

LUNG CANCER DETECTION USING DIGITAL IMAGE PROCESSING AND ARTIFICIAL NEURAL NETWORKS

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Abstract: Detection of lung cancer is the most interesting research area of researcher's in early stages. The proposed system is designed to detect lung cancer in premature stage in two stages. The proposed system consists of many steps such as image acquisition, preprocessing, binarization, thresholding, segmentation, feature extraction, and neural network detection. Lung cancer keeps on changing on various medical factors depending on topographic areas. The identification of Lung cancer at initial stages is of extreme importance if it is intended to degrade high mortality rate. The worldwide lung screening program focuses to imagine PET/CT examinations amongst most matured gatherings at danger to upgrade the early location rate. In spite of the fact that utilization of obtrusive procedures, the side effects will scarcely show up until infection is propelled, this will make it troublesome for radiologist to recognize sores. Every year, the American Cancer Society appraises the quantities of new growth cases and passing that will happen in the world in the present year and aggregates the latest information on tumor frequency, mortality, and survival. Genuine and precise information is the basis of disease control initiatives. More than 3/4th of the illness is identified with tobacco utilization. Furthermore, hereditary components, presentation to ecological poisons, second hand smoking expand illness quickly. Cures including chemotherapy, radiotherapy, surgery, epidermal open medications raise survival rate and personal satisfaction. Location of CT pictures received from cancer research organizations is investigated utilizing MATLAB.

Keywords: Lung Cancer; MATLAB; American Cancer society; Noise Removal; Segmentation; Mortality Rate.

1. Introduction:

Lung cancer is one of the major cancer deaths worldwide. It is the most dangerous cancer as compared to any other like Breast Cancer, Skin Cancer and many more. It is really tough to detect lung cancer in its beginning because its symptoms appear at the advanced stage where the chance of survival is very low. Every year many people die suffering from lung cancer than other cancer. There is a significant reason which shows that early detection of this cancer will increase the chance of survival. According to world health organization 7.6 million deaths are only because of lung cancer that is obtained from the latest statistics. Furthermore, the death rate from cancer is expected to rise continuously up to 17 million worldwide till 2030[1]. There are many techniques to diagnosis lung cancer, such as Chest Radiograph (x-ray), Computed Tomography (CT), Magnetic Resonance Imaging (MRI scan) and Sputum Cytology [2]. However, most of these techniques are expensive and time consuming. In other words, most of these techniques are detecting the lung cancer in its advanced stages, where the patient's chance of survival is very low. Therefore, there is a great need for a new technology to detect the lung cancer in its early stages. Image processing techniques provide a good quality tool for improving the manual analysis. A number of medical researchers utilized the analysis of sputum cells for early detection of lung cancer [3], most recent research relay on quantitative information, such as the size, shape and the ratio of the affected cells [4]. For this reason we attempt to use automatic diagnostic system for detecting lung cancer in its early stages based on the analysis images of lung cancer of the gray level. In order to formulate it we are applying a rule which is based on the threshold technique through which we apply segmentation pre-processing technique which divide image into several steps and many steps are being applied on it by which we obtain fully diagnosis image by the help of which detection of lung cancer in early stage become easy. In image segmentation we used as the first step is image enhancement by the help of histogram Equalization we get frequency level of a image. There are many algorithms which are used in image segmentation in medical field, such as histogram analysis, regional growth, edge detection and Adaptive thresholding [5]. A review of such image segmentation techniques can be found in [6]. For lung cancer diagnosis many authors have used color information as the key discriminating factor for cell segmentation [7]. The analysis of sputum images have been used in [8] for detecting lung cancer; it consists of images for detecting gray level. They used analysis techniques and feature extraction for the enhancement of the images, such as edge detection, heuristic knowledge, region labeling and removing. This research approached the segmentation of lung cancer problem by using thresholding techniques: For segmentation it has used thresholding OSTU method and 2D histogram analysis. The images are obtained from hospitals [9]. However, the images are described by a noisy and cluttered background patterns that make the segmentation and automatic detection of the cancerous cells very difficult. In addition to that there are many gray levels in the background of the images. Aim was to design a system that maximizes the true positive and minimizes the false negative to their best level. These make me to think about a pre-processing technique which can cover all these gray levels and keep the nuclei and cytoplasm.

There are several methods through which we detect cancer which are being used over decade of years. Radiograph is a noninvasive medical test that helps physicians diagnose and treat medical conditions. Chest x-rays involves exposing a part of the body to a small dose of ionizing radiation to produce pictures of the inside of the body. It is the oldest and most frequently used form of medical imaging. It is used to evaluate the condition of lungs, heart and chest wall, to diagnose shortness of breath. It doesn't require any special preparation. Women should always inform their physician and radiograph technologist if there is any possibility that they are pregnant. Many imaging tests are not performed during pregnancy. If an x-ray is necessary, precautions must be taken. Computed tomography (CT) has experienced a tremendous explosion in technological development over the last quarter century, a phenomenon rarely seen in industry. Few could have predicted the speed, magnitude, and duration of the progress. The third edition of Computed Tomography captures the most recent advances in technology and clinical applications. MRI is a non-invasive imaging technology that produces three dimensional detailed anatomical images without the use of damaging radiation. It is used for disease detection, diagnosis, and treatment monitoring. It is based on sophisticated technology that excites and detects the change in the direction of the rotational axis of protons found in the water that makes up living tissues. MRIs employ powerful magnets which produce a strong magnetic field that forces protons in the body to align with that field. When a radiofrequency current is then pulsed through the patient, the protons are stimulated, and spin out of equilibrium, straining against the pull of the magnetic field. When the radiofrequency field is turned off, the MRI is able to detect the energy released as the protons realign with the magnetic field. The time it takes for the protons to realign with the magnetic field, as well as the amount of energy released changes depending on the environment and the chemical nature of the molecules. Physicians are able to tell the difference between various types of tissues based on these magnetic properties. The problem we want to address here is whether or not a pixel in the blemish solution image which is attached to the sputum cell. The Papanicolaou discoloring method using a red dye results in a dark-blue nucleus of small refused cells with clear-blue cytoplasm regions, and sputum cell with dark-red nucleus and clear-red cytoplasm. This blemishing allows, to some extent, the sputum cell to have a distinctive chromatic appearance. Therefore it become easy to automatically separate it from the background using color attributes. The sputum image segmentation into a sputum cell region and a background can be viewed as classification problem, in which each pixel has to be assigned to one of the two classes. Image segmentation is a process in which regions or features sharing similar characteristics are recognize and grouped together. It can use statistical classification, thresholding, edge detection, region detection. There are several techniques which are being used for the implementation of segmentation through which obtain perfect image of CT scan.

