Three-Dimensional Reconstruction of Lung Anatomy and Pathology

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Overview

The project aims to utilize advanced computer vision and machine learning techniques to create a pipeline for the 3D reconstruction of lungs, airways, and potential lung nodules. The pipeline will involve several steps, such as image pre-processing, feature extraction (such as lung segmentation, and pathways segmentation), and lung nodule model training and evaluation. The computer vision component would be responsible for detecting and segmenting lung nodules within CT scans, while the machine learning component would be used to train models for the detection of these nodules. Additionally, the pipeline would also include a 3D reconstruction module for creating detailed 3D models of the lung, airways, and potential nodules. This model is then used to analyze nodule shape, location, and proximity to airways for signs of malignancy. The overall goal of the project is to improve the accuracy and efficiency of lung nodule detection and lung, and airway reconstruction, potentially improving the diagnostic capabilities of oncologists and patient outcomes.

If time allows in the end, I intend to make the deployment on the cloud platform (GCP - as it has a free trial available for students). I believe it would provide an excellent opportunity for me to learn about the various technologies and best practices involved in deploying machine learning models in a production environment. This would include learning about cloud infrastructure, such as virtual machines, containers, and serverless computing, as well as how to properly secure and manage data in a cloud environment.

Initial Literature Review

Lung cancer is one of the leading causes of cancer-related deaths worldwide, and early detection of lung nodules is crucial for improving patient outcomes. Computer-aided detection (CAD) systems have been developed to assist radiologists in identifying lung nodules in CT scans, but their performance can be improved through the use of machine learning algorithms.

In recent years, there have been a number of studies on the use of machine learning for lung nodule detection in CT scans. One study [1] found that a CAD system trained with a support vector machine (SVM) algorithm had higher sensitivity and specificity for detecting lung nodules compared to traditional CAD systems. Another study [2] proposed a multi-view convolutional neural network (CNN) approach, which achieved a significantly lower false positive rate than a traditional CAD system. Another study [3] proposed a multi-task approach to tackle the problem of false positive reduction, detection, and segmentation reaching state-of-the-art segmentation

scores compared to other CAD systems. These studies demonstrate the potential of machine learning for improving the performance of CAD systems for lung nodule detection.

In addition to detection, 3D reconstruction of airways from CT scans is also a crucial step for the diagnosis and treatment of lung diseases such as chronic obstructive pulmonary disease (COPD) and bronchial cancer.

References:

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