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Ascertainment of Lung Cancer at an Early Stage

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ABSTRACT

Lung cancer is a disease of abnormal cells multiplying and growing into a tumour. Recently, image-processing techniques are widely used in several medical areas for image improvement in earlier detection and treatment stages, where the time factor is very important to discover the abnormality issues in target images, especially in various cancer tumours such as lung cancer, breast cancer, etc. 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, pre-processing, binarization, thresholding, marker controlled watershed segmentation. At first Input lung CT, X-Ray images are taken and then passed through the image pre-processing stage by using some image processing techniques. In first stage, Binarization technique is used to convert binary image and then compare it with threshold value to detect lung cancer. In second stage, marker controlled watershed segmentation is performed to segment the lung CT images. The performance of proposed system shows satisfactory results and proposed method gives 97% accuracy.

Keywords: Binarization, Histogram Equalization, Lung Cancer Detection, Preprocessing, Segmentation.

I. INTRODUCTION

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. 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. This classification is based upon the microscopic appearance of the tumour cells. These two types of cancers grow, spread, and are treated in different ways, so a distinction between these two types is important. Around 2.5 million people are living with the disease. Cancers of oral cavity and lungs in males and females account for over 50% of all cancer deaths in India. These cancers can be prevented, screened for and/or detected early and treated at an

early stage. This could significantly reduce the death rate from these cancers. There are many existing techniques (most of these are expensive and time consuming) that are used to detect lung cancer in advanced stages, such as Computed Tomography (CT), Chest Radiography (x-ray), Magnetic Resonance Imaging (MRI scan) and Sputum Cytology. Therefore, it is a great needed for a new technology to detect lung cancer in its early stages. The proposed techniques provide a good quality tool to detect lung cancer in early stages. Related works are explained in section II. The Proposed system employed in this paper is also explained in section II. The Result and discussion of this paper is explained in section III. Implementation method proposed in this paper is also explained in section III. Conclusion of this paper is in section IV.

II. METHODS AND MATERIAL

Lung cancer is one kind of dangerous diseases of the world. In [2] they have used image-smoothing method, which results in poor detection at the later stages of process. In [1] of Haar wavelet decomposition, Haralick feature extraction methods have been used which yielded them an accuracy of 91%.[3] In this paper they have used Gabor filter, auto enhancement algorithms and fast Fourier methods for image enhancement followed by thresholding segmentation and binarization and masking methods to segment the image and extract the features respectively. In the paper they have applied the above techniques for only PET scanned images. After surveying different research works, the objective of proposed system is to represent a fast and robust system for detecting Lung Cancer properly in early stage and our proposed system provide more accuracy than many other existing techniques.

Figure 1 shows a general description of lung cancer detection system that contains four basic stages. The first stage starts with taking a collection of CT images (normal and abnormal) from the available Database.

Block Diagram

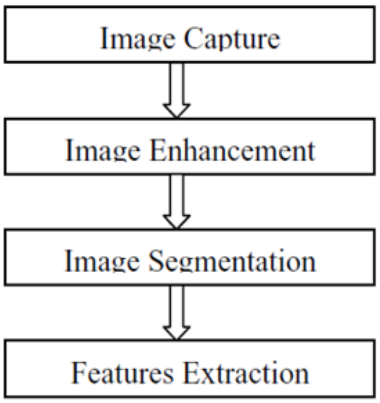

Figure 1: Lung Cancer Image Processing Stages

The second stage applies several techniques of image enhancement, to get best level of quality and clearness. The third stage applies image segmentation algorithms, which play an effective rule in image processing stages, and the fourth stage obtains the general features from enhanced segmented image, which gives indicators of normality or abnormality of images.

Image Acquisition

Normally a special type of digital X-Ray machine is used to acquire detailed pictures or scans of areas inside the body called computerized tomography (CT). Computed tomography is an imaging procedure. The system has been collected total 30 Lung CT images and X-Ray images that are cancer and normal image of lung from the Internet. The system used Lung CT images that are jpeg file format.

Image Enhancement

The image Pre-processing stage starts with image enhancement; the aim of image enhancement is to improve the interpretability or perception of information included in the image for human viewers, or to provide better input for other automated image processing techniques. Image enhancement techniques can be divided into two broad categories: Spatial domain methods and frequency domain methods. Unfortunately, there is no general theory for determining what “good” image enhancement is when it comes to human perception. If it looks good, it is good. However, when image enhancement techniques are used as pre-processing tools for other image processing techniques, the quantitative measures can determine which techniques are most appropriate.