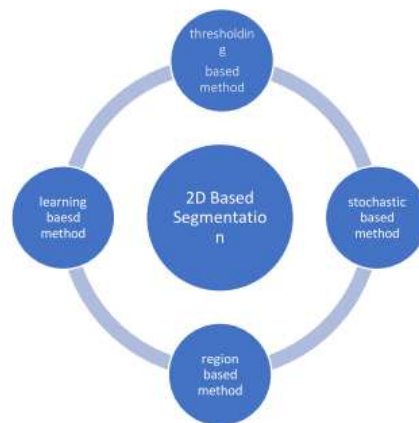


Figure-1 2D segmentation Approach

2. Experimentation:

In the proposed work for designing the Intelligent CADs system are: (1) Image Acquisition (2)Image enhancement (Histogram equalization) (3) Segmentation(Thresholding approach) (4) Dilation (5)Image filling (6)Feature Extraction from CT images(5) Classification using ANN. The dataset from lung images are collected from a database of Lung Image Consortium (LIDC). We have taken around 150 CT images which contain both male and female. The lung CT images having low noise when compared to X-ray scan image and MRI image. So, we have taken the CT images for detecting of the lungs.

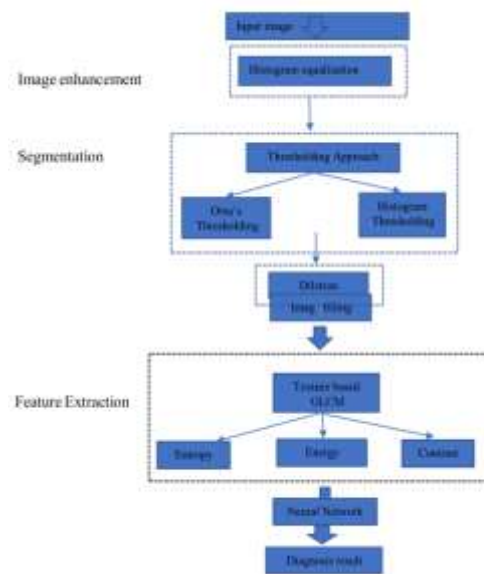


Figure-2 Flow chart of Proposed Work

The main advantages of computed tomography image have better clarity, low noise and distortion. Lung CT images are given as input. Dimensions of images are 512×512 pixels in size with the layer thickness of $0.75 - 1.25\text{mm}$. Here 110 nodules of size less than 3mm used. There are different stages of lung cancer nodules such as pleural nodules and vascular nodules have been taken in this project work. In the first step we select an image and apply it for classification through which we get all pre-processing images. The second we have applied is image enhancements in this step filters are being applied filters are on the images to remove some problems of images such as noise, blurring and etc. For image enhancement different types of filters are being applied on images, here we are applying filters like Historical equalization. Histogram equalization is the one of the well-known methods for enhancing the contrast of given images in accordance with the sample distribution of an image. Let $X = \{X(i, j)\}$ denotes the image we have taken composed of L discrete gray levels denoted as $\{X_0, X_1, \dots, X_{L-1}\}$, where $X(i, j)$ represents an intensity of the image at the spatial location (i, j) and $X(i, j) \in \{X_0, X_1, \dots, X_{L-1}\}$. For the applied image X , the probability density function (X_k) is defined as

$$p(X_k) = \frac{n^k}{n} \quad (1)$$

For $k = 0, 1, \dots, L - 1$, where n^k represents the number of times that the level X_k appears in the input image X and n is the total number of samples in the input image. Where (X_k) is associated with the histogram of the input image which represents the number of pixels that have a specific intensity X_k . Now the cumulative density function is

$$c(x) = \sum_{j=0}^k p(X_j) \quad (2)$$

Where $X_j = x$, for $k = 0, 1, \dots, L - 1$.

