A Review on Lung Cancer Detection using PET Scan

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Abstract- *Image processing techniques are widely used in the medical field for image improvement in earlier detection and treatment stages. Here, time factor is crucial to discover the abnormality in target images, especially in cancer tumours such as lung cancer. Lung cancer is a disease characterized by uncontrolled growth of cell in tissues of the lung. If left untreated, this growth can spread beyond the lungs, even, into other parts of the body. Image quality and accuracy are the core factors. Image quality assessment and improvement depend on the enhancement stage where a low pre-processing technique is used, which is based on Gabor filter within Gaussian rules. For early detection and treatment stages image processing technique are widely used and for prediction of lung cancer, identification of genetic as well as environmental factors are very important in developing novel method of lung cancer prevention. In various cancer tumours such as lung cancer the time factor is very important to discover the abnormality issue in target images. Prediction of lung cancer we consider significant pattern and their corresponding weight age and score using decision tree algorithm. Using the significant pattern tool for lung cancer prediction system will develop.*

Keywords- Manet Routing, Energy Efficiency, EPAR, Cryptography.

I. INTRODUCTION

Image processing techniques provide a good quality tool for improving the manual analysis. Image processing techniques are used in several areas such as military, space research, medical and many more. In this proposed system image processing techniques are used for image improvement in earlier detection and treatment stages. Image quality assessments as well as improvement are depending on the enhancement stage where pre-processing technique is used based on principal component analysis and Histogram Equalization. Classification is very important part of digital image analysis. It is computational procedure that sort images in to groups according to their similarities. In proposed system Histogram Equalization is used for pre-processing of images and feature extraction process and neural network classifier to check the state of a patient in its early stage whether it is normal or abnormal. After that we will predict the survival rate of patient by extracted features. Lung cancer is one of the major reasons of death from cancer in the world. Small-cell lung cancer (SCLC) and non-small-cell lung cancer (NSCLC) are the two categories of cancer. It is a state which consists of uncontrollable growth of cell and tissues in affected part. If it is not treated, this growth can spread beyond the lung by procedure of metastasis into nearby tissue or other parts of the body. Surgery, chemotherapy and radiotherapy are the common treatments of cancer. Overall, 15% people diagnosed with lung cancer survive five year after the diagnosis [1].

The early detection of lung cancer can increase overall 5-year survival rates from 14 to 49 percent for patients [2]. Hence, computer-aided diagnosis (CAD) systems using images processing are implemented to find the occurrence of lung cancer cell in a CT-Scam images of patients. The typical CAD system for lung cancer detection mainly consists of four phases: segmentation of the lung, detection of nodules, segmentation of nodules and diagnosis. The main aim of this review is to analyse the various nodules detection techniques that are used by present existing CAD for lung nodule detection at early stage. In addition, we also outline the strengths and limitation of the existing approaches.

Cancer is one of the most serious health problems in the world. In 2012, cancer is leading cause of death worldwide, accounting for 8.2 million deaths. The mortality rate of lung cancer is the highest among all other types of cancers, contributing about 1.3 million deaths/year globally [1]. According to the report of World Health Organization (WHO), death rate caused by lung cancer has already jumped to the highest among all cancers in the world. It is responsible for more than 25% of all cancer-related deaths every year and kills more people than breast, colon and prostate cancers combined [2].

Usually, lung cancer does not cause symptoms early in the disease process, and is mostly diagnosed at a late stage in a clinical setting, when the probability of cure is rare. Only 16% of lung cancer patients are diagnosed before their diseases have spread to other parts of their bodies (e.g., regional lymph nodes and beyond), compared to more than 50% of breast cancer patients and 90% of prostate cancer patients [3]. These figures call for effective cancer control and prevention strategies such as lung cancer screening programs.