Binarization

Image binarization is a technique that converts an image gray level to a black and white image. Binarization is used as a pre-processor frequently. Typically, the two colours used for a binary image are black and white. Binary images are also called bi-level or two-level. This means that each pixel is stored as a single bit i.e. a 1 or 0.Covert into Binary image. Let f(x, y) is an input image. T is the threshold value and g(x, y) is the output image of thresholding process then the mathematical equation of this conversion is:-

g(x, y) = I, if f(x, y) 2' T otherwise 0

Image Segmentation

Image segmentation is an essential process for most image analysis subsequent tasks. In particular, many of the existing techniques for image description and recognition depend highly on the segmentation results. The goal of segmentation is to simplify and/or change

the representation of the image into something that is more meaningful and easier to analyse. 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 visual 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 (edge detection). All pixels in a given region are similar with respect to some characteristic or computed property, such as colour, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s).

Thresholding Method

Image thresholding is a simple, yet effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting gray scale images into binary images. Image thresholding is most effective in images with high levels of contrast. Thresholding method is based on a threshold value to turn a gray-scale image into a binary image. The key idea of this method is to select the threshold value (or values when multiple levels are selected). Recently, methods have been developed for thresholding computed tomography (CT) images. Thresholding is one of the most powerful tools for image segmentation. The segmented image obtained from Thresholding has the advantages of smaller storage space, fast processing speed and ease in manipulation, compared with gray level image, which usually contains 256 levels.

Watershed Segmentation

Watershed segmentation extracts seeds indicating the presence of objects or background at specific image locations. The marker locations are then set to be regional minima within the topological surface (typically, the gradient of the original input image) and the watershed algorithm is applied.

III. RESULTS AND DISCUSSION

The images used in this study are shown in FIG-3a to FIG- 7a. Morphological operations led to the accurate segmentation of lungs. Binarization Technique along with marker controlled watershed segmentation provides 99% (approx.) correct result for this system. This methodology successfully developed an automated lung cancer detection system. Lung Nodule Detection in CT Scans is an active area of research, which is continuously emerging, and there are many enhancements that can be included to make more efficient.

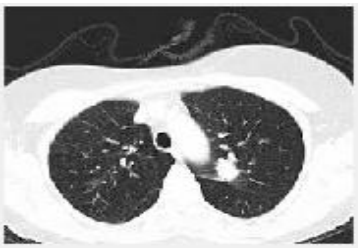

Figure 2a: Original Images

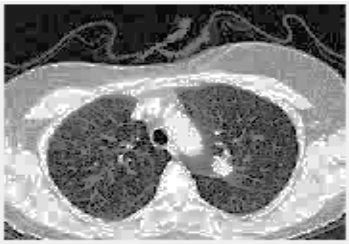

Figure 3a: Histogram Equalised Image

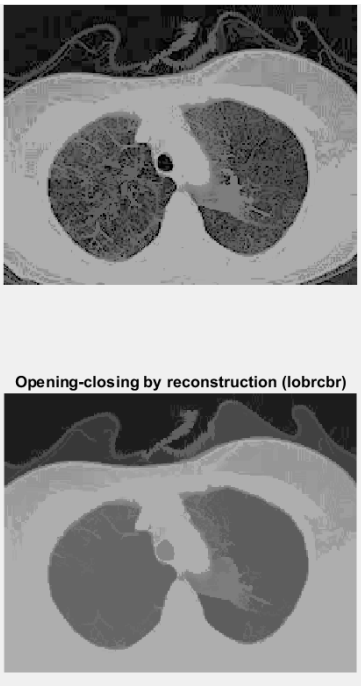

Figure 4a: Morphological Operation

Figure 5a: Binarized Image

Figure 6a: Thresholded Image

Figure 7a: Marker Controlled Watershed Segmentation

IV. CONCLUSION

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. An image improvement technique is developing for earlier disease detection and treatment stages; the time factor was taken in account to discover the abnormality issues in target images. Image quality and accuracy is the core factors of this research, image quality assessment as well as enhancement stage were adopted on low pre-processing techniques based on histogram equalization. The proposed technique is efficient for segmentation principles to be a region of interest foundation for feature extraction obtaining. The proposed technique gives very promising results comparing with other used techniques.

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