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Lung Cancer Detection Using GLCM based Micro Vascular Decompression Analysis

ANEETA SINGH[1], NAVNEET KAUR[2]

[1]Student, Department Of Electrical Engineering,
[2]Prof, Department, Of Electrical Engineering,
BBSB Engineering College, Fatehgarh Sahib, Punjab-140406 .

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 tumors 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

Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a strongly wider breadth of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Pro images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems.
Computer Vision is a field of applied sciences whose main objective is to provide to computers those functions which are present in human vision. The typical computer-vision applications include robot navigation, medical imaging, video streaming, industrial quality control etc. Without any doubt, during the past decades, impressive progress has been made in this field, but nowadays the computer-vision applications depend heavily on the human visual system regarding their robustness and performance. The human-vision inspired computer-vision systems are promising alternatives as far as the robustness and performance of computer-vision solutions are concerned. If we think as researchers in developing computer-vision applications, the question should be asked, and answered, what mechanisms are involved in human vision that make it easy for humans but difficult for computers. Visual Attention is an ability of the vision systems to rapidly select the salient and relevant data/objects in a visual scene. The core objective of visual attention is to achieve the least possible amount of visual information to be processed to solve the high level complex tasks e.g. object recognition, which can lead the whole vision process to become efficient. This visual attention mechanism must be part of the answer to the question which has been asked above.

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 applicin this able 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:

III.I Pre-Processing

The image before it is actually processed needs pre-processing. The image taken from a camera includes noise which introduces some distortions in the image which is needed to be eliminated; so we use some filtering techniques like low-pass filtering for Gaussian noise, median filtering for salt-pepper noise, notch filtering for periodic noise etc. The next step is to convert the RGB image to gray scale image; after that the gray scale image is converted to binary image by use of thresholding technique. The process of filtering out the noise involves deriving the properties of the noise i.e. to determine what kind of noise is present in the image. One way of determining the property of noise is to take Fourier transform of the image and then study the spectra. Noises present in the image in general have higher frequency than that of original image. There are different types of noises that distort an image which classified according to their probability density function. Although the salt and pepper noise is present almost in every image acquisition systems. The process of converting of gray scale to binary image is also important as it depends upon the application i.e. which type of image is being converted to binary; whether it only a certain amount of pixels which are higher gray level to be segmented or a significant amount of pixels which are high gray levels but with variable intensity in different areas of the image. For the first case we can use global thresholding and for the second we can use adaptive thresholding by processing blocks by blocks in the thresholding operation in the image.

III.II Object Boundary Extraction

Object boundary detection lies in a very trivial concept that at the boundary of an object there is a sudden abrupt change in the intensity value as we just cross the boundary. We make use of this elegant concept. What we do is take any pixel and traverse to its corresponding neighbor pixel and see the change in the intensity values during such travel. If the change in intensity is too high, we assign the pixels from which we traverse as the boundary pixels. We can use the derivative function for getting such a result. If the derivative at a point is too high we can assign it as a boundary pixel. The boundary of an object serves in our purpose to be a major and vital factor for recognition and hence it's efficient and precise detection is highly a necessity. Hereafter the boundary has been detected, now we again apply some morphological operations to make the boundary pixels to be of unit width to avoid any further complications in the processing of these boundary elements.

III.III Feature Extraction

A simple question is how to make use of these detected corners for object shape recognition. Various approaches can be made for such a task to perform. Here we use a simple technique. Deriving a feature vector from the

corner points for recognition of a proper shape or an approximation of an object to proper shape. Suppose we have 'n' corners detected, then we form a feature vector of nC2 dimension. The elements of this vector are the all possible distances between any two corner points. Then what we sort this feature vector elements in decreasing order. Now the first element is the length between corners which are the most farthest from each other and the last element is the distance between the corners which are nearest to each other.

Now the challenge is to use the feature vector for a powerful recognition technique. The first approach is to match the feature vector obtained from the above said algorithm of the test image with the feature vector of the reference image stored in database. The second approach we follow is a non-matching technique which is helpful in recognition of proper shapes as described earlier or in a proper shape approximation to an object. We will use some of the examples to have an insight on the use of feature vector. Suppose the number of corners detected is 4. Now the feature vector would contain 6 elements. Now if all the elements are unequal with some error value permitted, then the object is a quadrilateral. (The assumption here is that the object is a convex polygon). Again if the first two elements are equal i.e. the diagonals are equal and all other elements are equal then it is a square, of course some percentage of error permitted. Similarly if first two elements are equal and fourth and fifth elements are unequal then it is a rectangle and lastly if first two elements are not equal but all others are equal then it is a rhombus. The use is completely based on the geometrical intuitive of any convex polygon. Since, the feature vector consists only the Euclidean distance between any two corner points of the object; thus the feature doesn't get affected on rotation and translation; however it does while scaling. To make it rotationally invariant the feature vector is normalized.

