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Automatic Segmentation and Extraction of Lung Tumour Using Grey Level Segmentation and Run Length Coding

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Abstract: Lung cancer is one of the most threatening cancers to cure and provide treat. The early detection of lung cancer is helpful in medical field to lower the chance of danger. A conventional Technique that helps detection methods so easier is computed tomography (CT) scan. When there is a large number of CT scans that should be observed by radiologists is a time spending process, so as to reduce radiologists workload computer aided detection(CAD) systems are used. So that CAD system is other ways known as second reader after radiologists. Here proposing a new system of automatic segmentation using gray level segmentation and run-length coding with the help of seed growing method to estimate the cancerous part in the lung region. The proposed CAD system is able to assist the radiologist for identifying the defected portion of lung and also it is very helpful to monitor the rate of change of growth of tumour in further scans by the detailed study of radiologists. The segmentation algorithm is applied to detect the cancer nodules from the extracted lung image. Generally the proposed system first segments the lung CT image and then analyzes the obtained area for nodule extraction and hence diagnose the stage of disease. Also the size can be estimated mathematically by calculating the area, perimeter, and eccentricity of the connected components from the segmented region of lung CT image which constitutes the size. So the proposed method plays a vital role in detecting a small notable change in the size of detected nodule to study and measure the growth of tumour over a period to the radiologists.

Keywords: Computed Tomography (CT), Computer Aided Detection (CAD), Run-length coding, Region Growing segmentation

I. INTRODUCTION

Medical imaging is a method used to create images of the human part or complete body for the medical diagnostics purpose and detailed examination about the particular diseases. The technical aspects in medical imaging described in diagnostic radiography and usually the radiographer has the duty to acquire medical images of good quality for the efficient disease diagnosis purposes. Medical imaging is a sub part of biomedical engineering, medical physics or medicine depending on some type of context. So, many of the techniques that are developed for medical imaging to promote scientific and industrial applications. The recent progress in computerized medical image reconstruction and the related developments in its analysis methods and computer-aided diagnosis system has made medical imaging into one of the most important fields of scientific imaging. The evolution of CT(Computed Tomography) imaging has made a vital role in the detection of many type of diseases by the detailed evaluation of the radiologists. CT scan is an imaging method that uses X-rays for getting the information about the structure and function of human body. So the CT image is the reconstructed image and is reconstruction id based on X- ray absorption profile. CT scans are mainly used in imaging and diagnosis of the body parts such as brain, liver, chest, abdomen and pelvis, spine and for CT based angiography. Lung cancer is a disease in which a cell growth is present in tissues of the lung. If it remains untreated or not examined by the doctor, this growth can spread rapidly or in a uncontrolled manner beyond the lung in a process named metastasis, and also spread into nearby tissue or other parts of the body. The rapid change in the food systems, exploitation of environment by humans creates a variety of diseases that may or may not injurious to health. The serious diseases that are affected in the major parts of the human body such as heart, lungs, brain etc, but in recent years this type of diseases which kills humans without considering their age differences. However cancer is the second death cause existing in the world after heart issues accounting 1 person's death in every 4 deaths. The name of cancer may varied among the change of location of body part, the cancer affects in the portion of lungs, it is called as lung cancer. When it is affected in brain, it is brain cancer and other particular cancers are breast cancer, abdominal cancer etc. Most of the cancers that start their action in lung, known as primary lung cancers, which are termed as carcinomas that derive from epithelial cells. The main types of lung cancer are small-cell lung carcinoma (SCLC) or oat cell cancer, and non-small-cell lung carcinoma (NSCLC).