Lung cancer can be detected using chest radiograph and Computed Tomography (CT) scan. Chest radiograph is used to investigate the occurrence of the disease however the extent and the type of the disease can be exposed using CT scan. In

CT scan nodule is defined as a rounded and irregular opaque figure on a CT scan, with a diameter up to 30mm. Each scan contains hundreds of images that must be evaluated by a radiologist, which is a difficult process. So for this reason, the use of a Computer-Aided Detection (CAD) system can provide an effective solution by assisting radiologists in increasing the scanning efficiency and potentially improving nodule detection [4]. CAD is a relatively new technology combining elements of computer vision: an application area of artificial intelligence, and digital image processing. The applications of CAD include identification of cancer in lung(s), breast(s), and colon, coronary artery disease, heart congenital defect, and nuclear medicine. In radiology CAD implies that the radiologist uses the outcome of computerized analysis of a medical image [5]. The underlying idea is to increase overall sensitivity detection rate through automated identification of suspicious objects, rather than absolute delegation of diagnosis to deployed CAD system. Consequently, the associated advantages are manifold. CAD increases therapy success in case of early disease detection, and may avoid unnecessary biopsies. Further, it reduces error rate in screening situations with massive load of medical images [6]. In this paper we propose method for detection of Lung cancer using image processing (mean shift) algorithm followed by edge detection using Morphological operator.

II. RELATED STUDY

Fuzzy k-c-means clustering algorithm used for medical image segmentation which was introduced in (Ajala, 2012). Here fuzzy-c-means is a method of clustering algorithm which allows one piece of data belongs to two or more clusters and k-means is a simple clustering method in which we use low computational complexity as compared to fuzzy c-means. When both Clustering methods were combined to produce a more time efficient segmentation algorithm called as fuzzy-k-c-means clustering algorithm. They offered that thresholding which is the most elementary technique for medical image segmentation, in which this algorithm divides pixels in different classes depending upon their gray level. It is also said that it approaches division of scalar images by forming a binary partition of the intensity values of an image and lastly determines an intensity value. This intensity value is termed as threshold, which separates the desired classes. Classifier techniques which were used for pattern recognition, partitions a feature space derived from the image using data with known labels. A feature space is a set of N*M matrix where N relates to the number of observations and M relates to the number of attributes. Classifiers are known as supervised methods since they require training data which are manually segmented and then used it for automatically segmenting new data.

A comparison between two methods was made in (Christian, 2012). These methods are rule based method and Bayesian classicism method for the extraction of cell region from background and debris cell region, and after experimentation the Bayesian classicism method was found applicable for classification of sputum cell region from background region. But they did not remove the nucleus region from cytoplasm region with this technique.

In this (Fatma, 2012) two more segmentation methods were used which were Hopfield Neural Network (HNN), and Fuzzy C-Mean (FCM) clustering algorithm. In this they found that the HNN provides enhanced, accurate and reliable segmentation results than FCM clustering in all cases. The HNN also divides the nuclei and cytoplasm regions while FCM failed in the detection of the nuclei. FCM only detected a part of the nucleus not the whole nucleus in a particular cell. Also FCM was not found subtle to intensity variations because the segmentation error at convergence was found larger with FCM in comparison to HNN. According to the utmost latest estimates of the statistics which are provided by world health organization indicates that there happened around 7.6 million deaths worldwide each year because of this type of cancer. Moreover, they also found that mortality from cancer are estimated to rise continuously, and will come near to 17 million deaths worldwide in 2030. So, better methods are required to extract the nucleus region for very early detection. A magazine in (IEEE, Pulse) provided us the knowledge about current trends in medical image analysis.

In (Mokhled, 2012) first images which were improved through Gabor filter. It has given better results than other enhancement techniques. They only worked on colored image enhancement and not extract the nucleus region and even not the cell region. In Features Extraction stage they acquire the general features of the enhanced and segmented image which later they used in Binarization. A refined Charged Fluid Model (CFM) along with improved Otsu's method was used for the automatic segmentation of MRI images in (Nagesj, 2012). This method gave enhanced results than the result given by the approaches used in previous experiments.

