PET-CT LUNG TUMOR SEGMENTATION BY USING MULTI MODAL SPATIAL ATTENTION MODULE

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***Abstract*— One of the major causes of death in humans is due to a disease called Lung Cancer. Cancer is a disease in which cells in the body grow out of control and is one of the most serious health issues. Lung cancer is the uncontrolled cell growth in tissues of lungs. Early detection of the cancer helps the physicians to act quickly which in turn which increase the survival chances of the infected patients. This is a review paper wherein different methodologies for the detection of Lung Cancer from Computed Tomography (CT) scan images are presented. It is observed that Convolution Neural Network along with Image Processing is the most suitable approach to detect the Lung Cancer from the CT scan image which is provided as input.**

Keywords—Lung cancer, CNN, Image processing.

I. INTRODUCTION

Overview

Cancer is one among the foremost serious health problems within the world. Cancer disease is caused due to the out-ofcontrol growth of the cells in the body parts. Among the different types of cancer, Lung Cancer is the most dangerous type of cancer. This is due to the fact that its one of the leading causes of death in both men and women and also according to World Health Organization, it was seen that 2.09 Million cases of Lung Cancer was found and a sum of 1.76 Million people died due to the Lung Cancer in a single year of 2018. The cause for the large number of people getting infected with lung cancer is the fact that there are many ways present surrounding us and with the use of these or by coming in contact with these like Smoking and many more, we will be quickly prone to be infected with Lung Cancer. Also, the reason for high death rates is because of the late detection of the cancer. All these factors make it necessary to devise a methodology using current technology which can help to Detect the Lung Cancer from the scanned images of the Lungs. Once the Lung cancer is detected, there are various possible biological treatments available which includes Thoracic Surgery, Chemotherapy, Radiotherapy. Depending on the Cancer stage and other factors, the physicians can choose the appropriate treatment for the Lung Cancer. Hence, if the cancer is detected at the early stage, the chances of survival of the patient increases. A literature survey is made on the possible techniques and methodologies which can be used to detect the Lung Cancer. There are various techniques, methodology and technology which can be used to accomplish the required objective.

Probelm Statement and definition

Software's which are developed and designed are not accessible to any normal patient or else they are not free of cost. It is available offline hence it consumes more space to save the dataset of patients hence it creates the space and time complexity and makes the application bulky. The problem with these existing system is that, in order to evaluate the best performance, many parameters need to be hand-crafted which is making it difficult to reproduce the better results. In the structure of cancer cell, where most of the cells are overlapped with each other. Hence early detection of cancer is more challenging task.Among all types of pathological tests, CT Scan is used mostly and it is also popular for diagnosis. It takes a High definition and high contrast images of the lung and orientation providing a three-dimensional assessment of the lesion. In this study, an automated approach has been proposed where CT Scan gray-scale images were incorporated for cancer detection. After an extensive study, we found that svm classifier was performed well when compared with the other machine learning algorithms. Lung cancer images were taken as input and after being processed by medical image processing methods such as pre-processing and post-processing output images were generated containing the region only. The preprocessing consists of gray scale conversion, noise reduction, and segmentation. The post-processing consists of feature extraction and identification.

Objectives

The main objective of the project is to detect the lung cancer through CT scan images by using machine learning algorithm. We can cure lung cancer, only if you identifying the yearly stage. So here, we use machine learning algorithms to detect the lung cancer. This can be made faster and more accurate. In this study we propose machine learning strategies to improve cancer characterization. Main strengths expecting from the proposed model are pointed as below:

- Increase in accuracy of cancer nodule detection than the best current model.
- Removes salt-pepper noises and speckle noise that creates false detection of cancer

II. RELATED WORK

Lung cancer is one of the key causes of death amongst humans globally, with a mortality rate of approximately five million cases annually. The mortality rate is even higher than breast cancer and prostate cancer combination. However, early detection and diagnosis can improve the survival rate. Different modalities are used for lung cancer detection and diagnosis, while Computed Tomography (CT) scan images provide the most significant lung infections information. This research's main contribution is the detection and classification of different kinds of

lung cancers such as Adenocarcinoma, Large cell carcinoma, and Squamous cell carcinoma. A novel lung cancer detection technique has been developed using machine learning techniques. The technique comprises feature extraction, fusion using patch base LBP (Local Binary Pattern) and discrete cosine transform (DCT).