But in this work, lung of the human body is considered and the issues in the lung tissue can be evaluated. Hence the estimation of cancerous part in the lung region can be carried out and also assist the radiologists to make their work easier for analysing the defected portion present in the lung. In this project, doing a characterization of the lung tissues from CT images with the help of image segmentation technique. As the lung cancer is the leading cause of cancer death in the medical field, Computed Tomography (CT) scan of the thorax is used for the diagnosis of identifying the lung cancer. Lung cancer may be observed by taking chest radiograph and CT scan. The confirmation is only done with a biopsy and it is a invasive technique and time consuming process. Treatment depend on the type of cancer, the stage at which person stands ie, the degree of spread of cancer and the person's overall health, measured by performance status. The treatments for cancer are surgery, chemotherapy, and radiotherapy. The figure 1 shows an example of person's lung which is affected by a lung tumour in the left lung.

Fig. 1 CT scan of Cancerous Tumor in the Left Lung.

In this work local thresholding, image segmentation and feature extraction steps are carried out in order to evaluvate the lung cancer more accurately and also for the work load reduction and time reduction of radiologists. The early detection only helps the survival of cancer patients. Here the segmentation step is done through gray level segmentation and run length coding. Generally the proposed system initially segment the lung CT image and then analyzes the obtained area for nodule extraction and hence diagnose the stage of disease. Also the size can be estimated mathematically by calculating the area, perimeter, and eccentricity of the connected components from the segmented region of lung CT image which constitutes the size.

II. LITERATURE SURVEY

Various investigators have described and developed so many methods for the automatic detection of lung nodules from CT scan images and also several researchers are came up to facilitate the fast diagnosis of diseases regarding the image analysis methods. Some of the developed techniques and research works of number of groups for computer assisted segmentation and classification of CT images are listed below.

"Texture Information in Run-Length Matrices "by Xiaoou Tang in IEEE Transactions on Image Processing, VOL. 7, NO. 11, November 1998 [3] uses a multilevel dominant eigenvector estimation algorithm for developing a new run-length texture feature extraction algorithm that provides texture information in run-length matrices and hence improves image classification accuracy over other run-length techniques. The advantage given is demonstrated experimentally by the classification of two texture data sets. Comparisons with other methods this run-length matrices contain great discriminatory information and that a good method for extracting such information importance to successful classification.

“Characterization of the interstitial lung diseases via density-based and texture-based analysis of computed tomography images of lung structure and function" by Hoffman EA, Rein- hardt JM, Sonka M, Simon BA, Guo J, Saba O, Chon D, Samrah S, Shikata H, Tschirren J, Palagyi K, Beck KC, McLennan G [4] tells about the efforts that are to be establish a quantitative approach to the computed tomography based lung parenchyma characterization in interstitial lung disease incorporating emphysema. The patchy nature of regional parenchymal pathology can be imaged as textural structure and function by the improved resolution and speed of CT imaging. By careful control of imaging protocols and with the help of objective image analysis methods it is conveniently provide site-independent tools for the assessment of interstitial lung disease. And also there is the need for scanner manufacturers to focus on quantitatiably accurate images rather than pleasing images.

“A common medical error:lung cancer misdiagnosed as sputum negative tuberculosis" by Singh V. K, Chandra s, kumar S, Pangtey G, Mohan A, Guleria R in 2009 [5] describes about various delay in diagnosis of lung cancer. It is common in Medical field that cancer in lung is misdiagnosed as negative tuberculosis. In countries afflicted by tuberculosis a lot can be generated by the wrong analysis of tuberculosis. Finding out and analysis of cancer in lungs can help to boost the chance of tumor resectability and through chemo-radiotherapy person’s life can be saved. The methods that have been taken has Proven that lung cancer patients was treated for anti-tubercular treatment (ATT) due to identical symptoms. This was studied in the period and all the data was collected through Patient interview and medical records. The result shows that total of 14 out of 70 patients has received wrong diagnosis of tuberculosis and had received ATT for twelve male, two female. Twelve NSCLC, two SCLC, twelve was smokers with smoking years of forty four. It is found that because of high TB popularity and radiological closeness, they always see many patients with lung cancer get wrongly treated for TB. Clinics sees lung cancer with high case fatality and do ATT without doing medical investigation. Thus leads to delay in diagnosis, progression and controlling of disease.

