduction using anisotropic diffusion filter in inverse electrocardiology” used anisotropic diffusion filter to cancel the noise at the frame floor potentials measurements with the aim of enhancing the corresponding answers of the inverse hassle of electrocardiology.

[7] Reitseng Lin, et.al., “Morphological operations on images represented by quadtrees” proposed set of rules to directly carry out morphological operations on photographs represented via quadtrees and produce the dilated/eroded snap shots, additionally represented through quadtrees

[8] Ruchika Chandel, et.al., “Image Filtering Algorithms and Techniques” described the diverse image filtering algorithms and techniques used for image filtering/smoothing. Image smoothing is one of the most critical and widely used method in image processing.

[9] N. Howard, et.al.,“A Novel Fully automated Liver and Tumor Segmentation System using Morphological Operations” purposed to develop an automated Hepatocellular Carcinoma detection system in Computed Tomography images with high sensitivity and low specificity.

CHAPTER 3 IMAGE PROCESSING

3.1 Image

An image is a two-dimensional picture, which has a similar appearance to some subject usually a physical object or a person.

Image is a two-dimensional, such as a photograph, screen display, and as well as a threedimensional, such as a statue. They may be captured by optical devices—such as cameras, mirrors, lenses, telescopes, microscopes, etc. and natural objects and phenomena, such as the human eye or water surfaces.

The word image is also used in the broader sense of any two-dimensional figure such as a map, a graph, a pie chart, or an abstract painting. In this wider sense, images can also be rendered manually, such as by drawing, painting, carving, rendered automatically by printing or computer graphics technology, or developed by a combination of methods, especially in a pseudo-photograph.

Figure 1:The Color & Gray scale Images

3.2 Image Acquisition

Image Acquisition is to acquire a digital image. To do so requires an image sensor and the capability to digitize the signal produced by the sensor. The sensor could be monochrome or color TV camera that produces an entire image of the problem domain every 1/30 sec. the image sensor could also be line scan camera that produces a single image line at a time. In this case, the objects motion past the line.

Scanner produces a two-dimensional image. If the output of the camera or other imaging sensor is not in digital form, an analog to digital converter digitizes it. The nature of the sensor and the image it produces are determined by the application.

3.3 Image Enhancement

Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interesting an image. A familiar example of enhancement is when we increase the contrast of an image because “it looks better.” It is important to keep in mind that enhancement is a very subjective area of image processing.

Figure 2:The Basic Example for Image Enhancement

3.4 Image restoration

Image restoration is an area that also deals with improving the appearance of an image. However, unlike enhancement, which is subjective, image restoration is objective, in the sense that restoration techniques tend to be based on mathematical or probabilistic models of image degradation.

Enhancement, on the other hand, is based on human subjective preferences regarding what constitutes a “good” enhancement result. For example, contrast stretching is considered an enhancement technique because it is based primarily on the pleasing aspects it might present to the viewer, where as removal of image blur by applying a deblurring function is considered a restoration technique.

3.5. Segmentation

Segmentation procedures partition an image into its constituent parts or objects. In general, autonomous segmentation is one of the most difficult tasks in digital image processing. A rugged segmentation procedure brings the process a long way toward successful solution of imaging problems that require objects to be identified individually.

On the other hand, weak or erratic segmentation algorithms almost always guarantee eventual failure. In general, the more accurate the segmentation, the more likely recognition is to succeed.

CHAPTER 4 PROPOSED METHODOLOGY

Liver cancer detection using image processing can be done with three main phases. They are,

- Preprocessing of image
- Processing of image
- Highlighting the tumor in given image

Computed tomography (CT) images are used for observation of liver tumors. MATLAB is the software used for processing the images given.