III. OUR APPROACH

Lung cancer detection systems with image processing are used to classify the presence of lung cancer in CT images. This study uses Python software for analysis. With regard to image processing, methods such as image preprocessing, segmentation, and feature extraction areexplained in detail.

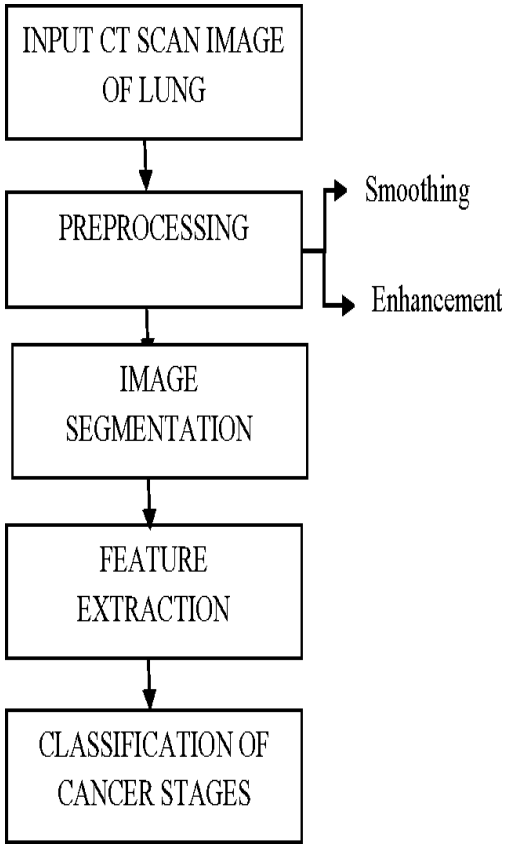
In the medical field to detect a disease, many of the image pro-cessing strategies can be applied. To improve the detection of lung cancer in the CT images there are four main steps involved. At each step, various techniques are applied which resulted in different accuracies in detecting the lung cancer. Firstly, the lung CT 9 image is pre-processed to remove any noises that exists in the image. Secondly, the image is segmented to get Region of Interest (ROI). Thirdly, feature extraction is applied to extract features like energy, entropy, variance. Finally, different classification algorithm is applied on the extracted features of the lung CT image.

Image acquisition:- The first step we gone follow in this system is acquiring CT scan images of user. As compared to X-ray and MRI images CT scan replica have less noise therefore CT scan image is taken as input. To get better accuracy and less distortion, these images are used.

Grayscale conversion: In this step an RGB image is converted to Grayscale image. An intuitive way to convert a color image 3D array to a grayscale 2D array is, for each pixel, take the average of the red, green, and blue pixel values to get the grayscale value. This combines the lightness or luminance contributed by each color band into a reasonable gray approximation.

Binarization: Binarization is the process of converting the grayscale image (which is having pixel range from 0 to 255) into binary image (which is having (0, 1)) by a threshold value. Segmentation Image segmentation act as a part of screening in medical imaging field. Segmentation algorithm divides the replica into multiple meaningful segments. In computerized vision system and recognition, the digital image is divided into many segments. The main objective of segmentation is to make simple and transform the delegation of CT scan replica into more informative and examine it easily in details. Segmentation of Image is used to reduce unnecessary information in the image and locate object, boundaries like lines, curves etc. in images. In the proposed system, segmentation process consist of some steps. Firstly, it transforms the original/real image into edge only image. The transformed edge only image into dilated image and filled image and at last finally both (left and right lungs) are segmented.

Feature Extraction: Feature Extraction is an essential step/stage that uses algorithms and techniques to recognize the patterns of an replica. The Segmented output are given as input for the feature extraction. The following features are covered under feature extraction such as Area, Perimeter and Eccentricity and these all are scalar quality.



IV. SYSTEM DESIGN

1. Project Modules

Overview : This section outlines the wireframes designed for the view of the application. These wireframes are used to outline the benefit of the user and to get a general idea of how the application should look and feel prior to development.

Home Page

The wireframe for the first page of the application. The only feature of the homepage is to allow the user to upload a CT Scan in his computer. The interface will ask the user to upload a metadata file and a raw file. The system will capture this data via POST request to the back end server and get the prediction to the UI

<<Attach Home Page image here>>

Prediction Page

This wireframe is what's shown when the user uploads the CT scan and the system finishes unpacking the raw file that the user has uploaded. The main feature of this wireframe is that a user will be able to select a scan that he wants to predict and the system will then take those images and feed it to the deep learning model.