A transform function based on the cumulative density function is

$$f(z) = X_0 + (X_{L-1} - X_0)c(x) \quad (3)$$

Then the output image of the histogram equalization, $= \{Y(i, j)\}$, can be expressed as

$$Y = f(X) \quad (4)$$

$$Y = \{f(X(i, j)) | \forall X(i, j) \in X\} \quad (5)$$

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        wcardlg('File is not selected');
        else
            I=imread(filename);
            axes(handles.axes1);
            imshow(I);
            title('Input Image');
        end
    title('Input Long Image')
end
function pushbutton2_Callback(hObject, eventdata, handles)
global I
I=rgb2gray(I);
h=histeq(I);
axes(handles.axes2);
imshow(h);
title('Histogram Equalization')
function pushbutton3_Callback(hObject, eventdata, handles)
global I
I=rgb2gray(I);
h=histeq(I);
threshold = graythresh(h);
bw = im2bw(h,threshold);
axes(handles.axes3);
imshow(bw);
title('Segmentation by Thresholding')
function pushbutton4_Callback(hObject, eventdata, handles)

```

Figure-3 Code of histograms equalization



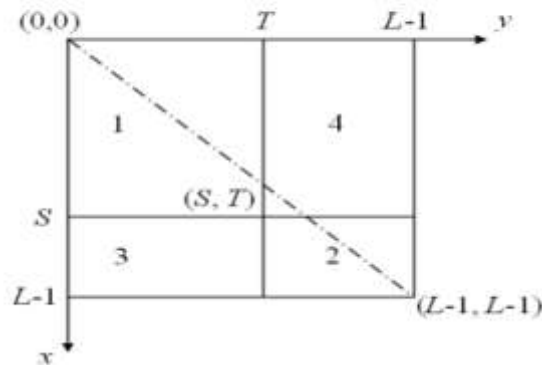
Figure-4 Output of histogram equalization

Segmentation is a important step in image processing. Through the help of segmentation, images are divided to some regions that contents of each region have the same specifications. Changing the image representation for easier explanation is the main purpose of segmentation. Representation of segmentation is in medical images in 2D, slice by slice has many useful applications in medical world such. Image segmentation is basically used to locate objects and boundaries (lines, curves) in images. The aim of segmentation is to simplify the representation of the image into something that is more meaningful and easier to analyze. Image segmentation is basically used for assigning a label to every pixel in an image such as pixels with the same label share specific visual characteristics [9]. The output of image segmentation is a set of segments that collectively cover the whole image (edge detection). All pixels in a given region are similar with respect to some characteristic such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic. Its algorithms are based on two basic properties of intensity values that are: discontinuity and similarity. Here we are applying thresholding approach which is one of the most powerful tools for image segmentation. The image obtained from thresholding has the advantages of smaller storage space, fast processing speed and easy in manipulation, compared with gray level image which usually contains 256 levels. Therefore, thresholding techniques have drawn a lot of attention during the past 20 years [10]. The basic idea of applying threshold approach is to automatically select an optimal gray-level threshold values for separating objects of interest in an image from the background based on their gray-level distribution. Over several years, many technologies have been intended for selecting the threshold automatically. Sezgin and Sankur [1] give an exhaustive description and the comparison of the performance measures performed over many image thresholding techniques. Automatic thresholding techniques can be represented as global thresholding and local thresholding. Otsu thresholding technique [2] is one of the global thresholding method and it is an effective technique [3,4,5]. In Trier and Jain's study [4], four global thresholding techniques were compared and Otsu method performed best, followed, in order, by Kapur et al.'s Entropy technique [6], Abutaleb's entropy technique [7], and Kittler and Illingworth's minimum error technique [8]. However, some issues are still on in this method.

3. Two-Dimensional OTSU Method:

Two Dimensional Histogram: A image with size $M \times N$ can be shown by a 2D black level intensity having function (x, y) Here $f(x, y)$ is representing black level whose value is ranging between $0 - (L-1)$, and L is representing number of black levels. The local average gray level is divided into same L values, let us suppose (x, y) be the function of the local average black level, then

$$g(x, y) = \frac{1}{n^2} \sum_{i=-n/2}^{n/2} \sum_{j=-n/2}^{n/2} f(x+i, y+j) \quad (6)$$



Here $n \leq \min \{M, N\}$

