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Image Processing for Medical Image Analysis: A Review

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Abstract: Image processing techniques are used widely in medical areas for improving the image in earlier detection and treatment stages, it is very important to discover the abnormality issues in given images, specially in various cancer, tumours such as lung cancer, breast cancer, etc. Image quality and accuracy is the main factors of this work, image quality improvement and assessment are depending on the enhancement stage where pre-processing techniques is used. The principal objectives of this course are to provide basic introduction and techniques for medical image processing and to promote for further study and research in medical image processing.

Keywords: *Image Processing, Medical Modilities, Cancer Detection*

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I. INTRODUCTION

Information is transfer through images. Image processing is a process where input is image, it is processed to get output. It is also image. Main aim of image processing techniques is to recognize the image [5].All the images are used in this world today are in the digital format. Medical images show the physical attributes distribution. Medical imaging modalities as in CT scan, MRI mostly depend on computer technology to generate and display digital images of the internal organs of the human body which helps the doctors to visualize or show the inner portions of the body. CT scanner, Magnetic Resonance Imaging and Ultrasound took over conventional x-ray imaging, by allowing the doctors to see the body's third dimension [14].

Medical image processing deals with the development of problem-specific approaches to the enhancement of unprocessed medical image data for the purposes of selective visualization as well as further study. There are many topics are available in medical image processing: some hit general applicable theory and some focus on specific applications.
We focus mostly on image segmentation for detecting lung cancer and brain tumor [1].

1.1 Medical Imaging Techniques

Medical imaging is the technique that gives and producing visual representations of areas inside the human body to diagnose medical problems and monitor treatment. There are many types of medical imaging is available. Here we use only computed tomography (CT), magnetic resonance imaging (MRI) for detecting lung cancer and brain tumor.

In medical imaging different types of images are used, but for the detection of lung Computed Tomography (CT) images are being used because of better clarity, low noise and less distortion. One more important feature of CT scan images is that it is very easy to calculate the mean and variance of CT scan images. The detection process are mainly divided into four parts: Image enhancement, lung segmentation, feature extraction and classification[2].

MRI Images play main role in brain tumor for analysis, diagnosis and treatment planning after diagnosis. It is easy to doctors for determine the previous steps of brain tumor. Brain tumor detections using MRI images is a challenging task, because the structure of the brain is complex. Brain tumor is an abnormal growth of cell inside the brain cranium. MRI images offer better difference task of various soft tissues of human body. MRI image provides better results than the CT scan, Ultrasound and X-ray images. Magnetic resonance Imaging (MRI) gives the better results than Computed Tomography (CT), because MRI provides greater contrast between different soft tissues of human body [10]. MRI scan is a powerful magnetic fields component to determine the radio frequency pulses and to makes the detailed pictures of organs, soft tissues, bone and other internal structures of human body. The MRI technique is most effective and important for brain tumor detection. The brain tumor detection done through MRI images. Image processing and image enhancement these tools are used for medical image processing to improve the quality of images and provide clearer images. The contrast adjustment and threshold techniques are used for highlight the features of MRI images. The edge detection, histogram, segmentation and morphological operation play a vital role for the classification and detecting the tumor of brain is present or not.

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1.2 Image Processing Techniques

The various image processing techniques are as follows. These are use in detection of lung cancer and brain tumor shown in figure 1.[2]

- Image preprocessing
- Image enhancement
- Image segmentation
- Feature extraction
- Image classification

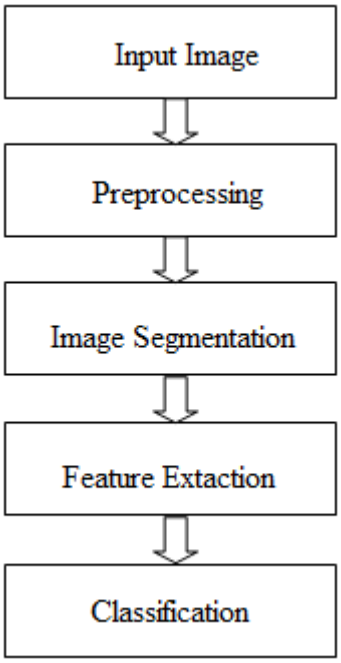

Figure 1 Steps for Image Processing

- **Image Preprocessing:** The remove the image distortions such as noise and separate the background as well as the enhancement of image contours and other relevant properties. To make the image better it enhance from noising, corruption or interference. The various steps involved in image processing are smoothing, image enhancement and gray level conversion.
- **Image Segmentation:** Image segmentation is the process of partitioning the image into multiple segments. In which divide and segment the enhanced images, the used algorithms on the Region of interest of the image (just for lungs, the methods used are: Thresholding approach and Marker-controlled watershed segmentation approach (this approach gives better results than thresholding).
- **Features Extraction:** To obtain the general features of the enhanced segmented image using binarization and masking approach.
- **Image classification:** It is the labeling or a group of pixels based on its grey value [5]. Classification is one of the most used methods of information extraction. In Classification, multiple features are used for a set of pixels i.e. many images of a particular object are needed.

