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Differential Imaging: A Panacea for Medical Diagnosis World

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Abstract: This paper aims at extending an eminent feature of Technology to Medical world for the benefit of Humanity. This paper explains the shifting of trend of Differential Diagnosis from manual to software based. The modalities which have always been diagnosed by doctors specialised in treating the particular diseases now will be diagnosed using a common, user friendly software. Our mission is to advance our understanding of the human body example like Lung Cancer. This paper aims to start with the CT scans of Lung Cancer and later on fusion techniques in near future. There is a common use Digital Image Processing on the concerned modality. This paper describes about the use of algorithm of sharpening and increasing the contrast of the digital modality. It helps and enhances the detection process in the progression of the disease. It develops algorithms to contrast such areas in a digital modality that could be the basis for the diagnosis.

Keywords: CT Scan, PET Scan, MRI, CAD, MATLAB, X-Ray etc.

I. INTRODUCTION

The goal of this research project is to utilize modern algorithm to examine the wide yielded datasets by current imaging techniques. This research paper focuses on CT scans [1] and the diagnosis of moderate to severe bodily disease example lung cancer. The project aims to supplement current diagnosis techniques and improve diagnostic capabilities. The design, evaluation and optimization of computer detection system for medical imaging associated mainly with seeking to maximize the information that may be extracted from medical images subjective, qualitative interpretation of the displayed images with objective, quantitative computations of the underlying numeric image data. The techniques include the detection of disease and structures of interest, disease progression, risk assessment, and physiologic evaluation [2]. Medical imaging having several different technologies which are used to view the human body in order to diagnose, monitor, analysing and treating medical conditions. Various type of technology gives different information about the area of the body of study or treated, related to possible disease, injury, or the effectiveness of medical treatment.

II. LITERATURE REVIEW

MORDERN TECHNIQUES USED

- Computed Tomography

CT (Computed Tomography), a computerized X-ray machine that examines the body. The scanner is comprised of a table and a block. This block is the donut shape has the X-ray source. CT can identify specific features in lung nodules that are diagnostic. The ability of CT scanning to evaluate the entire respiratory system [4] at the time of nodule assessment that is of further benefit. Spiral or helical CT is advantageous as small nodules are not missed between slices and non-spiral machines. It also increases the detection rate of nodules v5 mm in diameter. The acquisition of continuous volume data sets permits three-dimensional image reconstruction and multi-planar (non-axial) reformatting. Further manipulation of raw data sets enables the technique of virtual bronchoscopy. An interactive, simulated bronchoscopy [5] can be performed with the added benefit of simultaneous information on adjacent mediastinal structures.

- Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) is usually used for solving problem and where it has ability to detect invasion of major mediastinal structures. MRI [6] becomes more accurate than CT in the separating stage IIIa from IIIb (i.e. from resectable to unresectable) tumours in body, i.e. T4 disease. The major advantages that MRI has over CT are:

1. Multi-planar imaging capability,
2. Better soft tissue contrast.

MRI is useful in the assessment of chest wall invasion and of mediastinal as having the ability to determine the involvement of the diaphragm [7], spinal canal and fat-stripe invasion. MRI has some disadvantages as compared to CT scan-

1. It is slower and expensive than others,
2. It has very low spatial resolution which provides very limited lung parenchyma [8] information.

- **Positron Emission Tomography**

Positron emission tomography [9] (PET), new imaging modality which assesses the lung cancer which is still being determined. It has advantages over other modalities which are:

1. It has ability to image the entire body in single examination.
2. It has sensitivity in detecting the malignancy

PET is a physiological imaging technique uses radiopharmaceuticals [10] produced by amino acids or glucose (labelling metabolic markers) with positron emitting radio nuclides. PET performed along these agents exploits the differences in glucose metabolism, neoplastic cells and in normal cells, which allows very accurate and non-invasive differentiation of benign versus malignant abnormalities. PET also scans and detects malignancy in focal pulmonary opacities with a sensitivity of 96%. These results are then compared with FDG-PET imaging and can be performed using a standard gamma camera.

III. MATERIALS & METHODS

Here we see the pre-process of the images which has been applied and represented the methods that are used in steps of the system proposed. The discovery of a criterion to detect cancer tissue and create pattern from the extracted cancer tissue. Lastly the training of cellular automata by a pattern to construct a self-organizing diagnosis like a system discussed below.

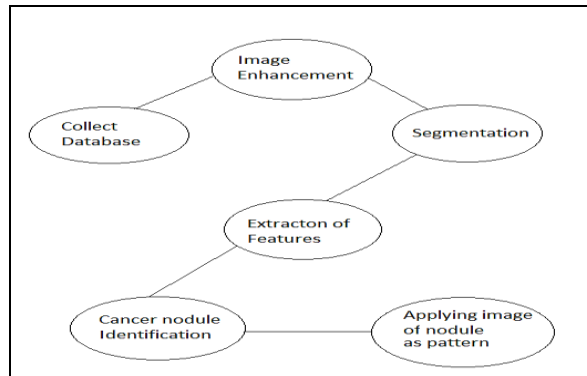


Fig 1: Steps in Differential Imaging

Our Database that was used in this study includes 10 CT scan image of lung having 5 cancerous and 5 healthy images. It comprises digital CT scanner Lung Cancer Images in a specialist medical imaging software and the dimension of images was taken 256×256. Image pre-processing, a process which eliminates the image distortion and enhances important features. For the pre-processing approach, MATLAB software and Osirix software on mac virtual machine software were used. By using these processes a corrected image produced.