Let r_{ij} be the total number of occurrence of the pair (i, j) which represent pixel (x, y) with

$(x, y) = 1$ and

$(x, y) = j, 0 \leq r_{ij} \leq M \times N$, then the joint probability mass function P_{ij} is given by

$$P_{ij} = \frac{r_{ij}}{M \times N}$$

Where $i, j = 0, \dots, L - 1, \sum_{i=0}^{L-1} \sum_{j=0}^{L-1} = 1$

Figure represents the top view of 2D histogram. It covers a square region with size $L \times L$.

x coordinate (i) is representing black level and the y coordinate (j) is representing local average black level. The graph is divided into four quadrants at vector where $0 \leq S \& T \leq L - 1$.

Two-dimensional Otsu Method:

$$p_0(s, t) = \sum_{i=0}^s \sum_{j=0}^t p_{ij} \quad p_1(s, t) = \sum_{i=s+1}^{L-1} \sum_{j=t+1}^{L-1} p_{ij} \quad (8)$$

The corresponding class mean levels are

$$\mu_0 = (\mu_{00}, \mu_{01})^T = \left(\frac{\sum_{i=0}^s \sum_{j=0}^t i \cdot p_{ij}}{p_0}, \frac{\sum_{i=0}^s \sum_{j=0}^t j \cdot p_{ij}}{p_0} \right) \quad (9)$$

$$\mu_1 = (\mu_{10}, \mu_{11})^T = \left(\frac{\sum_{i=s+1}^{L-1} \sum_{j=t+1}^{L-1} i \cdot p_{ij}}{p_1}, \frac{\sum_{i=s+1}^{L-1} \sum_{j=t+1}^{L-1} j \cdot p_{ij}}{p_1} \right) \quad (10)$$

The total-mean level vector of Two dimensional histogram is

$$\mu_t = (\mu_{T0}, \mu_{T1})^T = \left(\sum_{i=0}^{L-1} i \cdot p_{ij}, \sum_{i=0}^{L-1} \sum_{j=0}^{L-1} j \cdot p_{ij} \right) \quad (11)$$

A threshold vector (S, T) is selected by maximizing $t_r S_B$

$$t_r S_B(S, T) = \max_{0 < s, t < L-1} (t_r S_B(s, t)) \quad (12)$$

Here we using following fast recursive algorithm to obtain the above method.

$$p_0(s, 1) = p_0(s-1, 1) + p_{s1} \quad (13)$$

$$p_0(s, t) = p_0(s, t-1) + p_0(s-1, t) - p_0(s-1, t-1) + p_{st} \quad (14)$$

$$\mu_i(s, 1) = \mu_i(s-1, 1) + s \cdot p_{s1} \quad (15)$$

$$\mu_i(s, t) = \mu_i(s, t-1) + \mu_i(s-1, t) - \mu_i(s-1, t-1) + s \cdot p_{st} \quad (16)$$

$$\mu_j(s, 1) = \mu_j(s-1, 1) + t \cdot p_{s1} \quad (17)$$

$$\mu_j(s, t) = \mu_j(s, t-1) + \mu_j(s-1, t) - \mu_j(s-1, t-1) + t \cdot p_{st} \quad (18)$$

Two dimensional histogram analyses: Because of Otsu threshold approach proposed method will give the improper results when the size of the object is very different from the background [10], so we are applying 2D histogram projection to get correct Otsu threshold. In our renal biopsy samples, the object we want has a high gray level. If we project the 2D histogram in x and y axes, the last peak must be object. So after projection, the valleys corresponding to the last peak in x and y axes are regarded as the auxiliary threshold. The final threshold is calculated as

$$(S_{final}, T_{final}) = \left(\frac{S_{otsu} + S_{hist}}{2}, \frac{T_{otsu} + T_{hist}}{2} \right) \quad (19)$$

Where (S_{otsu}, T_{otsu}) is the threshold by Otsu method and (S_{hist}, T_{hist}) is the threshold by histogram analysis. By applying all the above steps our image get segmented which makes us easy to detect the presence of cancer cells through which on early stage of cancer the patient should get the treatment to avoid measure problems

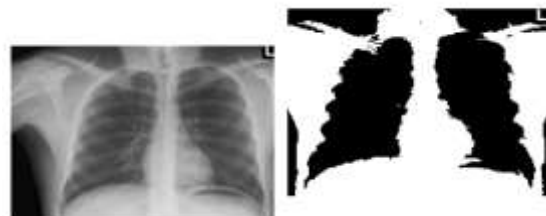


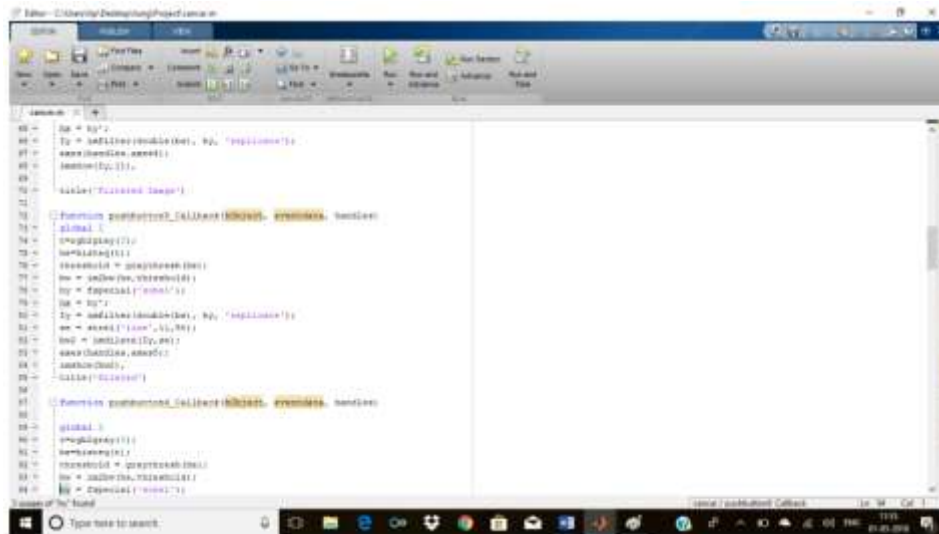
Figure-5 Two dimensional histogram analysis

We have compared 2D histogram projection with traditional Otsu method through which we can solve the problem which were occurring in traditional Otsu. Using this method, the problem of its sensitivity to the object size can be overcome.

4. Morphological Operation:

After segmentation of images, morphological operation is performed it is used to obtain individual lung images and also to remove unnecessary parts. Morphology is a technique of image processing based on shapes. A structuring element is a shape mask used in the basic morphological operations. Morphology is performed into two operations that are: -Dilation and Erosion. Dilation operation is used to extract image component which is used to extract image components that are useful in the representation and description of region shape such as boundaries, skeletons, and convex hull. Dilation of a set A by another set B is denoted by:

$$A \oplus B = \{z | (B)_z \cap A \neq \phi\} \quad (1)$$



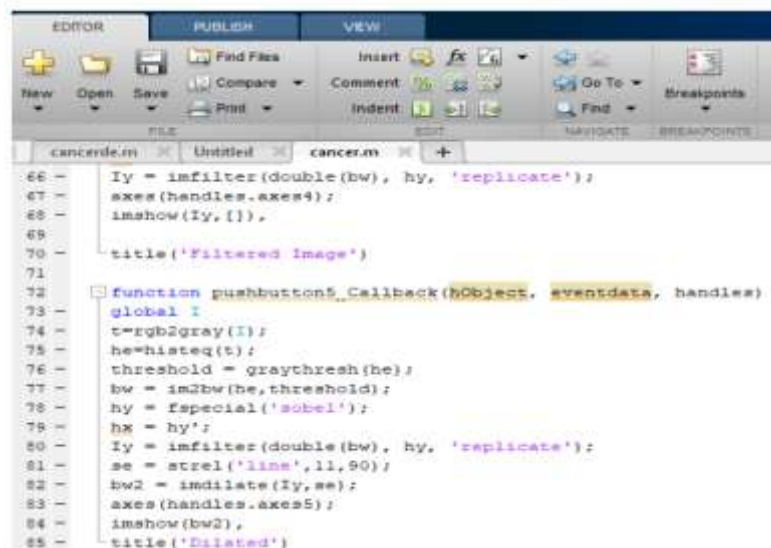
```

