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Quantitative And Qualitative Analysis For Lung Nodule Segmentation

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Abstract

Prevention of lung cancer is the toughest problem due to cancer cells' structure, where most of the cells are combined. The image processing techniques are mostly used for the prediction of lung cancer and also for early detection and treatment to prevent lung cancer. Various features are extracted from the 2D images; therefore, pattern recognition based approaches are useful for predicting lung cancer. 2D Image processing techniques are used in most medical areas for image improvement and analysis in earlier detection and treatment stages. The time factor is very important to discover the abnormality points in target images, especially in various cancer nodules such as lung cancer, breast cancer. Image quality assessment and efficiency are the main factors of this research; image quality assessment, as well as improvement, are depending on the enhancement stage where low pre-processing techniques are used based on the filter. Following the Output segmentation principles, an enhanced region of the object of interest used as a basic foundation of feature extraction is obtained. Relying on general features, a normality comparison is made. A comprehensive and comparative review for lung cancer prediction by a previous researcher using image processing techniques is presented. The objection for the prediction of lung cancer by a previous researcher using image processing techniques is also presented

Keywords — *Image processing, Segmentation, lung cancer, feature extraction.*

I. INTRODUCTION

Lung cancer, also called carcinoma of the lungs, is caused due to the unstoppable growth of cells in the lung tissues. Most cases of lung cancer are due to smoking. The treatment of this disease and its outcomes depends on the type of cancer, stage, i.e., degree of spread, and persons' all health performance. Exhaled breath analysis is becoming an increasing area of interest for studying the respiratory system and function. Exhaled breath and some more parameters have been analyzed in non-malignant respiratory disorders such as chronic obstructive pulmonary disease (COPD), asthma, bronchiectasis, cystic fibrosis, and pulmonary fibrosis. Measurement of VOCs in the gaseous phase of exhaled breath has become an increasing research area, including lung cancer. Some are now in early clinical development. Other VOC methods adapt include solid-phase microextraction (SPME), a virtual array of surface acoustic wave (SAW) gas sensors with an imaging recognition technique. Possible biomarkers indicative of pulmonary carcinogenesis

II. LITERATURE SURVEY

Image processing techniques have been used to detect early-stage lung cancer in CT scan images. The CT scan image is pre-processed, followed by Segmentation of the ROI of the lung. Discrete waveform Transform is applied for image compression, and features are extracted using a GLCM. The results are fed into an SVM classifier to determine if the lung image is cancerous or not. The SVM classifier is evaluated based on an LIDC dataset. The classifier achieves an accuracy of 95.16%, a sensitivity of 98.21%, and a specificity of 78.69%. In future work, sensitivity and accuracy could be improved further by improving the candidate nodule pruning algorithm.

III. SYSTEM IMPLEMENTATION

The medical specialist first identifies the pulmonary nodules from a CT scan and then makes a possible prognosis based on the nodule morphology assessment, including the clinical context. However, he often has to analyze many nodules and make a prognosis quickly, and such tasks become burdensome under these circumstances. Thus, computer-aided diagnosis (CAD) systems have arisen to overcome such situations. CAD systems are categorized into two groups, (i) detection systems (CADe) and (ii) diagnostic systems (CADx). CADx systems perform an automatic diagnosis based on features extracted from the system input images. The automatic classification of the nodules into malignant or benign using CT images supports the medical specialist when assessing nodules.

A combination of texture and shape features was used for the classification of pulmonary nodules into malignant or benign ones using several classifiers. The author used 25 cases. The highest accuracy achieved was 95%. A deep learning model of the Neural Network to classify the lung nodules was introduced.

The remaining part of this work is organized as the feature extractors and classification methods and details the proposed approach and the experiment setup. Then, we present the results and its discussion. Finally, some concluding remarks are presented.

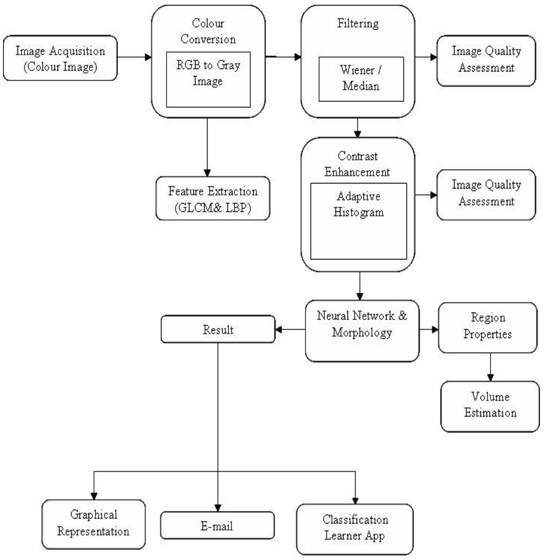

Fig. 1 Block diagram – MATLAB Unit

A. Image Acquisition

Digital processing is the creation of a digitally encoded representation of the visual characteristics of an object, such as a scene or the interior structure of an object. The term is often assumed to imply or include the digital processing, compression, storage, printing, and display of such images. The main advantage of a digital image, versus an analog image such as a film photograph, is making copies lose image quality.