4.1 Work Flow of Process

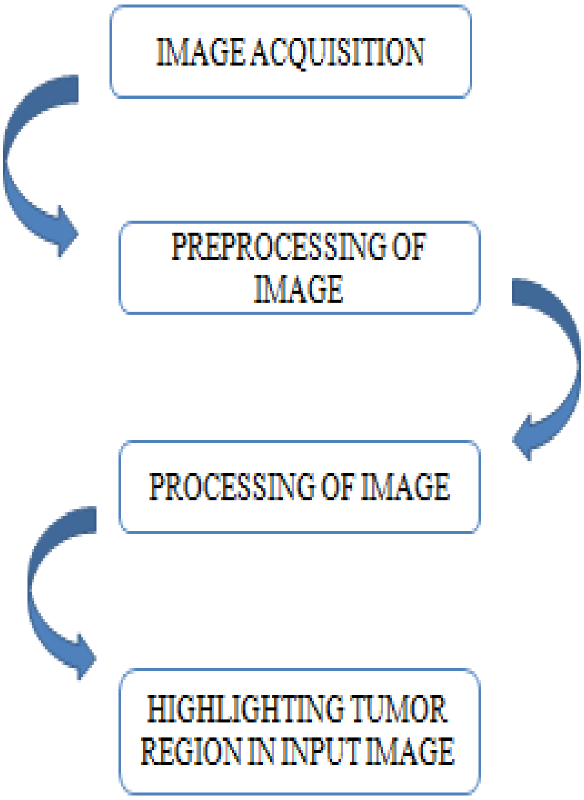

Figure 3: Work Flow of Process

4.2 Software Description

MATLAB is the most popular software used for Digital Image Processing. MATLAB (matrix laboratory) is multipurpose tool used for matrix manipulation, plotting of functions and data, implementation of algorithm and creating user interface. For detecting liver cancer using image processing, MATLAB software is used. It is a general usage programming language. When it is used to process images by generally writing function files, or script files to perform the necessary operations. It forms a formal record of the processing used and the final results can be tested and replicated by others. It provides many important advantages for forensic image processing.

MATLAB 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

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 noninteractive 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.

The MATLAB System

The MATLAB system consists of five main parts:

The MATLAB language**.**

This is a high-level matrix/array language with control flow statements, functions, data structures, input/output, and object-oriented programming features. It allows both "programming in the small" to rapidly create quick and dirty throw-away programs, and "programming in the large" to create complete large and complex application programs.

The MATLAB working environment.

This is the set of tools and facilities that you work with as the MATLAB user or programmer. It includes facilities for managing the variables in your workspace and importing and exporting data. It also includes tools for developing, managing, debugging, and profiling M-files, MATLAB's applications.

Handle Graphics.

This is the MATLAB graphics system. It includes high-level commands for two-dimensional and three-dimensional data visualization, image processing, animation, and presentation graphics. It also includes low-level commands that allow you to fully customize the appearance of graphics as well as to build complete Graphical User Interfaces on your MATLAB applications.

The MATLAB mathematical function library.
This is a vast collection of computational algorithms ranging from elementary functions like sum, sine, cosine, and complex arithmetic, to more sophisticated functions like matrix inverse, matrix eigenvalues, Bessel functions, and fast Fourier transforms.

The MATLAB Application Program Interface (API).
This is a library that allows you to write C and Fortran programs that interact with MATLAB. It include facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing AT-file

4.3 Preprocessing of Image

preprocessing in image processing is to improve the quality of image, suppressing unwanted distortions in image due to noise and enhance image features for further processing. Normally in performing medical image processing, preprocessing of an image plays a crucial role so that the input image does not have any impurities or imperfections, and it is done to be better for the upcoming process such as segmentation, feature extraction, etc.

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies

Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analysing and manipulating the image;
- Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display, information extraction

4.4 Anisotropic Diffusion Filter

Diffusion filters contain two different filters called isotropic diffusion filter and anisotropic diffusion filter. Isotropic filters are linear and anisotropic filters are non-linear filters. Linear filters are homogeneous in nature and is with constant conductivity. Hence to overcome this smoothening Perona and Malik proposed the non liner method called anisotropic filters. Anisotropic filters are also called as perona-Malik equation. It is the powerful image enhancer.

The main aim of this filter is to reduce noise without removing significant parts of given image, sharp edges and significant lines. Image processing with anisotropic diffusion in MATLAB code contains some important parameters. The anisotropic diffusion is represented as,

Diff_image=anisodiff(Im, NUM_ITER, KAPPA, LAMBDA, DELTA, OPTION)

Here, IN the figure input image, Num_itr is used to represent number of iterations, Kappa is the conduction coefficient, lambda is the maximum value of 0.25 for stability, delta is integration constant. There are two options first prefers smaller region over wide region whereas next prefers wide region over smaller one. In this project the input image is computed tomography image of liver as shown in the figure 8

2. This image is preprocessed for further processing.

Figure 4:Input Image

After applying anisotropic diffusion filter the given image is filtered and the noise and imperfections are removed for clear inference. It plays an important role in processing the image in next stage for clear observation of liver tumor region. The filtered image is shown in the figure 9