IV. IMAGE ENHANCEMENT

The image enhancement filters on images were applied to remove the problems such as blurring, noise and etc. These filters applied and Gabor filter [11] gave better result between some of the other filters that were used for image enhancement. Example of one of these images have been provided.

A. Extraction in lung region

Using segmentation, images are divided to some specific regions where the contents of each region have same specifications. Segmentation is the most important step in image processing. It is easier to analyse by changing the image representation which is the main purpose of segmentation. In this step, to extract the region of interest (ROI) in the lung image, the CT lung images of the lung tissue and bones are separated. The step very useful is thresholding, which has many advantages as-

1. Easy influence,
2. Fast processing,
3. The resulting images do not keep weight space and another method is region growing.

These algorithm starts from a pixel of image and checks other pixels that are surrounding the start point and if there is a non-assigned pixel that neighbours with region checked which are similar to that region, region growing but if there is a difference between neighbour pixel where region is more than the threshold, then the process is halted. In this paper, onto enhanced image the region growing segmentation algorithm based thresholding was applied which shows the application of segmentation which has passed through two filters as-

1. Low-pass filter and

2. High-pass filter,

As we know that band-pass filter is the fusion of the low-pass filter and high pass.

B. Cellular automata

Cellular automata or cellular machines is a mathematical model and studied by Neumann in 1966. Aim of automata is to design a self-reproductive system which in terms of computationally is complete. Cellular automata model is a lattice of cells where each cell has its own a set of states and its own local rules which governs them. Time is discrete in Cellular Automata model [12], each cell can select a state, states of cells update according to local rules, the state of cells in time $t+1$ depends on previous state of cell and the neighbours in time t . There are three types of cellular automata:

1. One dimensional cellular automata,
2. Two dimensional cellular automata
3. Three dimensional cellular automata

For this paper the two dimensional Cellular Automata was used. It is comprising of a 4- tuple namely-

$$A \sim (S, N, F)$$

Where, A is a set of cells

S is the set of possible states for cells

N means the neighbour-hood position

F represents a function that after its action obtain a new state for cell so

$$F: S \times N \rightarrow S [15].$$

C. Feature Extraction

After the segmentation process in the region of lung, the feature is extracted and also for analysing diagnosis to identify the cancer in the lung efficiently.

V. RESULTS AND DISCUSSION

In this study a lung CT scan image database was used which has obtained from a specialist medical imaging center. First for enhancing the images, Gabor filter was used on the CT images. For segmentation section the images that have passed from enhancement step, were segmented by region growing algorithm, that resulted lung region or (ROI) being extracted. The processes that were used on CT lung images are shown below in Fig. below

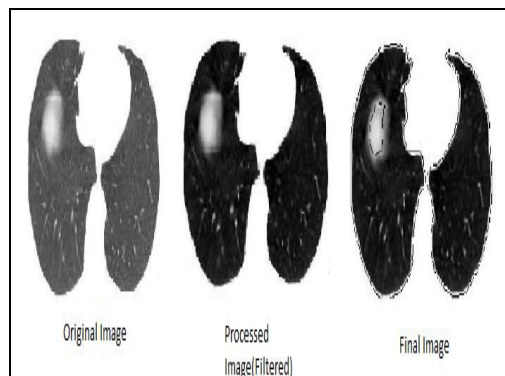


Fig 2: (i) Original Image (ii) Image filtered (Gabor filter) (iii) Final Image segmented

Criterion such as contrast, shape, and size were considered and features were extracted. Using a band-pass filter the cancer nodule were detected. The image gained from previous stages was digitalised or binarised, and it was used as input for training cellular automata, after cellular automata learning step the proposed system is examined by CT lung images to detect healthy images and cancerous images.

Cellular automata to follows some rules for the diagnosis of Lung Cancer, after the band-pass filter, a pattern is achieved and based on this pattern the local rules of cellular automata are generated by using the image obtained here. Therefore, according to the generated rules and totally rules, each pixel of test images is matched with a pattern or not, so if the area through the rules match the pattern, the image system diagnosis is the Lung Cancer. The environment for training the learning automata in the pattern works. Cellular learning automata by using training images are trained and update the action vector. With each session in training time, the capability of the system is increased efficiently and the possibility of error occurrence is reduced. At the end, the results indicate that the proposed system has a good performance on this dataset in the comparison.

VI. CONCLUSION

A Computer Aided Diagnosis system is studied for detecting the early nodules disorder at early stage increase the surviving chances. The CAD system makes use of Computer Tomography images. The lung region extraction technique is used on CT images. Then segmentation is used on the specific lung region which is

based segmentation approach. Next stage is the feature extraction technique in which the features are extracted from the partitioned image for the diagnosis. Then the last filtered image is compared to the other images for the favourable result. These are most prominent advantages of this imaging diagnosis. This whole process was accurate and a useful method for the medical image diagnosis of the lung cancer. It also enhances the reliability of system.

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