Fig. 2 Input Image

B. Gray Image

Grayscale images are distinct from one-bit bi-tonal black-and-white images, which, in the context of image processing, are images with only two colors: black and white (also called bi-level or binary images). Greyscale images have many shades of gray in between.

Fig 3 Gray Image

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

If the original primary color image has no defined color space, or if the grayscale image is extended to have the same human-perceived achromatic intensity as the color image, then there is no unique mapping from such a color image to a grayscale image.

C. Median Filter

The Median Filter is a non-linear digital filtering technique, often used to reject noise from an image or signal. Such noise reduction is a main pre-processing step to improve later processing results (for example, edge detection on an image). Image Median filtering is very used in digital image processing because, under certain conditions, it preserves edges while removing noise (but see discussion below), also having applications in signal processing.

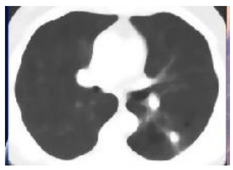

Fig 4 Median Filter

AD	2.35028
MD	218
MSE	501.13
RMSE	22.3859
PSNR	21.1313
NAE	0.0616983
NCC	0.978377
SC	1.02764

Fig 5 Image Quality Assessment Result

D. Wiener Filter

In 2D image processing, the Image Wiener filter is a filter used to produce an estimate of a desired or target random process by linear time-invariant (LTI) filtering of an observed noisy process, assuming known stationary signal and noise spectra, and additive noise. The Image Wiener filter minimizes the mean square error between the estimated random process and the desired process.

Fig 6 Wiener Filter

AD	0.0315647
MD	44
MSE	23.672
RMSE	4.86539
PSNR	34.3885
NAE	0.0193031
NCC	0.99683
SC	1.0056

Fig 7 Image Quality Assessment Result

E. Gray Level Co-Occurrence Matrix (GLCM):

Feature extraction Gray Level Co-Occurrence involves simplifying the number of resources required to describe a large set of data accurately. Feature extraction using GLCM is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy. Texture analysis aims to find a unique way of identifying the underlying characteristics of textures and represent them in some simpler but unique form to be used for robust, accurate classification and Segmentation of objects.

CORRELATION	0.933877
CONTRAST	0.798584
ENERGY	0.310004
HOMOGENITY	0.89085

Fig 8 GLCM Output

F. Neural Network

Neural network using MATLAB software is used to execute research, develop, and apply ANN software concepts adapted from biological neural networks, and in some cases, a wider array of adaptive systems such as artificial intelligence, deep learning, and machine learning.

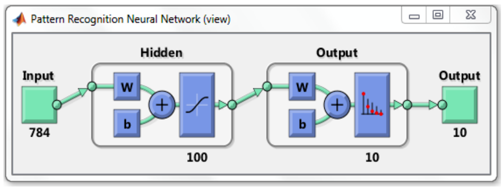

Fig 9 Neural Network Block Diagram

G. Adaptive Histogram Equalization

Adaptive histogram equalization (AHE) is a computer 2d image processing technique method used to improve contrast in images. It totally diverts from ordinary histogram equalization in the respect that the adaptive method computes several histograms technique, each corresponding application to a distinct section of the image, and uses them to redistribute the lightness values of the image. It is, therefore, suitable for improving the local contrast and enhancing the definitions of edges in each region of an image.

However, AHE tends to amplify or increase the noise in relatively homogeneous application regions of an image. A variant of adaptive histogram equalization called contrast limited adaptive histogram equalization (CLAHE) prevents this by limiting the amplification.