Figure 5:Filtered Image

CHAPTER 5 SUPPORTING FILE

```
function diff_im = anisodiff(im, num_iter, delta_t, kappa, option)
fprintf('Removing noise\n');
fprintf('Filtering Completed !!');
% Convert input image to double.
im = double(im);
% PDE (partial differential equation) initial condition.
diff_im = im;
% Center pixel distances.
dx = 1;
dy = 1;
dd = sqrt(2);
% 2D convolution masks - finite differences.
hN = [0 1 0; 0 -1 0; 0 0 0];
hS = [0 0 0; 0 -1 0; 0 1 0];
hE = [0 0 0; 0 -1 1; 0 0 0];
hW = [0 0 0; 1 -1 0; 0 0 0];
hNE = [0 0 1; 0 -1 0; 0 0 0];
hSE = [0 0 0; 0 -1 0; 0 0 1];
hSW = [0 0 0; 0 -1 0; 1 0 0];
hNW = [1 0 0; 0 -1 0; 0 0 0];
% Anisotropic diffusion.
for t = 1:num_iter
        % Finite differences. [imfilter(.,.,'conv') can be
replaced by conv2(.,.,'same')]
nablaN = imfilter(diff_im,hN,'conv');
nablaS = imfilter(diff_im,hS,'conv');
nablaW = imfilter(diff_im,hW,'conv');
nablaE = imfilter(diff_im,hE,'conv');
nablaNE = imfilter(diff_im,hNE,'conv');
nablaSE = imfilter(diff_im,hSE,'conv');
nablaSW = imfilter(diff_im,hSW,'conv');
nablaNW = imfilter(diff_im,hNW,'conv');
```

```
% Diffusion function.
 if option == 1
     cN = exp(-(nablaN/kappa).^2);
     cS = exp(-(nablaS/kappa).^2);
     cW = exp(-(nablaW/kappa).^2);
     cE = exp(-(nablaE/kappa).^2);
     cNE = exp(-(nablaNE/kappa).^2);
     cSE = exp(-(nablaSE/kappa).^2);
     cSW = exp(-(nablaSW/kappa).^2);
     cNW = exp(-(nablaNW/kappa).^2);
     elseif option == 2
     cN = 1./(1 + (nablaN/kappa).^2);
     cS = 1./(1 + (nablaS/kappa).^2);
     cW = 1./(1 + (nablaW/kappa).^2);
     cE = 1./(1 + (nablaE/kappa).^2);
     cNE = 1./(1 + (nablaNE/kappa).^2);
     cSE = 1./(1 + (nablaSE/kappa).^2);
     cSW = 1./(1 + (nablaSW/kappa).^2);
     cNW = 1./(1 + (nablaNW/kappa).^2);
 end

 % Discrete PDE solution.
 diff_im = diff_im + ...
           delta_t*(...
           (1/(dy^2))*cN.*nablaN + (1/(dy^2))*cS.*nablaS + ...
           (1/(dx^2))*cW.*nablaW + (1/(dx^2))*cE.*nablaE + ...
           (1/(dd^2))*cNE.*nablaNE + (1/(dd^2))*cSE.*nablaSE + ...
           (1/(dd^2))*cSW.*nablaSW + (1/(dd^2))*cNW.*nablaNW );
  end
```