In (Nikita, 2012), a sober edge detection method was used which is based on finding the image gradient. This method tells that intensity of the image will be maximum where there is a separation of two dissimilar regions and thus an edge must exist there. On this basis they found the nodules in CT images.

In (Parsh, 2011), a new variation level set algorithm without re-initialization was used. They also used thresholding to reduce the noise component of the images.

In (Sajith, 2012) glandular cells were detected by using multiple color spaces and two clustering algorithms which were K-means and Fuzzy C-means.

In (Sonith, 2012) an overview of entire process for processing digital images for lung cancer detection is given in this paper. This paper also describes all the essential steps required for the better performance starting from the pre-processing till the very end phase extraction of features.

III. IMPLEMENTATION PROCESS

In this, to obtain more accurate results we divide the work into the following three stages:

- Image Enhancement: To improve the image and eliminate the noise, corruption or interference, three methods are used: Gabor filter (has the best results), Auto enhancement algorithm, and Fast Fourier Transform (FFT).
- Image Segmentation: To segregate and segment the enhanced images, the methods used are: Thresholding approach and Marker-Controlled Watershed Segmentation approach (which gives better results than thresholding).
- Features Extraction stage: To obtain the specific features of the enhanced segmented image using Binarization and Masking Approach.

A. Image Enhancement

The pre-processing of the image starts with image enhancement; the aim of which is to improve the perception of information in the image for human viewers, or to provide better interpretability of the input for other computerized image processing techniques. Image enhancement is a way to improve the quality of image, so that the resulting image is superior to the original one. It also involves the process of improving the quality of the digitally stored image by altering the image with MATLAB™ software. Image enhancement techniques belong to one of two broad categories:

- Spatial domain techniques, which operate directly on pixels.
- Frequency domain techniques, which operate on the Fourier transform of an image.

On the medical images, three types of enhancement techniques were carried out: Gabor filter, Fast Fourier transform, and Auto-enhancement.

B. Image Segmentation

Image segmentation is the next essential process for image analysis. Many of the existing techniques for image recognition depend highly on the result of segmentation. Segmentation divides an image into regions that constitute the image. The segmentation of images in 2D has many useful applications in the medical sector: estimation of volume and visualization of objects of interest, detection of abnormalities (such as tumors), tissue quantification and classification, are among the few. The objective of segmentation is to change the representation of an image into something more meaningful and easier to analyse. Image segmentation is generally used to locate objects and boundaries in images. To be more precise, image segmentation is the process of assigning a label to each pixel in an image such that the pixels with the same label share certain visual characteristics. The result of segmentation is a set of similar segments that collectively make up the entire image. All pixels in a given region are similar with respect to some characteristic or computational property, such as color, intensity or texture. Adjacent regions greatly differ with respect to the same characteristics. Segmentation algorithms are based on one of two basic properties of intensity values: discontinuity and similarity. Discontinuity is to partition the image on the basis of abrupt changes in intensity, such as edges in an image. Similarity is based on partitioning the image into regions that are similar according to some predefined criterion. Histogram thresholding approach falls under this category.

C. Image Feature Extraction

The Image features Extraction stage is a very important stage in image processing which uses algorithms and techniques to detect and isolate various desired portions or shapes (features) of an image, which is essential to predict the probability of lung cancer presence. The objective is that the features should carry enough information about the image and not require any domain-specific knowledge for their extraction. The sequence of stages starting from image enhancement, image segmentation and cropping, and finally feature extraction gets introduced. Feature extraction is a vital stage that results in determining the normality or abnormality of an image. Two approaches fall under this category: first is Binarization and the second is Masking. Both of these methods are based on lung anatomy and related information of lung CT imaging.

D. Lung Cancer Detection And Prediction Technique

The exact segmentation of lung nodules is important and crucial. Well segmentation makes physicians task easy. It

plays a crucial role in proper diagnosis and treatment procedure for lung cancer [1]. The segmentation accuracy directly affects many aspects, such as the malignancy classification of lung nodules in CAD for feature extraction. In section of paper we study various segmentation techniques for lung nodules from images.