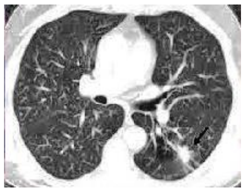

Fig 10 Image Enhancement

AD	-0.48569
MD	69
MSE	400.348
RMSE	20.0087
PSNR	22.1064
NAE	0.0905233
NCC	0.980973
SC	1.02563

Fig 11 Image Quality Assessment Result

Fig 12 Region Properties Parameters

H. Image Quality Assessment

Measurement of image quality assessment for an image is important for many 2d image processing applications. Image quality assessment is basically related to image Quality assessment in which quality is based on the differences (or similarity) between a degraded image and the original, unmodified image. Subjective evaluations are good expensive, and good time-consuming. It is not possible to execute them into automatic real-time systems. Objective evaluations can be defined as automatic and mathematical way defined algorithms. Subjective measurements can be used to validate the usefulness of objective measurements. Therefore objective methods have attracted more attention in recent years. Major objective evaluation algorithms approach for measuring image quality include Mean squared error (MSE) and peak signal-to-noise ratio (Peak Signal Noise Ratio). Mean squared error & Peak Signal Noise Ratio are very simple and easy to use.

IV. OUTPUT

Qualitative analysis like Clustering and quantitative analysis like feature extraction and image quality assessment is used to segment cancer detected portion in lung scanned images. To segment, the portion first has to filter out the acquired image based upon the masking methodology. The Clustering function will be applied extracted throughout the filtered image. By method of the morphological bounding box will be drawn over the affected portion. Then, the region enclosed by the bounding box will be segregated separately. After filtering and contrast enhancement, image quality assessment (Mean Square Error, Peak Signal to Noise Ratio) is calculated to compare other techniques. After segmenting the cancer region, the patient's caretaker can receive the details through E-mail as a report. Finally, Accuracy estimation will be done for the efficient algorithm level.