CHAPTER 6 SOURCE CODE

```
clc
close all
clear all
%% Input
[I,path]=uigetfile('*.jpg','select a input image');
str=strcat(path,I);
s=imread(str);
figure;
imshow(s);
title('Input image','FontSize',20);
%% Filter
num_iter = 10;
    delta_t = 1/7;
    kappa = 15;
    option = 2;
    disp('Preprocessing image please wait . . .');
    inp = anisodiff(s,num_iter,delta_t,kappa,option);
    inp = uint8(inp);
inp=imresize(inp,[256,256]);
if size(inp,3)>1
    inp=rgb2gray(inp);
end
figure;
imshow(inp);
title('Filtered image','FontSize',20);
%% thresholding
sout=imresize(inp,[256,256]);
t0=60;
th=t0+((max(inp(:))+min(inp(:)))./2);
for i=1:1:size(inp,1)
    for j=1:1:size(inp,2)
        if inp(i,j)>th
```

```
                sout(i,j)=1;
            else
                sout(i,j)=0;
            end
        end
    end
    %% Morphological Operation
    label=bwlabel(sout);
    stats=regionprops(logical(sout),'Solidity','Area','BoundingBox');
    density=[stats.Solidity];
    area=[stats.Area];
    high_dense_area=density>0.6;
    max_area=max(area(high_dense_area));
    tumor_label=find(area==max_area);
    tumor=ismember(label,tumor_label);
    if max_area>100
       figure;
       imshow(tumor)
       title('tumor alone','FontSize',20);
    else
        h = msgbox('No Tumor!!','status');
        %disp('no tumor');
        return;
    end
    %% Bounding box
    box = stats(tumor_label);
    wantedBox = box.BoundingBox;
    figure
    imshow(inp);
    title('Bounding Box','FontSize',20);
    hold on;
    rectangle('Position',wantedBox,'EdgeColor','y');
    hold off;
```

```
%% Getting Tumor Outline - image filling, eroding, subtracting
% erosion the walls by a few pixels

dilationAmount = 5;
rad = floor(dilationAmount);
[r,c] = size(tumor);
filledImage = imfill(tumor, 'holes');

for i=1:r
   for j=1:c
       x1=i-rad;
       x2=i+rad;
       y1=j-rad;
       y2=j+rad;
       if x1<1
           x1=1;
       end
       if x2>r
           x2=r;
       end
       if y1<1
           y1=1
 end
       if y2>c
           y2=c;
       end
       erodedImage(i,j) = min(min(filledImage(x1:x2,y1:y2)));
   end
end
figure
imshow(erodedImage);
title('eroded image','FontSize',20);
%% subtracting eroded image from original BW image
```

```
tumorOutline=tumor;
tumorOutline(erodedImage)=0;
figure;
imshow(tumorOutline);
title('Tumor Outline','FontSize',20);
%% Inserting the outline in filtered image in green color
rgb = inp(:,:,[1 1 1]);
red = rgb(:,:,1);
red(tumorOutline)=255;
green = rgb(:,:,2);
green(tumorOutline)=0;
blue = rgb(:,:,3);
blue(tumorOutline)=0;
tumorOutlineInserted(:,:,1) = red;
tumorOutlineInserted(:,:,2) = green;
tumorOutlineInserted(:,:,3) = blue;
figure
imshow(tumorOutlineInserted);
title('Detected Tumer','FontSize',20);
%% Display Together
figure
subplot(231);imshow(s);title('Input image','FontSize',20);
subplot(232);imshow(inp);title('Filtered image','FontSize',20);
subplot(233);imshow(inp);title('Bounding Box','FontSize',20);
hold on;rectangle('Position',wantedBox,'EdgeColor','y');hold off;

subplot(234);imshow(tumor);title('tumor alone','FontSize',20);
subplot(235);imshow(tumorOutline);title('Tumor
Outline','FontSize',20);
subplot(236);imshow(tumorOutlineInserted);title('Detected
Tumor','FontSize',20);
```

CHAPTER 7 PROCESSING

Processing of image is performing certain operations on the image to obtain certain information from the image. It is a type of signal processing where the input is an imageand output is a feature extracted from the image. Digital image processing helps in manipulation of image using digital computers with help of certain algorithms. It avoids building of noise and distortion of image during processing.

Digital image processing is the use of computer algorithms to create, process, communicate, and display digital images. Digital image processing algorithms can be used to:

- Convert signals from an image sensor into digital images
- Improve clarity, and remove noise and other artifacts
- Extract the size, scale, or number of objects in a scene
- Prepare images for display or printing
- Compress images for communication across a network
- Effective techniques for processing digital images include using algorithms and tools that provide a comprehensive environment for data analysis, visualization, and algorithm development.

CHAPTER 8 IMAGE PROCESSING TOOL

An X-ray Computed Tomography (CT) image is composed of pixels, whose brightness corresponds to the absorption of X-rays in a thin rectangular slab of the cross-section, which is called a ’’voxel’’ [1,3]. The Pixel Region tool provided by MATLAB 7.0.1 superimposes the pixel region rectangle over the image displayed in the Image Tool, defining the group of pixels that are displayed, in extreme close-up view, in the Pixel Region tool window. The Pixel Region tool shows the pixels at high magnification, overlaying each pixel with its numeric value [2,5]. For RGB images, we find three numeric values, one for each band of the image. We can also determine the current position of the pixel region in the target image by using the pixel information given at the bottom of the tool. In this way we found the x- and y-coordinates of pixels in the target image coordinate system. The Adjust Contrast tool displays a histogram which represents the dynamic range of the X-ray CT image (Figure.2.).