IV. LUNG CANCER:

Lung cancer is a disease of abnormal cells multiplying and growing into a tumour. Cancer cells can be carried away from the lungs in blood, or lymph fluid that surrounds lung tissue. Lymph flows through lymphatic vessels, which drain into lymph nodes located in the lungs and in the centre of the chest. Lung cancer often spreads toward the centre of the chest because the natural flow of lymph out of the lungs is toward the centre of the chest.Metastasis occurs when a cancer cell leaves the site where it began and moves into a lymph node or to another part of the body through the blood stream [1]. Cancer that starts in the lung is called primary lung cancer. There are several different types of lung cancer, and these are divided into two main groups: Small cell lung cancer and non-small cell lung cancer which has three subtypes: Carcinoma, Adenocarcinoma and Squamous cell carcinomas.

Lung cancer is the most dangerous and widespread cancer in the world according to stage of discovery of the cancer cells in the lungs, so the process early detection of the disease plays a very important and essential role to avoid serious advanced stages to reduce its percentage of distribution.

All PET/CT scans were performed on a combined in-line system (Discovery PET/CT 600, GE Healthcare, Milwaukee, WI, USA) with a multidetector helical 16-slice CT and integrated full-ring PET. This dedicated system allows for acquisition of co-registered PET and CT images in one step. After the injection of a standard dose of 300 to 340 MBq 18F-FDG, the PET/CT imaging started with a delay of 60 min. The patients were advised to drink 1,000 ml of oral contrast medium during this uptake time. The non-enhanced low-dose CT part of the combined scan was acquired with a tube voltage of 120 kV, a tube current of 40 mA, and a tube rotation time of 0.5 s. The imaging range was from the vertex to the upper thighs. Consecutively, the emission PET data acquisition started with an acquisition time of 2 min per bed position. The CT data was used for attenuation correction. CT images were later reconstructed with 3.75-mm slice width, using a fully 3D iterative algorithm (ordered subset expectation maximization (OSEM)). For image post-processing, coregistration, and analysis, the reconstructed images were transferred to a commercially available computer workstation. All evaluations were performed as a lesion-based analysis by two experienced radiologists in consensus. CT perfusion parameters blood flow (BF), blood volume (BV), and mean transit time (MTT) were determined by post-processing on the workstation, using a dedicated lung tumor preset of a perfusion evaluation software. A dataset motion correction and a noise reduction algorithm were applied automatically. The processing thresholds or segmentation tissue limits were −50 and 150 HU to exclude bone and other hyperdense materials. The window width and center for the reference vessel input was 300 and 150 HU, respectively. The relative threshold for inside and outside was 50%; an adaptive smoothing filter was used. The vendor's default standard algorithmic parameters were applied.

A Region of Interest (often revealing ROI), is a selected subset of samples Core a dataset identified for a particular purpose.[1] The inauguration of a ROI is commonly used in unheard-of application areas. For situation, in alexipharmic imaging, the mawkish of a tumor may be crowd on an somebody or in a volume, for the purpose of measuring its size. The endocardial bind may be defined on an image, dialect mayhap close to different phases of the cardiac cycle, for example end-systole and end-diastole, for the purpose of assessing cardiac function. In geographical inform systems (GIS), a ROI can be taken literally as a polygonal selection from a 2D map. In adding machine conjure up and optical flavour recognition, the ROI defines the borders of an object under consideration. In many applications, conceptual (textual) labels are added to a ROI, to describe its content in a compact manner.

V. PROBLEM FORMULATION:

The MVD analysis was only possible in one third of patients as the remaining patients did not qualify for surgery. Quantitative histopathological data about the presence of necrosis within tumors was not acquired. Most of the TNM stages reported were clinical as opposed to pathologic. The number of LC and SCC was quite small, and the results

regarding these NSCLC subgroups should be interpreted with caution. This technique did not acquire motion corrected PET, which could have contributed to the lack of correlations in the majority of tumors.

The early detection of lung cancer is a challenging problem, due to the structure of the cancer cells, where most of the cells are overlapped with each other. This paper has presented two segmentation methods, Neural Network (NN) and a Fuzzy C-Mean (FCM) clustering algorithm, for sputum color images to detect the lung cancer in its early stages. The manual analysis of the sputum samples is time consuming, inaccurate and requires intensive trained person to avoid diagnostic errors.