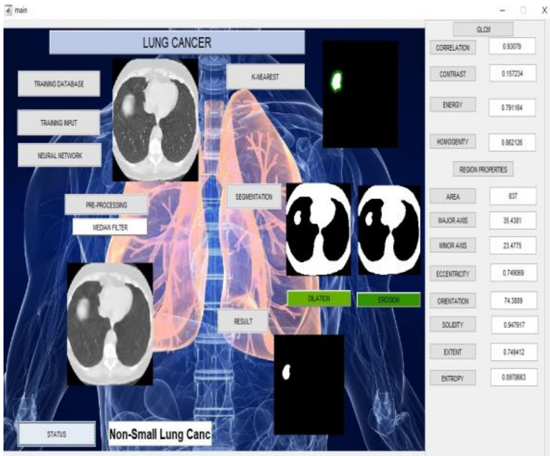

Fig 13 Lung Nodule Detection

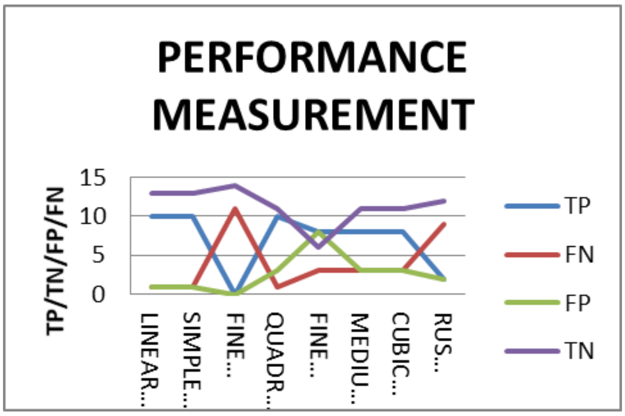

Fig: 14 Performance Measurement

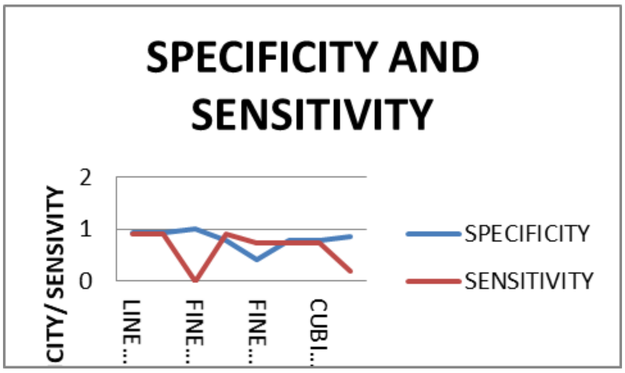

Fig: 15 Specificity And Sensitivity

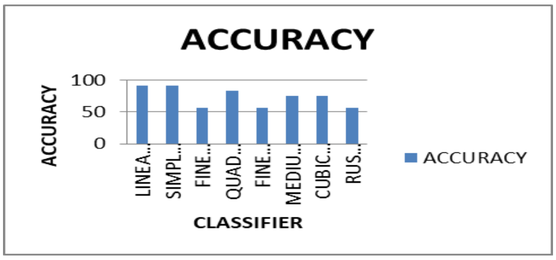

Fig: 16 Accuracy

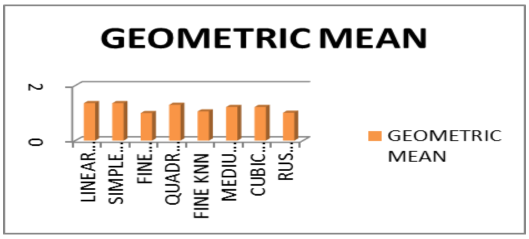

Fig:17 Geometric Mean

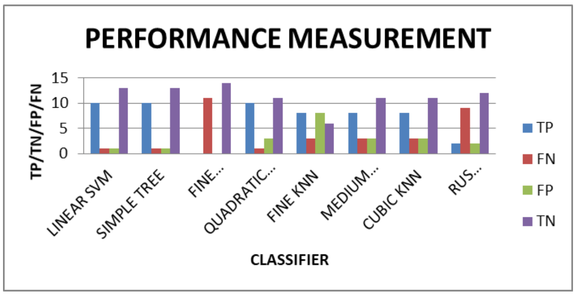

Fig: 18 Performance Measurement

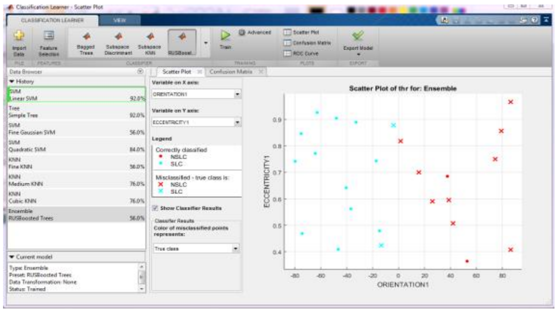

Fig: 19 Linear SVM

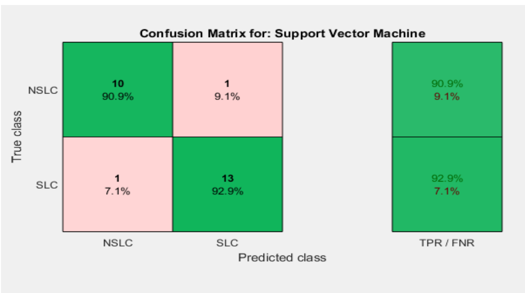

Fig: 20 Confusion Matrix SVM

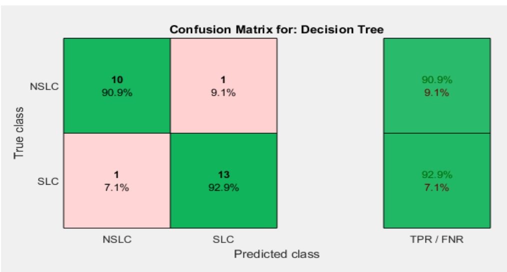

Fig: 21 Confusion Matrix – Decision Tree

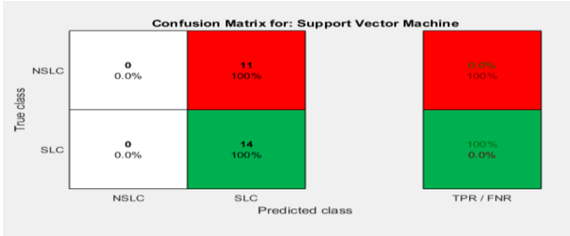

Fig: 22 Confusion Matrix SVM

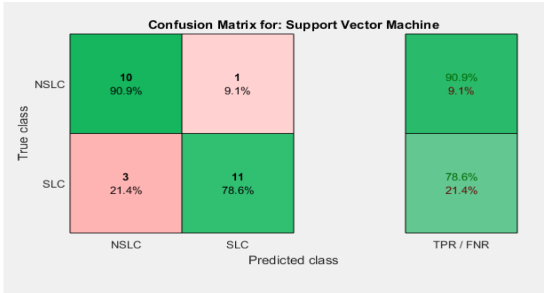

Fig: 23 Confusion Matrix SVM

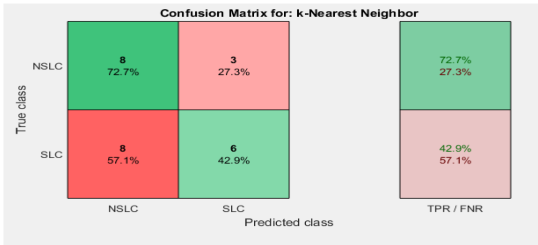

Fig: 24 Confusion Matrix KNN

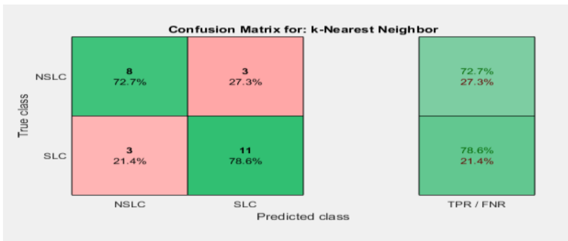