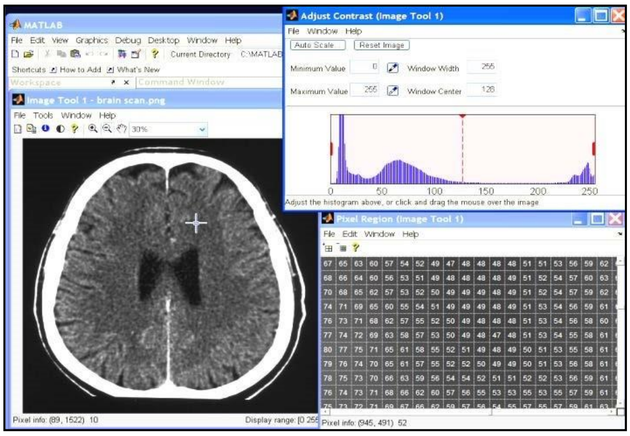

Figure 6: Pixel Region of an X-ray CT scan and the Adjust Contrast Tool

The Image Processing Toolbox provide a reference-standard algorithms and graphical tools for image analysis tasks including: edge-detection and image segmentation algorithms, image transformation, measuring image features, and statistical functions such as mean, median standard deviation, range, etc., (Figure. 6.)

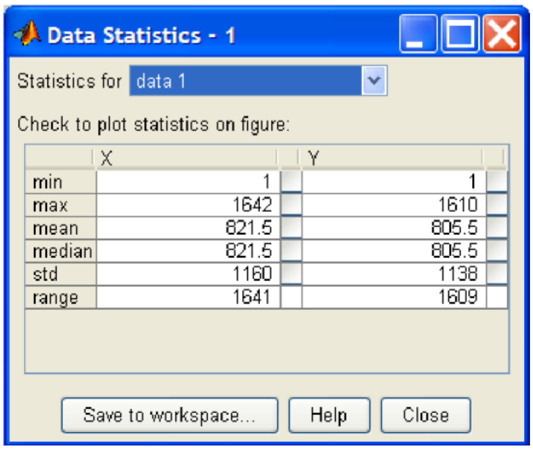

Figure 7: Data statistics of an X-ray CT scan performed by MATLAB

8.1 PLOT TOOLS

MATLAB provides a collection of plotting tools to generate various types of graphs, displaying the image histogram or plotting the profile of intensity values .

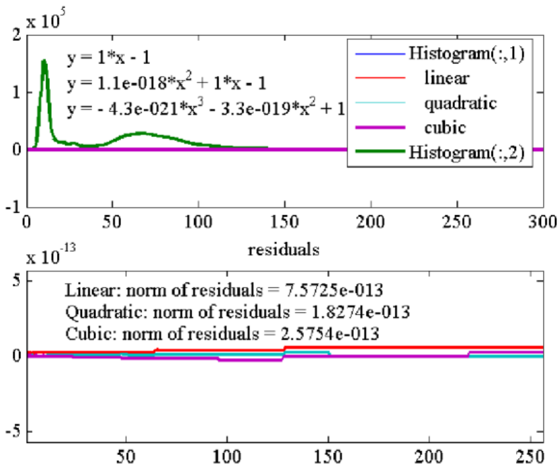

Figure 8:The Histogram of X-ray CT image and the plot fits

Figure 8. - The Histogram of X-ray CT image and the plot fits (significant digits: 2). A cubic fitting function is the best-fit model for histogram data plot. The fit curve was plotted as a magenta line through the data plot.

Area Graph of X-ray CT brain scan displays the elements in a variable as one or more curves and fills the area beneath each curve.

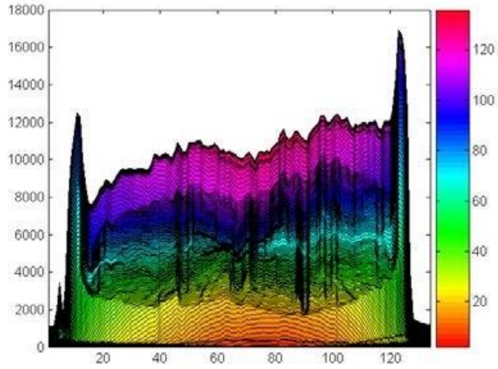

Figure 9:Area Graph of X-ray CT brain scan

8.2 Thresholding

It is one of the image processing method which converts the image from gray scale to binary images which is one of the segmentation method by setting up threshold value. It is most commonly used in binary images but can be applied for coloured images also. The pixel values greater than the threshold is converted into white (binary value 1) and the pixels lesser than the threshold is converted into black (binary value 0).The binary image should contain certain necessary information like position and shape of objects.