”Multi-modal gray-level histogram modeling and decomposition" was done by J. Chang, K. Fan, Y. Chang , Image and Vision Computing in 2002, [6] Analysis of TB and cancer in lung are always hard because symptoms of both diseases are same. Due to immense TB and radiological closeness, a huge number of lung cancer patients at the beginning get wrongly handled for tuberculosis only based on radiological picture. Treating TB leads to inflammatory fibrosis at some patients. From these cases, the diagnosis is accepted with a biopsy a nosy approach, usually achieved through Bronchoscopy and CT guided biopsy. Here comes the need of a Computer Aided Diagnosis (CAD) of the fibros is adenocarcinoma diseases. With the advice of CAD have heightens incident of defining tissues. The attainable workload reduction for the radiologist appeal the usage of these systems in CT screenings as well as daily hospital proceedings. The CAD is constructed up on the Region of Interest(ROI) which is given by the radiologist that makes system semi automated.

“Evaluation of Texture methods for Image Analysis" by Sharma. M, Singh.S [1] describes about the evaluation of texture features so as is important for various image converting applications. Texture analysis creates the footing of object acceptance and classification for several domains. There are various range of texture culled methods and their performance appraisal is very important part for understanding the service of feature extraction tools in image analysis. They appraise five different feature culled methods. These are auto correlation, edge frequency, primitive-length, Law’s method, and co occurrence matrices. All the said approaches are used for texture analysis of Meastex database. This is always a publicly accesable database and therefore a meaningful analogy between the several approaches is useful for understanding texture algorithms. The conclusion announce that the Law’s method and co occurrence matrix method yield best output. The best outputs are obtained when they use features from all five methods. Results are composed using leave-one-out method.

“Studies on tissue characterization by texture analysis with co-occurrence matrix method using ultra sonography and CT imaging" by Sheppard. M.A, Liwen Shih [7] used texture analysis with the co-occurrence matrix method to verify ultrasonograms from normal and diseased livers, and X-ray CT images got from normal cases and cases of idiopathic interstitial pneumonia. Ten cases of normal, fatty, and cirrhotic livers, ten cases of normal lungs and ten cases of idiopathic interstitial pneumonia, all confirmed by clinics are taken for study. They compared the results of texture analysis in normal and infected livers under the same status of gain, focus, magnification rate, probe frequency and depth of the region of concern. Here they discuss the relationship between fisher ratio of texture analysis and pathological character. The normal and diseased liver groups did not differ much. The different pathological grades of fibrosis and dissimilar size of modules in the cirrhotic and normal liver groups have dissimilar Fisher ratios. They have compared the results of texture analysis with images of normal cases and cases of idiopathic interstitial pneumonia. Thus they assume texture consideration can be used to consider ultrasonograms obtained from lesions of different pathological grades and to classify CT images.

These contributions has made an overview of

(1) Mis-diagonosis of lung cancer as TB and the related issues.

(2) Image classification improved by run-length textural features.

(3) Textural Classification is done for finding and characterization of lung issues.

III. Proposed System

In this paper, the proposed system consisting of a new segmentation method using grey level and run length coding and with the help of setting seeds by means of region growing algorithm lung tumor part is extracted from the binary image resulted from the segmentation. The various steps that are incorporated in this system is listed below.

1. *Segmentation*

Segmentation process mainly divides an image into regions with similar properties as gray level, color, texture, brightness, and contrast etc. Segmentation [11] has the role of subdividing the objects in an image. Though many of algorithms had proposed in the field of medical image segmentation, it continues to be a complex and challenging problem. Different researchers have made classification on the segmentation techniques in various ways. At present classification of segmentation techniques is made on the basis of gray level based and textural feature based techniques.