66 - Iy = imfilter(double(bw), hy, 'replicate');
67 - axes(handles.axes4);
68 - imshow(Iy, []);
69 - title('Filtered Image');
70 -
71 - function pushbutton5_Callback(hObject, eventdata, handles)
72 - global I
73 - t=rgb2gray(I);
74 - he=histeq(t);
75 - threshold = graythresh(he);
76 - bw = im2bw(he,threshold);
77 - hy = fspecial('sobel');
78 - hx = hy';
79 - Iy = imfilter(double(bw), hy, 'replicate');
80 - se = strel('line',11,90);
81 - bw2 = imdilate(Iy,se);
82 - axes(handles.axes5);
83 - imshow(bw2);
84 - title('Dilated');
85 -

```



Figure-6 Dilation Operation showing input image and code



```

66 - Iy = imfilter(double(bw), hy, 'replicate');
67 - axes(handles.axes4);
68 - imshow(Iy, []);
69 - title('Filtered Image');
70 -
71 - function pushbutton5_Callback(hObject, eventdata, handles)
72 - global I
73 - t=rgb2gray(I);
74 - he=histeq(t);
75 - threshold = graythresh(he);
76 - bw = im2bw(he,threshold);
77 - hy = fspecial('sobel');
78 - hx = hy';
79 - Iy = imfilter(double(bw), hy, 'replicate');
80 - se = strel('line',11,90);
81 - bw2 = imdilate(Iy,se);
82 - axes(handles.axes5);
83 - imshow(bw2);
84 - title('Dilated');
85 -

```

Figure-7 Dilation Operation Output

In feature extraction there are several methods through which we can detect or remove portions that are present in a image. To analyze the probability of lung cancer presence, we are applying – Gray level Co-occurrence matrix. GLCM is a matrix where the number of rows and columns is equal to the number of gray levels in the image.

Neighbour pixel value Ref pixel value:	0	1	2
0	0,0	0,1	0,2
1	1,0	1,1	1,2
2	2,0	2,1	2,2

Figure-8 Calculation of GLCM

```

Editor - C:\Users\hp\Desktop\lung\Project\cancer.m
EDITOR PUBLISH VIEW
New Open Save Compare Comment Indent Go To Breakpoints Run Run and Advance
FILE EDIT NAVIGATOR BREAKPOINTS RUN
cancer.m x Untitled cancer.m x Untitled2.m x +
134 - Iy = imfilter(double(bw), hy, 'replicate');
135 - se = strel('line',11,90);
136 - bw2 = imdilate(Iy,se);
137 - BW5 = imfill(bw2,'holes');
138 - C=BW5;
139 - c1=mean(C);
140 - c2=var(double(C));
141 - d=C;
142 -
143 - GLCM2 = graycomatrix(d,'Offset',[2 0;0 2]);
144 - c4 = graycoprops(GLCM2,{'contrast','homogeneity','Energy'});
145 - set(handles.edit4,'string',num2str(min(c4.Energy)));
146 - c24= graycoprops(GLCM2,'contrast');
147 - set(handles.edit3,'string',num2str(min(c24.Contrast)));
148 - c5=corr(double(d));
149 - c6=c5(1,:);
150 - c7=c1;
    
```

Figure-9 Code of GLCM

```

Editor - C:\Users\hp\Desktop\lung\Project\cancer.m
EDITOR PUBLISH VIEW
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105 - function pushbutton7_Callback(hObject, eventdata, handles)
106 - global I
107 - t=rgb2gray(I);
108 - h=histeq(t);
109 - threshold = graythresh(h);
110 - bw = im2bw(h,threshold);
111 - hy = fspecial('sobel');
112 - h8 = hy';
113 - Iy = imfilter(double(bw), hy, 'replicate');
114 - se = strel('line',11,90);
115 - bw2 = imdilate(Iy,se);
116 - BW5 = imfill(bw2,'holes');
117 - disp('Contrast Value');
118 - cmap = contrast(BW5);
119 -
120 - disp('Entropy Value');
121 - E = entropy(BW5);
122 - set(handles.edit2,'string',num2str(E));
123 -
    