Thresholding (TH): Threshold is the most significant tool for image segmentation. Threshold operation first converts the grey scale image into binary image. A threshold value T is selected in threshold operation and it assigns two levels to the images that is one is above and the other is below the threshold value. By using the threshold value T, we can separate the object from the background. Then any point (x,y) for which $f(x,y) > T$ is called an object point, otherwise the point is called a background point. The automatic threshold determination was suggested by Author [2] by using K-mean clustering and average gradient and edge compactness.

Mathematical Morphology (MM): To fill in holes and small gaps in the image morphological closing operation is applied on the threshold image. It first reserve the block whose area is the largest and then set the others to zero using 8-connected neighbours. Using the above step binary lung mask is obtained. To extract the lung edge set a pixel to 0 if its 4-connected neighbours are all 1's, this leaving only edge pixels. Original Lung CT image is multiplied with the lung masked image to get the final segmented lung region with gray level values as those of original image. An effective method for binary morphological filtering with various combinations of these basic operations was proposed by Author [3].

Region Growing (RG): Region growing also classified as a pixel-based image segmentation method since it involves the of initial seed points [4]. It start with a seed pixel, the initial region begins as the exact location of seeds points. The regions are then developed from these seed points to adjacent points depending on certain criteria. This is an iterative growth by keeping examining the adjacent pixels of seed points. If they have the same intensity value with the seed points, it classifies them into the seed points. The difference between pixels intensity and the regions mean is used to classify the similarity of the image into regions. It is an iterated procedure until there are no changes in two successive iterative stages. There are new latest studies on this algorithm that have extended its approach as main component of their segmentation algorithm. Author [5] suggested a region growing method by using fusion-segregation criteria using geodesic distances.

Graph Cut and Watersheds:A well-known standard image segmentation techniques are Graph cut and Watersheds. Author [6] used Watersheds in their volumetric study. Watersheds semiautomatic used to first segment each nodule and then by a model-based shape analysis is used to determine anatomical characteristics of all type of nodules.

Deformable Model: Deformable models have been extensively studied and widely used in medical image segmentation, with promising outcomes. Deformable models are curves or surfaces defined within an image domain. These can move under the influence of internal forces, which are defined within the curve or surface, and external forces, which are computed from the image data. The internal forces are intended to keep the model smooth during deformation. The external forces are intended to move the model toward an object edge or other needed features within an image. By constraining extracted boundaries to be smooth and incorporating other prior information about the object shape, deformable models offer robustness to both image noise and edge gaps and allow integrating edge elements into a coherent and consistent mathematical description. Such an edge description can then be readily used by subsequent applications. More-over, since deformable models are applied on the band, the resulting edge demonstration can attain sub pixel accuracy, a highly wanted property for medical imaging applications. Author [7] reported his works in the literature, on volumetric lung nodule segmentation.

Feature-based classifier extracts features including intensity, shape, size, area etc. of the segmented nodules that may use for classification.

Some most popular feature-based classifiers are as follows:

- Rule-based or linear classifier
- Template matching
- Nearest Cluster
- Support Vector Machine (SVM)
- Linear Discriminate Analysis (LDA)
- Artificial Neural Network (ANN)
- Markov Random Field (MRF)
- Fuzzy Inference System

IV. CONCLUSION

The procedures defined are very popular among commercial semiautomatic software packages and used into the medical practice. The review highlighted that all the proposed methods from different researcher has different level of accuracy in different areas. Region growing algorithm is one of the best know algorithm in the field of image segmentation and it's also most useful in lung nodule identification method. It is also concluded that in future

automatic determination of threshold value should be done to eliminate the failure in segmentation.

Many research for lung nodules have been going on. And the present challenges and trends, in this field, suggested that the search of more effective and accurate CAD for lung cancer detection will remain a dynamic research area. Many researchers suggested genetic algorithm based ANFIS classifier can be developed to accurate detection of lung cancer.

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