The steps to be followed for thresholding are, Set the initial threshold value, specifically the 8-bit value of original image. Separating the image into two parts, Pixels less than threshold –background Pixels greater than threshold – foreground Identify the average mean value of two images. Calculate the new threshold by finding the average of two mean values.

$G(x,y)=f(x)=1$,if $f(x,y)>T$; $G(x,y)=f(x)=0$,if $f(x,y)\leq T$

8.3 Bounding Box

Bounding box are imaginary boxes that are created around an object. It is also one of the method of identifying the target on the image. In digital image processing bounding box is nothing but the rectangular border that covers or encloses the digital images.

The coordinatein theupperleft corner is x and the coordinate in the lower right corner is y.Here we extract the tumor region present in the liver by covering it with a rectangular box which is nothing but bounding the tumor region. A specified pixel range of the original liver computed tomography (CT) image will be selected in the form of box which represents the tumor region of the image.

As shown in figure 2, the original image is being pre- processed for further image enhancement and filtered for reducing the noise signals present in the image and a rectangular box (bounding box) is made in the specified region. This region is the tumour region whose threshold value is greater than the normal threshold value.

Figure 10:Bounding box in given image

8.4 Morphological Operations

Morphological operation is a non-linear operation which is related to shapes or morphological featuresofanimage.This operation depends on theordering of the pixels in the image and not their numerical value. The operation deals with structuring element producing output image of the same size

8.5 Dilation

The dilation adds pixels to the edges of the object in the image. The number of pixels added in an image depends on the dimensions of that image. The assess of the output image is maximum in case of dilation and in binary image the pixel is to made 1 with respect to the neighbouring pixels. The dilation expands the object and fills the holes.

8.6 Erosion

The erosion removes pixels to the edges of the object in the image. The number of pixels subtracted in animage depends on the dimensions of that image. The assess of the output image is minimum in case of erosion and in binary imagethe pixel is to made 0 with respect to the neighbouring pixels. The erosion contracts the object and removes small objects in the image. The eroded image is shown in the figure 11

Figure 11::(A) Input image (B) Eroded image

8.7 Highlighting Tumor Region In Given Image

The last step is to present a clear indication of tumor region from the original image for our easy interpretation. By showing the tumor region alone is not sufficient for identification for normal humans. Hence this phase gives the obvious detection of tumor with its border in the giveninput image.

The final phase not only indicates the tumor normally it also border the tumor region in different color for spontaneous observation. Because the image is already given in the grey scale, so it is useless to show the tumor region in black or white. The other option is to represent it in red or green or blue. Here the tumor region will be indicated in red color as shown in the figure 12

Finally for clear observation all the processes image in step by step is sub plotted and shown clearly

The figure 12shows the complete processed images of whole process.