2. *Mechanism of Run Length Coding*

This technique is suitable for binary images, although it may in principle be applied to grey scale or colour image data if an associated property is stored along with regional shape definition. If regions are purely with same grey-scale value then information is preserved. If there is variation within regions then either poor coding will result or, if thresholded, though the image is degraded, possibility for compression has a greater chance. The idea is to identify a uniform run of values and replace it with the start and end location or counts. it shows the list of maximum length N, the vertical image dimension, of lists of maximum length M, the horizontal image dimension. Some features to be noted are: the Bias towards horizontal feature in which an image consisting of horizontal bars will have a more compact feature than which consisting of vertical bars and the Values will be needed with grey-scale images. Simple calculation of the area that is sum “on" sets for binary data, or a simple property check and addition for multi-property images. And other properties are also simple to compute, e.g. the centre of area or region unions and intersections.

3. *Concept of Region growing*

The region growth is start from how to select a set of seed points. Seed point selection depends upon user criterion and their needs. The first or initial region begins as the exact location of these seeds. The regions are then grown from these seed points to adjacent points based on various region membership criterion. Such as, pixel intensity, grayscale texture, or color. Since the regions are grown depend on the criterion, the image details itself is essential. For example, the criterion were a pixel intensity threshold value, knowledge of the histogram of the image would be of use, as one could use to determine a suitable threshold value for the regional membership criterion. Here explaining a simple example regarding this, using a 4-connected neighbourhood to enhance from the seed points. It can also select 8-connected neighbourhood for the pixels adjacent relationship. And decision make here is the same pixel value. That is keep experiencing the adjacent pixels of seed points. If having identical intensity value with the seed points, we classify them into the seed points. It is an iterated process until there are changeless in two successive iterative steps. The main goal involved is to classify the similarity of the image into regions.

4. Extraction of lung defected portion

By the help of region growing algorithm with seed growing, the defected part in the lung part can be determined and this makes the radiologists to take an appropriate decision about the medication and treatment that would given to a patient by analyzing his present condition. This technique will absolutely tell us about the size of the tumour by simply calculating the area, perimeter and eccentricity features that are estimated from labeling the components.

IV. EXPERIMENTAL RESULTS

The computer aided diagnosis helps the detection methods of tumour as very convenient for the radiologists with the help of a CT scan. Hence it results in time reduction and workload reduction of radiologists. The image segmentation is an essential process for most image analysis systems and the segmentation result having a great task in many of the existing techniques for image description and recognition. Here used a local thresholding grey level segmentation means of run length coding techniques. segmentation extracts seeds marking the presence of objects or background at specific image locations. Then the marker locations are set to be in regional minima within the topological surface. The feature Extraction of image is very important when working under image processing techniques which uses various algorithms and techniques to detect and differentiate various desired portions or shapes or features of an image. Here using a mathematical feature extraction in order to find out the size of tumour by calculating the area , perimeter and eccentricity. Feature extraction is an inevitable stage to determine the normality or abnormality of an image that indicates the final results and these features act as the basis for classification process. The features are given as follows:

Area: it is a scalar value that provides the actual number of overall nodule pixel. It is estimated by the summation of areas of pixel in the image that pointed as 1 in the binary image obtained.

Perimeter: is a scalar value that provides the actual number of the outline of the nodule pixel, get from the summation of the interconnected outline of the registered pixel in the binary image.

Roundness (Eccentricity): Called as metric value or roundness or circularity or irregularity index(I), taking 1 only for circular and it is less than 1 for any other shape.

Lung cancer is regarded as the most dangerous abnormality or disease in the world according to stage at which the detection of the cancer cells in the lungs occurs, so that the process of detection of disease plays a very important role in avoiding serious stages and to reduce its degree of distribution in the other parts. To obtain more accurate results the work can be divided into Image Enhancement stage, Image Segmentation stage and Features Extraction stage. So the detection of lung nodule in CT Scans is a continuously emerging area of research and there are many possibilities in the enhancements of computer aided diagnosis can be included to make it more efficient. This algorithm provides an extraction of lung tumour area from the lung using the segmentation by run length coding. The above figures showing the results that are get through when the image is passing through the series of methods such as local thresholding, image segmentation(seed growing) and feature extraction. By using this method, it can be easily analyse the growth of tumour in the adjacent scanning reports by simply estimating the size of the tumour that can be calculated from the area and perimeter that had determined in this work. For example an input image of CT scan is given for the processes such as segmentation by seed growing and extraction. Then the result can be shown as