1.3 Image Processing used for Lung Cancer Detection using medical imaging

Lung cancer is one of the most dangerous and widespread cancer in the world. According to stage of discovery of cancer cells in the lungs, so the process early detection of the disease plays a vital and essential role to avoid serious stages to reduce its percentage of distribution. The aim of this research is to detect features for accurate images comparison as pixels percentage and mask-labelling. Lung cancer is the common cause of death among people throughout the world. Early detection of lung cancer can increase the chance of survival rate from 1 to 5 years among people. The overall 5-year survival rate of lung cancer patients increases from 14 to 49% if the disease is detected in time and its early stage. Computed Tomography (CT) can be more efficient than X-ray because of less distortions. Hence, a lung cancer detection system uses image processing to classify the present of lung cancer in a CT images. In this study, MATLAB have been used through the every procedures made[2].

Now we proposed the system with some modifications to image visibility and improve the accuracy. For this at first step, noise content is remove to improve the image quality with median filter is used; the thresholding is used for the lung extraction which results into binary image. Then morphological operations including the opening, closing, edge detection are apply to remove any other irrelevant information present in the lungs. After the morphological operations, feature extraction is used. To differentiate this nodule (ROI) from the other structure of lungs, various textural and statistical parameters are extracted. On the basis of these features classification is done by the feed forward propagation network classifier. After the classification the nodule is decided on the basis of the size of tumor [13].

1.4 Image Processing used for Brain Tumor Detection using Medical Imaging

The structure of human body is made up of several type of cells. Brain is a highly specialized and highly sensitive organ of human body. So thats why brain tumor is a very harmful disease for human being. The brain tumor is intracranial mass and it made up by abnormal growth of tissue in the brain or around the brain. Brain tumour can be detected by the benign or malignant type. The benign is non-cancerous and malignant is cancerous.

In MRI scan is a powerful magnetic fields component and it used to determine the radio frequency pulses and to produces the detailed pictures of the organs, soft tissues, bone and also determine the internal structures of human body. The MRI technique is most useful for brain tumor detection.

In image processing, image enhancement and smoothing tools are used for medical image processing to improve the quality of images. The threshold techniques and contrast adjustment are used for highlighting the features of MRI

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images. The segmentation and morphological operations play a vital role for classification and detecting the tumor of brain. The various steps of MR imaging is preprocessing, feature extraction, segmentation, classification. this is used for finding the tumor region of MRI images.

II. REVIEW OF IMAGE PROCESSING

Many of the techniques of digital image processing, or digital picture processing were developed in the 1960s at the Jet Propulsion Laboratory, Massachusetts Institute of Technology, Bell Laboratories, University of Maryland. A few researches such as application to satellite images, medical imaging, videophone, wire-photo standards conversion, character recognition and photograph enhancement were also carried out[1].

William H et.al [1] was highlighted the progress in the image processing and analysis of digital images during the past ten years. The topics included for digitization and coding, enhancement, filtering, and restoration, reconstruction from projections, hardware and software, feature detection, segmentation, texture and shape analysis, matching, and pattern recognition and scene analysis.

Shanhui Sun Christian Bauer et.al [2] presented a fully automated system for segmentation of lungs in CT scan datasets. The method was specifically designed to segment lungs with cancer masses and consists three processing steps. First, a ribcage detection algorithm is used to initialize the model-based segmentation method. Second, a robust active shape model matching approach is applied to roughly segment image the outline of the lungs. Third, the outline of the matched model is nextly adapted to the image data by means of an optimal surface finding approach. The method was made on the 63 LOLA11 test set, consisting of 55 chest CT scans with a variety of different lung diseases.Compared to a reference standard, mean average and median volumetric overlap scores of 0 to 949 and 0 to 990 were achieved respectively. Several examples are demonstrated the ability of our method to successfully segment the lungs with cancer masses.

For diagnose indeterminate nodules correctly, allowing curative resection of early-stage malignant nodules and avoiding the morbidity and mortality of surgery for benign nodules, Weixing wang et.al [3] presented the newly developed ridge detection algorithm. The algorithm was compared to some image segmentation algorithms. All these results are satisfactory for diagnosis.

Bhausaheb Shinde et al [4] proposed a method for to improve the accuracy of MRI, X-ray and brain images for easy diagnosis. For this work they took different medical images like MRI, CT scan, X-ray, and brain and calculated standard derivations and mean of all these medical images. After that finding Gaussian noise and then applied to median filtering technique for removal of noise. After removing noise by using median filtering techniques, again standard derivations and mean are calculated. The results got were more useful and they proved to be helpful for general medical practitioners to analyze the symptoms of the patients with ease.