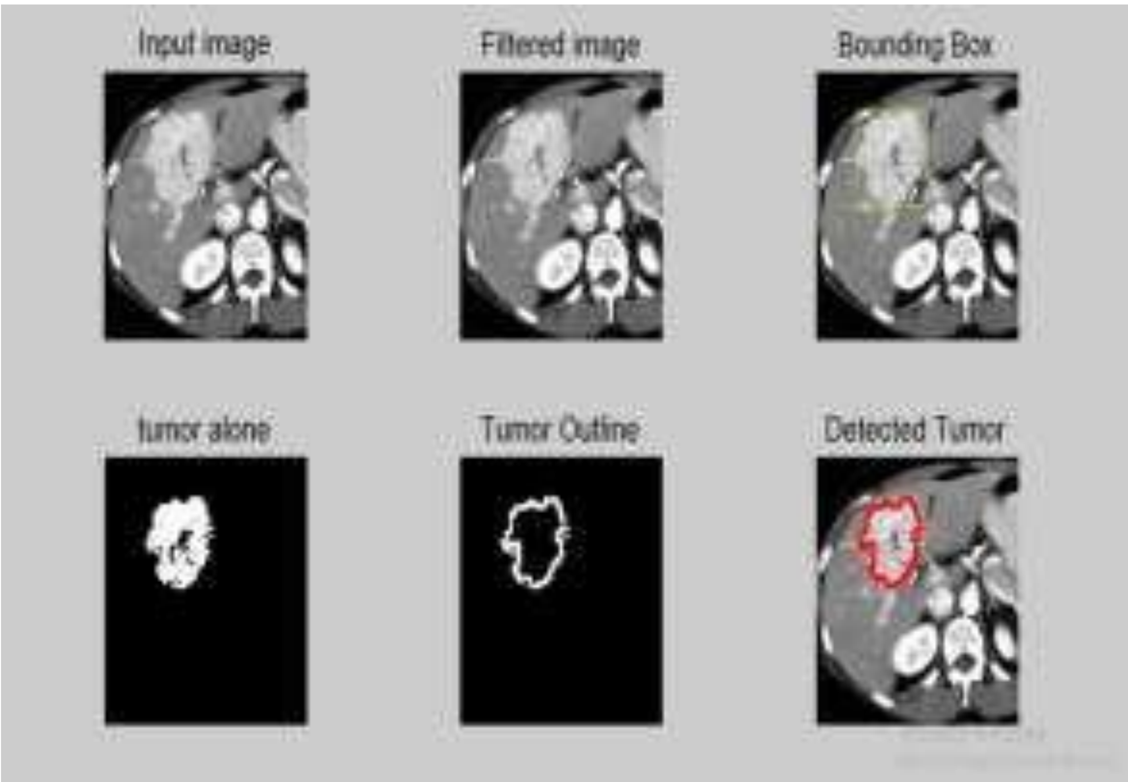

Figure 12:Complete images of whole process

CHAPTER 9 RESULTS AND DISCUSSION

Liver cancer detection using image processing is implemented and the tumor region is found medical images used for analysis and the complete observation is shown in the table 1

Table 1:Test results

IMAGES ANALYSED WITH SPECIFIC FEATURES	ACCURACY PERCENTAGE OBTAINED	RESULT OF THE PROCESS
Liver image with tumor in a single mass	96%	Outlines the tumor region clearly
Healthy liver	97%	None of the region is specified

This method liver cancer detection using image processing is analyzed with different kinds of sample for complete analysis. When image of liver cancer with single mass is given as input it outlines the tumor region with red color after processing. When images of healthy liver is given the indication will be of no specific region indication. Some deviations and inaccuracy takes place when very small tumors around the single mass of tumor are present. According to the proposed algorithm, it identify only the single mass of tumor in the liver. Many suspecting regions are discussed with medical persons for getting better accuracy

CHAPTER 10 CONCLUSION

The proposed research presents a liver cancer detection using image processing using morphological operations such as dilation and erosion for abdominal computed tomography scans. The obtained results ensure that this liver cancer detection can be effectively used to help medical persons in diagnosing hepato cellular carcinoma. It has been shown that morphological operations require less computational power and mathematical equations and calculations when compared to other image segmentation algorithms. A limitation of this research is that the performance was designed for only single mass of tumors. In future, we will collect clinical and computed tomography image data to ensure accuracy of evaluation and perfect validation for multiple tumors in the liver. We also intended to process with magnetic resonance imaging images and apply classification algorithms for classifying the tumors.

CHAPTER 11 REFERENCES

[1] Chen EL, Chung PC, Chen CL, Tsai HM, Chang CI. "Anautomatic diagnostic system for CT liver image classification" 1998; 45(6):78394.https://www.ncbi.nlm.nih.gov/pubme d/9609.

[2] Reitseng Lin, E.K. Wong. "Morphological operations on images represented by quadtrees" 2002. https://ieeexplore.ieee.org/document/545858

[3] Yuki Wakida, Yoshito Mekada, Ichiro Ide "Development of hepatocyte cancer detection method from dynamic Computed tomography images" 2004. https://www.researchgate.net/publication/310050 161.

[4] Jinshan Tang , Qingling Sun , Jun Liu , Yongyan Cao. "An Adaptive Anisotropic Diffusion Filter for Noise Reduction in MR Images" 2007. https://ieeexplore.ieee.org/abstract/document/43 03737.

Y. Masuda, A. H. Foruzan, T. Tateyama, Y. W. Chen, "Automatic liver tumor detection using EM/MPM algorithm and shape information ", IEICE technical2010.

https://ieeexplore.ieee.org/document/5542834.