<<Attach prediction page image here>>

2. Use case diagram

Use case overview : Shows an overview of the lung cancer detection system. Users will be able to upload a CT Scan,view the detection results and view cancer diagnostics.

Use case 1: Upload CT Scan

The user uploads a metadata file (.mhd) and a raw file(.raw) to the back end system via POST request. The system takes the metadata and uses it to unpack the raw files which contain the images. The system then takes the image data and saves it into image files (.png) and image data array (.npy) using OpenCV and Numpy. The reason for this is because the images generated by OpenCV is used to show to the users in the gallery. Saving the images into (.png) alters the image arrays so the model does not react well to the changes in the data. Instead we use create Numpy files for each image to give to the model and use the filenames to reference the image and the numpy files

Use case 2 : View CT scans

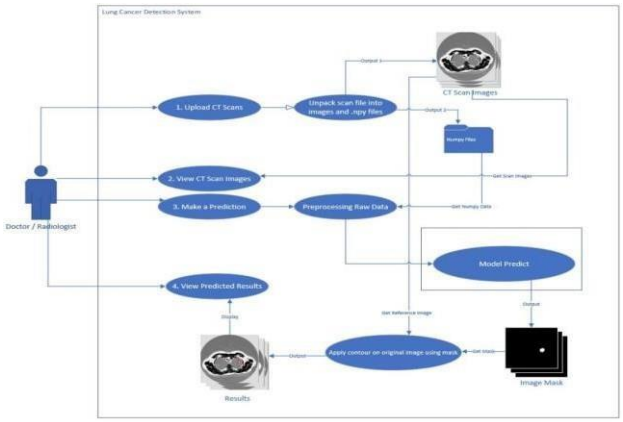
The system pulls the image files from the back end and displays it in the front end. The system does this by sending GET requests for each image. The images on the front end can be displayed via a carousel image or a gallery style.

Use case 3 : Make predictions

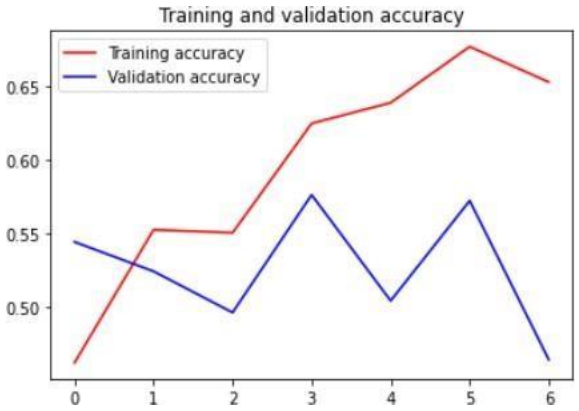
When a user selects and image that he or she wants to make predictions. The system takes the filenames from the user during selection and uses this filename to reference a numpy file. This numpy file is then preprocessed before its fed to the deep learning model. The model then outputs an image mask as seen on the diagram.

Use case 4: view predicitions

The system takes the original CT scan reference image and the associated mask and applies an image contour on the original ima



V. PERFORMANCE ANALYSIS



VI. CONCLUSION

This chapter aims to discuss the model results, an evaluation of the proof of concept, future work to improve the application and a personal statement.

The model resulted in a 90+% accuracy using the dice coefficient on the training set. The dice coefficient is much lower on the training set however the confusion matrix outputs a high true and false positive rate on a set that contains positive and negative samples. This indicates that the model is great at distinguishing between CT scan slices with no cancer nodules compared to the ones with cancer. I believe with more hyper parameter tuning and model training the accuracy could be increased.

When doctors find small nodules (less than 3mm) the current practice suggests that they should wait and rescan in 6-12 weeks to see signs of growth. Depending on the tumour, a tumour can grow up to double its size and evolve to a more advanced form of cancer. It is also important to note that the second most frequent diagnosis is small tumours. The project demonstrates that it would be possible for Doctor's to use deep learning applications to aid their decision making process regarding whether a patient with a small tumour should perform a biopsy or rescan in a few weeks which to a patient could mean early treatment and a better prognosis.

Doctor's who work in this field are prone to observer fatigue from viewing so many CT scan images. The research on that suggests that observer fatigue increases the risk of errors that can be made by doctors while analysing these scans. Many images in a CT scan also are irrelevant to doctors E.G for 200-300 images only 3 scans would show cancer depending on the stage of the patient.Although this feature was not implemented on the website, a more efficient deep learning model would be capable of alleviating these additional challenges.

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