```

Figure- 10 Code of Entropy and contrast

Statistical parameters calculated from GLCM values are as follows:-

A. Entropy

$$Entropy = - \sum \sum (i, j) \log p(i, j) \quad (20)$$

Where p is the number of gray level co-occurrence matrices in GLCM.

B. Contrast

$$Contrast = \sum \sum (i - j)^p p(i, j) \quad (21)$$

Where $(i, j) = \text{pixel at location}(i, j)$

C. Energy

$$Energy = \sum \sum (p(i, j))^2 \quad (22)$$

Table-1 Value of energy, contrast and entropy

S.No (images)	Entropy	Contrast	Energy
1.	0.39507	0.94255	0.8195
2.	0.76678	2.931	0.59029
3.	0.99408	1.0731	0.46667
4.	02.9395	3.2409	0.43659

5. Neural network Training Set:

Here we are applying neural network training set to get various levels of success for prediction that we have been performed in above steps. Through this we will get a prediction model which will show how much the performed job is correct. We have formed a manual dataset by that is obtained from feature extraction step. The data is based on the value of Entropy, Contrast and Energy. Through which we can predict how many person are suffering from cancer and how many are not suffering from cancer. To perform this job we have made dataset of 3 types input dataset, sample dataset and target dataset

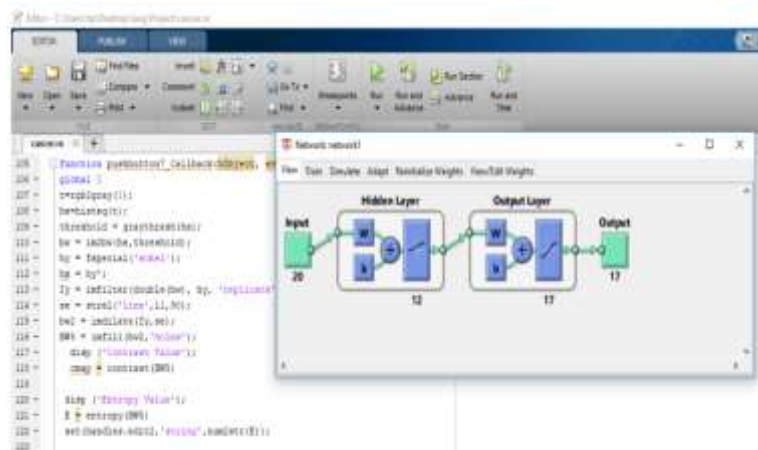


Figure-11 Neural network Training Set

6. Result and discussion:

GUI Design: GUI Design of lung cancer detection



Figure-12 GUI Design

Extraction of Neural Network

Step.1 When all 3 dataset are applied for designing neural network on (nntool) inbuilt in MATLAB.

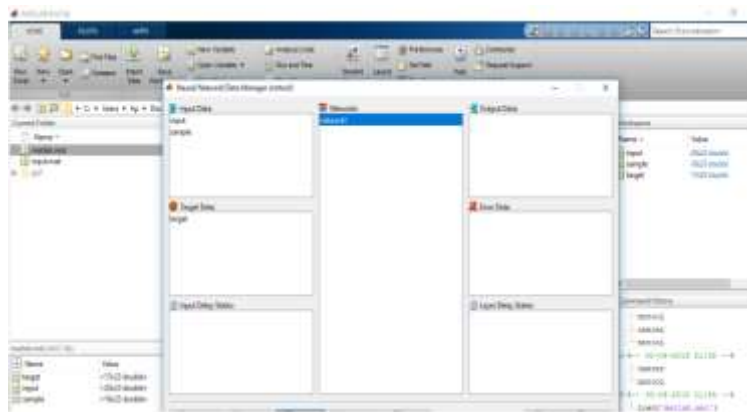


Figure-13 NetworksForming Step

Step 2. Viewing the training dataset.

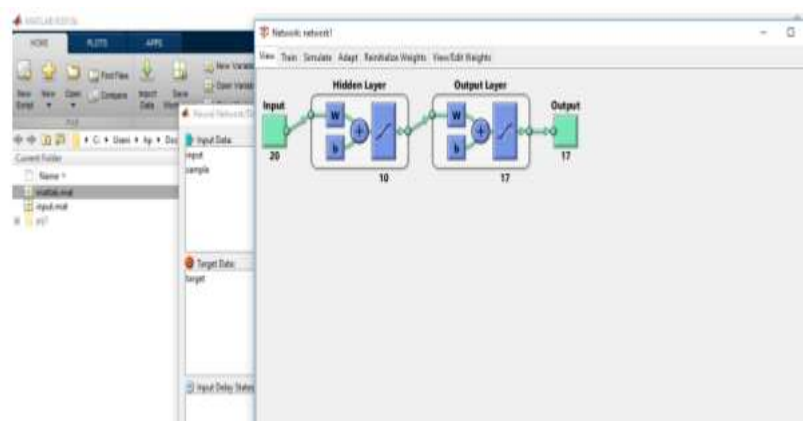


Figure-14 viewing network