T. Sowmiya, M. Gopi et.al [6],in this paper they described cancer as the most dangerous diseases in the world. Lung cancer is one of the most dangerous cancer type in the world.The uncontrolled cell growth in the tissues of the lung because of this, these diseases can spread worldwide. Early detection of the cancer can save the life and survival rate of the patients who affected by the lung cancer diseases. In this paper for lung cancer prediction of the patients we survey several aspects of data mining procedures which are used. In lung cancer classification data mining concepts is useful. We reviewed the aspects of ant colony optimization (ACO) technique in data mining. For increasing or decreasing the disease prediction value of the diseases ant colony optimization helps . This case study gives various data mining and ant colony optimization techniques for appropriate rule generation and classifications on diseases, which pilot to exact lung cancer classifications. In additionally to, it gives basic framework for next improvement in medical diagnosis on lung cancer.

Dasu Vaman Ravi Prasad (2013)[7] image quality and accuracy is the core factors of this research, image quality improvement are depending on the enhancement stage where low pre-processing techniques is used based on Gabor filter. Following the segmentation principles, an enhanced region of the object that is used as a basic foundation of feature extraction is obtained. Depending on general features, a normality comparison is made. In this research, the main detected features for accurate images of comparison are pixels percentage and mask-labeling.

Mokhled et.al[8], discussed the various lung cancer detection techniques for different stages. Three methods were used for image enhancement and to remove the noise from the image, to make the image better: (a) Auto enhancement, (b) Gabor Filter and (c)FFT (Fast Fourier Transform). Gabor filter is more efficient because it effectively optimize the border differences among the lung regions. For the image segmentation to separate the region controlled watershed segmentation is used. The extracted region differentiate from the lung structure binarization and masking approaches were proposed. In binarization, if the total numbers of black pixels less than threshold value, then it was classified as abnormal otherwise it is normal. In masking, white area inside the lung region was called as mass. The mass shows normality of blue color while RGB shows the abnormalities of the mass. On the basis of these features, the system classification accuracy was less.

Disha, Gagandeep et.al [9], proposed a CAD system in which for removing the noise content wiener filter was used .

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For extraction of lung region, image slicing algorithm was applied. With image segmentation each and every pixel were assigned a label so that the pixels who have same label, represent visual characterstics. To enhance the quality of image various morphological operations like opening, closing followed by erosion, dilation were applied to remove any irrelevant information in the image. Image segmentation is basically represent a set of contour (edge detection). For the edge detection sobel method was used because of its accuracy and two dimension values of the pixels so that no pixel can be left. Five features (area, calcification, shape, size, contrast Enhancement) were extracted on the basis of which the ROI was classified as tumor or non-tumor.

In the field of brain tumor detection various approaches have been carried out. Sindhushree K.S, et al[10] have developed a brain tumor segmentation method gives validated segmentation on two dimensional MRI data. Also, detected tumor from 3-Dimensional view. High pass filtering, histogram equalization, thresholding, morphological operations and segmentation was carried out to detect tumor. These two dimensional extracted tumor images reconstruct into three dimensional volumetric data. The tumor volume was also calculated . M.C. Jobin Christ and R.M.S. Parvathi[11] proposed a methodology for medical image segmentation that integrates K Means clustering with marker controlled watershed segmentation algorithm. Integrates Fuzzy C Means clustering with marker controlled watershed segmentation algorithm separately. The methodology gives two stage processes. First K-means clustering (Fuzzy C Means) is used to get a primary segmentation of the input image.Secondly marker controlled watershed segmentation algorithm is apply to primary segmentation to get the final image which is segmented .

P.Vasuda, S.Satheesh [12], proposed a fuzzy clustering technique to detect tumors from MR images. This algorithm uses fuzzy C-means algorithm. The major drawback of algorithm is computational time required. Classifiers are also refered as supervised methods. It require training data that are manually segmented and used as references for automatically segmenting the new data. The use of this same training data for classifying the large number of images and may lead to biased result. Supervised segmentation method, it requires considerable amount of training and testing data which complicates the process[13].

III. Conclusion

This paper gives the review on various types of techniques of image processing such as image enhancement, image segmentation, image classification and also provides the clear view of applications used in image processing. The major image modalities have been studied in this survey of cancer and tumor detection through image processing used on MRI, CT and Ultrasound images. We used a method for segmentation of CT images. Cancer cell correct identification is done by studying the necessary features extracted for the two images.

For accurate detection of brain tumor patients, proper segmentation method is required to be used for MR images to carry out an improved diagnosis and treatment. Information is provided by many images from this various slices required for accurate diagnosis, planning and treatment purpose.

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