Fig: 25 Confusion Matrix KNN

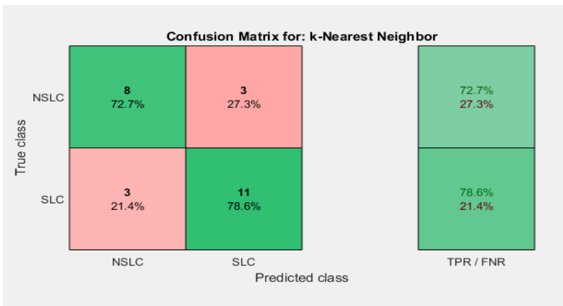

Fig: 26 Confusion Matrix KNN

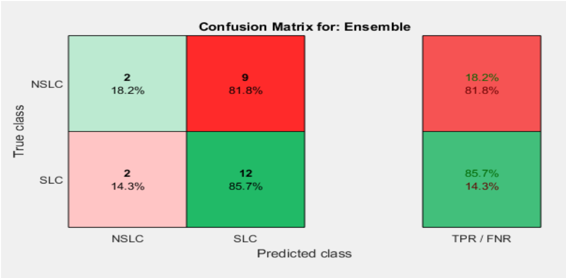

Fig:27 Confusion Matrix Ensemble

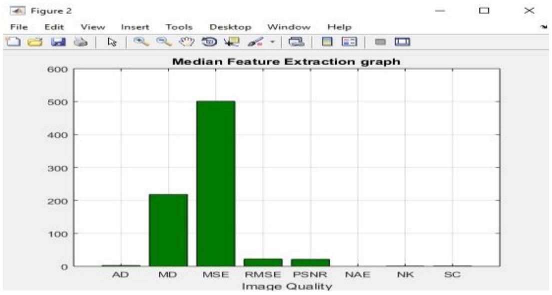

Fig:28 Median Feature Extraction Graph

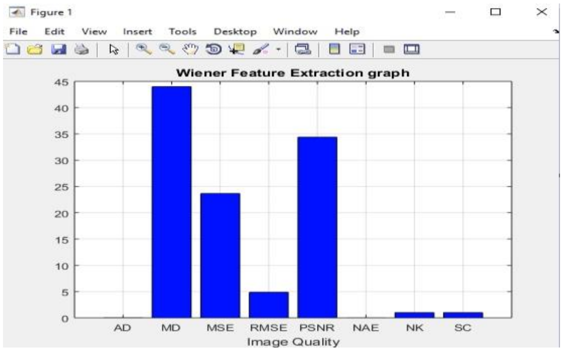

Fig:29 Weiner Feature Extraction Graph

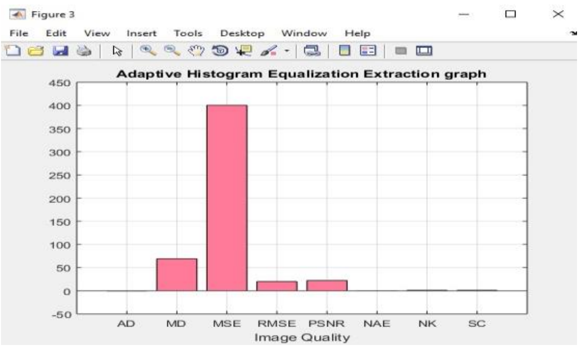

Fig:30 Adaptive Histogram Equalization Extraction Graph

V. CONCLUSIONS

In this paper, the finding of Lung cancer is made using KNN techniques, blood vessel segmentation, and detection employing intensity computation, thresholding, and features extraction. As an extension of our work, it is suggested to optimize the features selected, and the foremost features with different classifier techniques can be compared and analyzed

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