Key limitation of neural network is its inability to explain how the network has been build. Neural network gets better answer but have hard time explaining how they got there.

- Extraction of rules from neural network is difficult.
- Apriori specification of the number of clusters
- Time consuming process of training the neural network from complex data set.
- Neural network needs training to operate.
- Euclidean distance measures can unequally weight underlying factors.

VII. METHODOLOGY:

Lung cancer is a disease of abnormal cells multiplying and growing into a tumour. Cancer cells can be carried away from the lungs in blood, or lymph fluid that surrounds lung tissue. Lymph flows through lymphatic vessels, which drain into lymph nodes located in the lungs and in the centre of the chest. Lung cancer often spreads toward the centre of the chest because the natural flow of lymph out of the lungs is toward the centre of the chest.

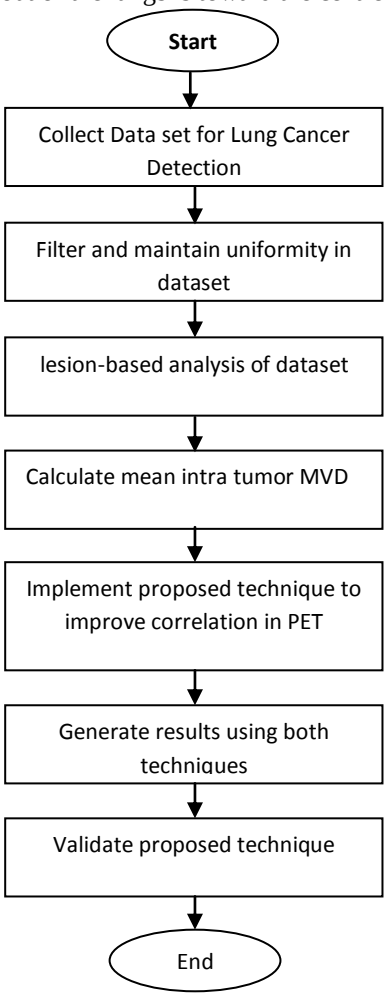


Figure 1: Block Diagram of the process followed

VI. RESULTS:

Image processing refers to processing of a 2D picture by a computer. Basic definitions:An image defined in the "real world" is considered to be a function of two real variables, for example, a(x,y) with a as the amplitude (e.g. brightness) of the image at the real coordinate position (x,y). Modern digital technology has made it possible to manipulate multi-dimensional signals with systems that range from simple digital circuits to advanced parallel computers.Image

Segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s).[1] When applied to a stack of images, typical in medical imaging, the resulting contours after image segmentation can be used to create 3D reconstructions with the help of interpolation algorithms like Marching cubes.

The approaches based on homogeneity include thresholding clustering region growing and region splitting and merging. A GUI is opened by clicking on the file and then running it or by writing 'guide' in command window of Matlab. Image is to be uploaded in which that image will be converted into gray scale image and then segmented it. In this research this is also proved that this implementation may include the noisy and distorted images also. In the last stage the tumor will be detected and the results for this may be generated. This technique is more robust as compare to the existing one.