Step 3. while applying training parameters

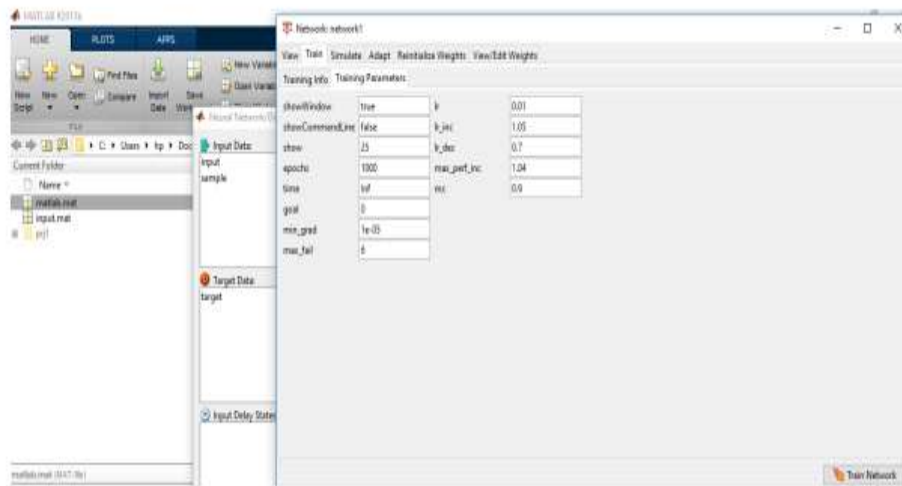


Figure-15 Applying Training Parameters

Step 4 Output obtained by neural training set

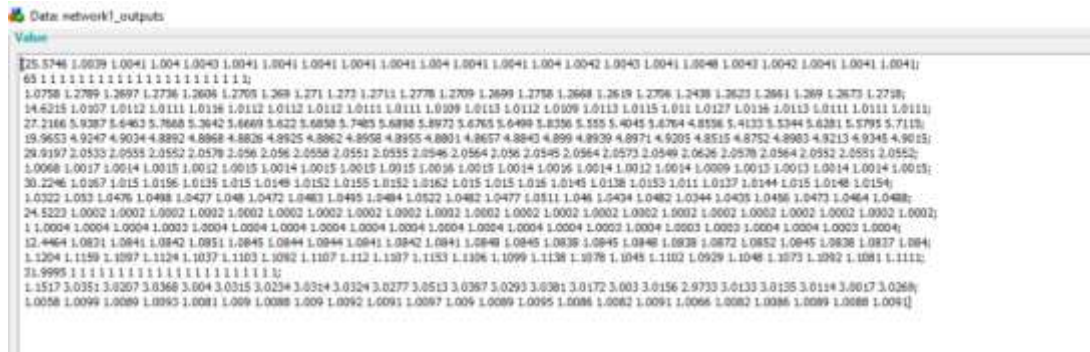


Figure-16 network1 Output

Step 5 Obtaining network error

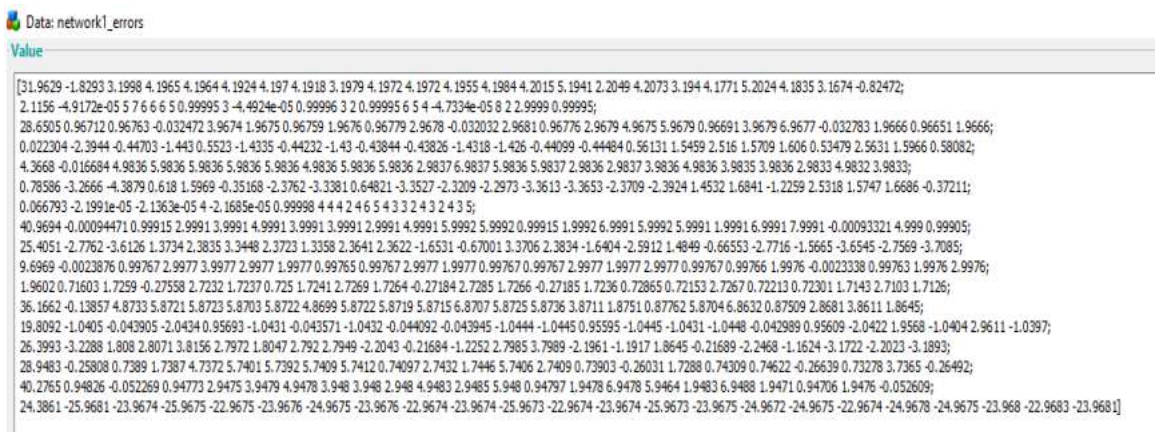


Figure-16 Networkerrors

Step 6 In this step we will be able apply process in Epoch, Time, Performance, Gradient, Validation checks.

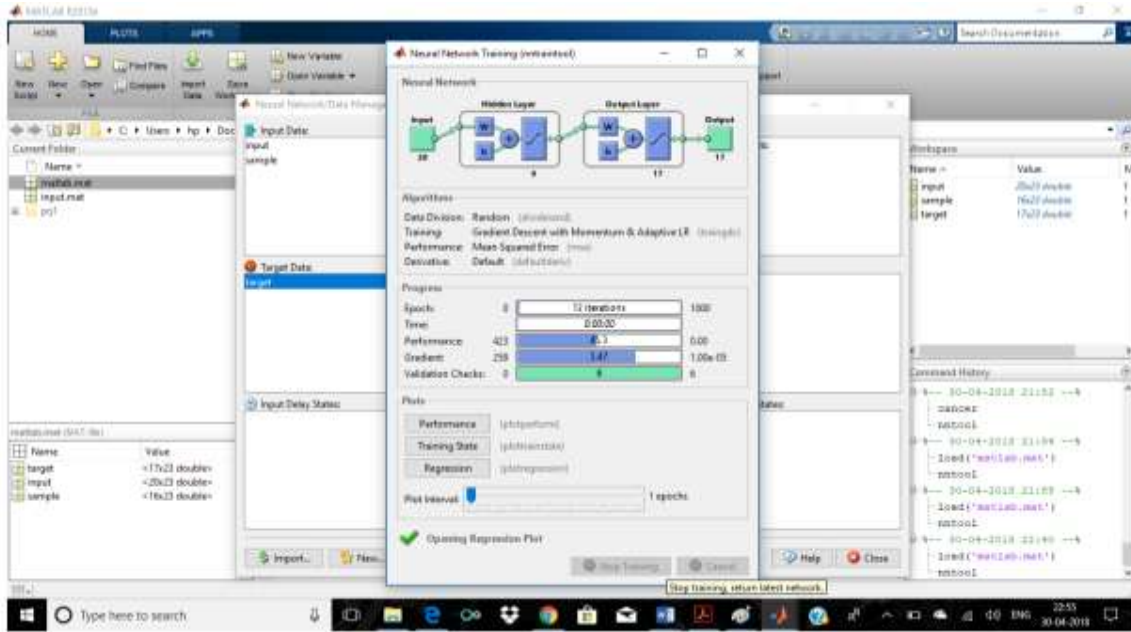


Figure-17 final neural network training

The Best Validation Performance is 44.6161 at epoch 6

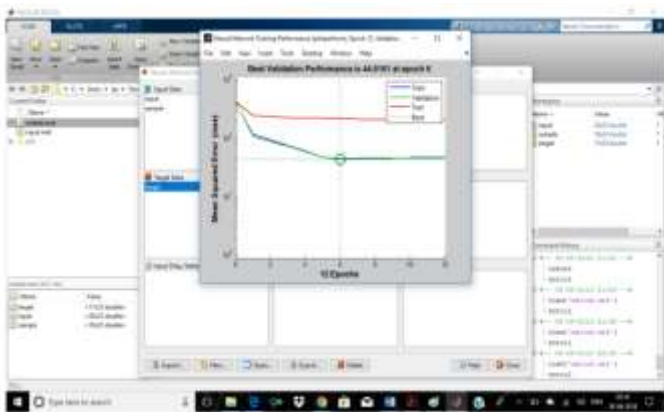


Figure-18 graphical representation of epoch

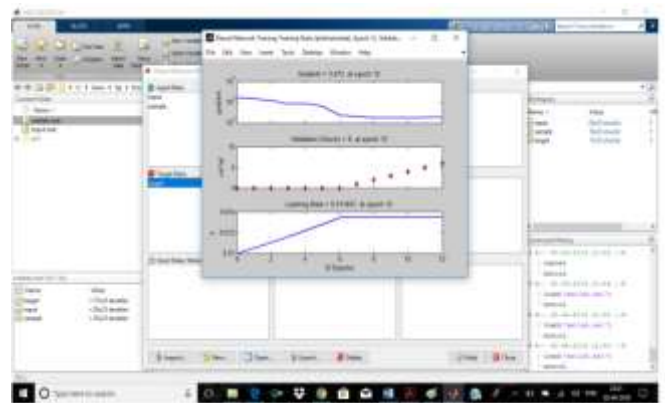


Figure-19 performance of neural network

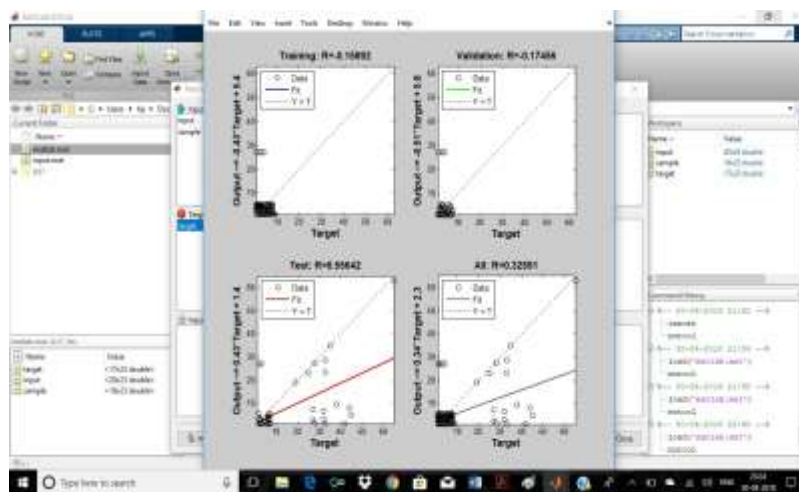


Figure-20 Result of all training from input, sample and target

7. Conclusion

The presented work is the detection of lung cancer nodules by applying implementation on image preprocessing and segmentation. By implementing these steps the nodules are detected and then some features are extracted. Then the obtained features are used for the classification of the disease stages. Through the obtained nodules feature more information about the condition of lung cancer at the early stages. After that we have applied prediction model by applying that we predict from the obtained dataset from feature extraction to know how many people suffering from cancer or not. This technique helps the radiologists and the doctors by providing more information and taking correct decision for lung cancer patient in short time with accuracy. Therefore, this method is less costly, less time consuming and easy to implement. Lung cancer is one of the most dangerous diseases in the world. Correct Diagnosis and early detection of lung cancer can increase the survival rate. The present techniques include study of X-ray, CT scan, MRI, PET images. The expert physicians diagnose the disease and identify the stage of cancer by experience. The treatment includes surgery, chemotherapy, radiation therapy and targeted therapy. These treatments are lengthy, costly and painful. Hence, an attempt is made to atomize this procedure to detect the lung cancer using image processing techniques. CT scan images are acquired from various hospitals. These images include less noise as compared to X-ray and MRI images. An image improvement technique is developing for earlier disease detection and treatment stages; the time factor is taken in account to discover the abnormality issues in target images. The CT captured images are processed. The region of interest i.e., tumor is identified accurately from the original image. Gabor filter and watershed segmentation gives best results for pre-processing stage. From the extracted region of interest, three features are extracted i.e., area, perimeter and eccentricity. These three features help to identify the stage of lung cancer. The results indicate that the tumors are of different dimensions. By measuring the dimensions of the tumor the lung cancer stage can be detected accurately using the proposed method. The results show good potential for lung cancer detection at early stage. Also for classification purpose, Support Vector Machines are an attractive approach to data modeling. They combine generalization control with a technique to address the curse of dimensionality. The kernel mapping provides a unifying framework for most of the commonly employed model.

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