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Fig. 2 Input Image showing lung tumour

The Input CT image is affected by lung tumour in one of the lung is shown in figure 2. In order to find out the lung tumour by means of segmenting the different regions by segmentation procedure in the input image. The segmented image is shown below in figure 3 after the application of grey level segmentation and run-length coding technique.


Fig. 3 Segmented CT Image

The binary image of same segmented image shown in figure 3 is represented below in the figure 4. The figure 5 represents the extracted lung tumour from the segmented binary image.

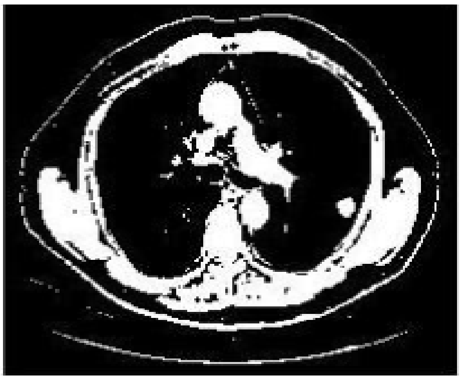
Fig. 4 Binary Image From Segmented CT image

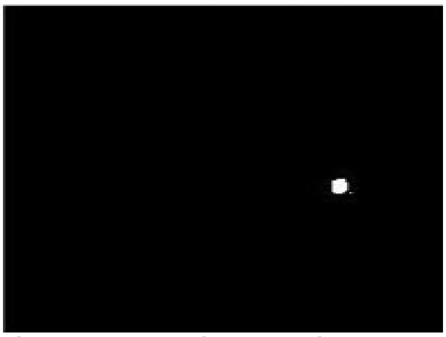
Fig. 5 Extracted Lung tumour From the Segmented Binary Image of CT Image

From the extracted tumour binary image the mathematical morphological features such as area, perimeter, ecentricity can be calculated. For this above particular image these values are:

area=45 mm.sqr

perimeter=23 mm

ecentricity=0.682

So that this technique of computer aided diagnosis of lung tumour helps the radiologists for the easier analysis of lung cancer by determining the size at frequent scans by simply estimating the area and perimeter of the extracted lung tumour portion of segmented binary image of CT scan. The area and perimeter are in the mm.square and mm respectively. By using this automatic segmentation method and run length coding technique the radiographer gets an accurate idea about the cancer growth and its size. Usually the radiographer confused with a CT scan image of cancerous patient since they have no idea regarding the type and its growth after did not done a detailed examination of biopsy. Thus the advantage of gray level segmentation and run length coding method gives an idea about the rate of growth of cancerous tissues and its size. It makes the reader an easier analysis about the particular lung cancer. So this method of extraction of cancerous region in the lung helps the radiographer to reduce their work to an extent.

V. Conclusion

The proposed CAD system provides an assistance tool for the radiologist to identify the defected area in the lung CT scan. Using this defected area calculation, the radiologist can easily decide the amount of spread. Moreover, it can be used to monitor the rate at which the tumour will grow since the system can detect small changes in size and displays the size of the detected area more accurately regardless of the changing direction that may be difficult to be localized by manual selection or visual inspection. For successive CT scans for a patient during a period of time in the inspection zone, the CAD system can measure the size of the detected nodules in each taken scan. For the respective scans the radiologist can able to compare the measured values with previous measured values and change is noted and appropriate decision can be made. So the system helps the medical practitioners to select appropriate medication at the early stages. Hence the CAD system will play an important role in detecting small changes in the size of the estimated defected nodules, giving the radiologist to study and measure the growth of the tumour over a period of time.

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