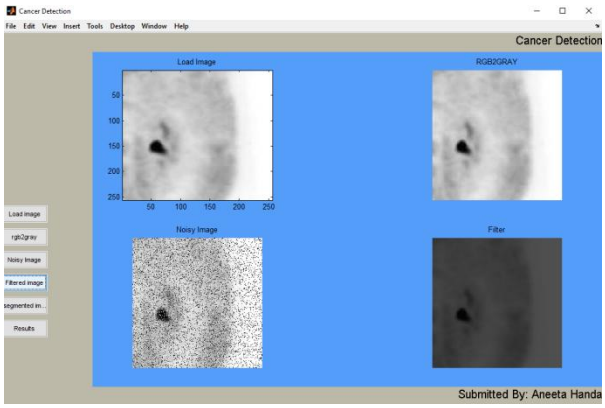


Figure 2: GUI showing Cancer Detection of PET image

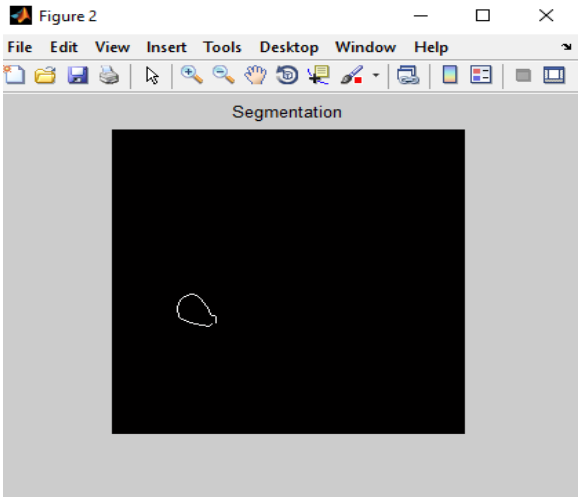
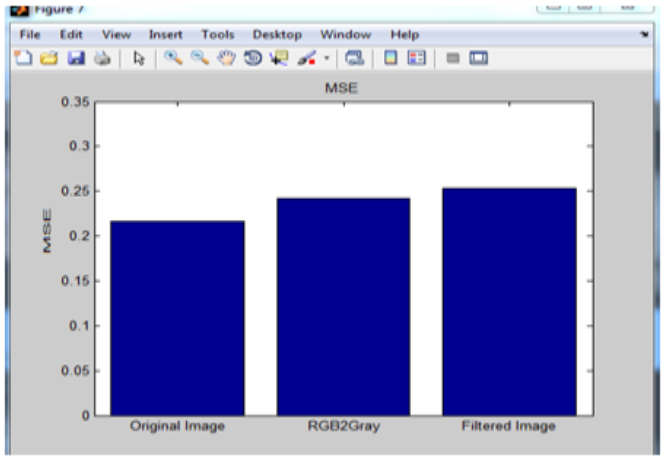


Figure 3: Localisation of cancerous tissue

Performance Analysis:

1) Mean Square Error: Mean Squared Error (MSE) or Mean Squared Deviation (MSD) of an estimator measures the average of the squares of the errors or deviations, that is, the difference between the estimator and what is estimated.

$$\text{Formula : MSE} = \sum \frac{(Yi - \overline{Yi})^2}{n-p}$$



2) Peak Signal to Noise Ratio: Peak signal-to-noise ratio, often abbreviated PSNR, is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation.

Formula: $PSNR = 10 \times \lg\left(\frac{255^2}{MSE}\right)$

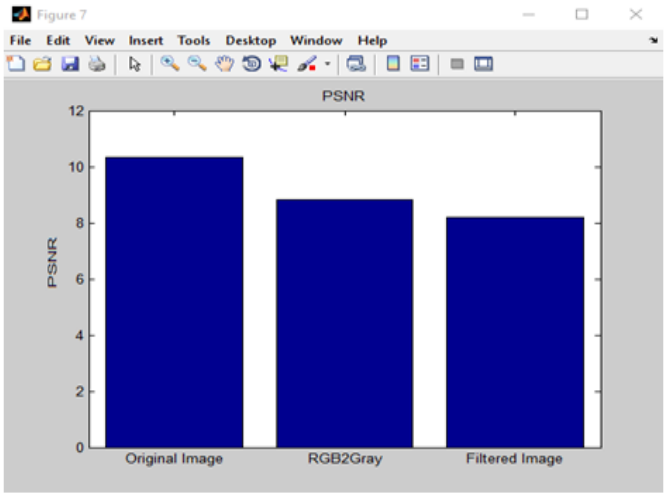


Table I: Comparative Study of GLCM based cancer detection and Geometric feature based cancer detection

Techniques / Metrics	Geometric features based lung cancer detection	GLCM based lung cancer detection
PSNR	10.1	9.8
MSE	0.15	0.13
Accuracy	93%	97%
Execution Time(s)	3.0	2.0

VII. CONCLUSION:

This work has shown that the localisation of image can be improved by considering frequency domain redundancy. The efficiency of feature extraction with the help of Gray Level Co-occurrence Matrix is far better than that of Geometrical or GLDM features. This research is based upon the effectiveness of checking of localisation of cancer in lungs using GLCM features technique. To achieve the compression techniques pre-processing of images are done using filtration techniques. After filtration process classifiers are applied to support the ROI technique. From graph it is clear that the metrics in the proposed technique is better as compare to existing approaches for lung cancer detection in PET scans. The proposed research has shown a great improvement in detecting the cancer area this is proved in the results also by the results defined in results section that is better than that of existing schemes by approx 10% in image data set.

In the future scope the proposed technique may be implemented on the hologram images. An image localisation problem is basically one of psychophysical perception and it is essential to supplement any mathematical solutions by a priori knowledge about the picture knowledge.

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