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Research Article

Lung Cancer Detection Using Convolutional Neural Network

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Abstract

Lung cancer is one of the deadly diseases in recent years. However, research proved that detection in an early stage improved the chances of survival. The disease is identified using nodules attached to lung walls and lung parenchyma. Nodules on the lungs are the major sign and symptoms for identifying lung cancer. The aim of this research work was to detect lung cancer using convolutional neural network. CT scanned images were obtained and form the datasets for training and testing the models then nodules are classified as benign or malign. The model helps in improving accuracy in identifying nodules in the lungs. Different classifiers such as Multilayered Perceptron and CNN classifiers are used in comparative analysis. Based on these findings it was conclude that the approach of feature extraction with CNN decreases the false positive rate significantly compared to the existing classification methods.

Keywords: Lung Nodules; CNN; Lung Cancer; Multilayered Perceptron

Introduction

Lung cancer is recently attract so much attention from researchers in both academia and industries because is the major killer among various types of cancer such as breast cancer, oral cancer, blood cancer etc. best on the report released by the global lung cancer coalition. Researches also shows that lung cancer cases in women are twice than that of men among cigarette smokers [1]. Recently different techniques are applied in either classifying or detecting cancer such as support vector machine, KNN classifier and other artificial neural techniques such as pattern recognition [2].

Several artificial intelligence algorithms such as machine learning and deep learning algorithms has been used by many researchers to detect, classify, diagnose, early detection of lung cancer such as in [4-9]. The research of [10] used CT images to diagnosis lung nodules using pattern recognition technique these systems are referred to as decision support systems that examine the images through the process of pre-processing, segmentation, feature extraction, and classification. Many papers are published regarding lung cancer detection, classification and diagnosis however; most of the system lacks detection accuracy and low performances. In this research work we are going to applied convolutional neural network for lung cancer detection.

Method

The Lung Image Database Consortium (also known as LIDC) and the Image Database Resource Initiative both contributed data to the training dataset (IDRI). The LIDC and IDRI databases each contain one thousand CT images of tumors ranging in size from very large to very small. These scans have been saved in the Digital Imaging and Communications in Medicine (DICOM) format.

During the preprocessing stage, the median filter is used to recover the image that is being evaluated by lessening the effect that acquisition degradations have had. The median filter works by simply replacing each pixel value with the value that corresponds to the median of all of its neighbors, including itself. As a direct consequence of this, pixel values that are noticeably dissimilar to those of their neighbors will be removed.

Figure 1: Proposed Model.

Convolutional neural network model is deep learning techniques that are mostly applied in computer vision research. It inspired the information processing capability of human nervous system. CNN is an advanced artificial neural network in terms of number of layers hidden layers and so on the architecture perform well when dealing with images [10].

CNN architecture used has mainly 3 major layers. These are convolution layers, pooling layers and fully-connected layer.

- **Input layer:** It takes raw pixel values of original image as the input.
- **Convolution layer:** This layer applies the convolution operation to the input image and passes the information to the next layer. This operation emulates the response of the individual neuron to visual stimuli.
- **Relu layer:** In this layer element wise activation function is applied. The size remains as unchanged as in convolution layer.
- **Pooling layer**: Down sampling operation is applied along the spatial dimensions. Pooling layers in the convolution networks may be local or global. Pooling layer reduces the dimension by connecting neuron clusters of the one layer to the single neuron of the other layer. Small clusters are combined in local pooling whereas global pooling acts on all the neurons in the layer.
- **FC layer:** It means fully connected layer in which every neuron in one layer will be connected to other neuron in other later. It will follow the principle same as of multilayer perceptron (MLP). It helps to classify or identify the images. Also for comparison analysis SVM (Support Vector Machine) and MLP (Multi-Layer Perceptron) classifiers are used.

Proposed flowchart

A flowchart is a diagram that depicts all of the individual steps of a process in their proper order. It is a general tool that may be used for a wide range of objectives, and it can be used to define a wide range of processes, including manufacturing, administrative or service operations, and project plans as depicted in figure 2.

Figure 2: Proposed Model.

Results

The proposed model was compared with the existing model in [1]. The existing approach considered only the nodules present in lung walls. The lung cancer diseases in this research were identified using nodules that are attached to the lung walls and lung parenchyma.

The approach does not consider juxta-pleural nodules which are also presented behind the bones. But the proposed approach considered these nodules into consideration, which makes complex for the classification. Figure 3 shows the nodule detection in both 2 dimensional and 3 dimensional view. The classification accuracy with MLP (Multilayer Perceptron) classifier is 79.67% and with CNN classifier is 94.13%.

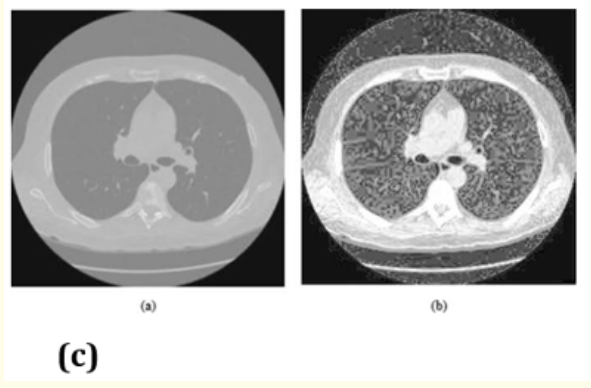

Figure 3: a) Input image b) Nodule detected 2D-image c) Nodule detected 3D-image.

Techniques	Accuracy (%)
MLP	79.67
CNN	94.13

Table 1: Comparison analysis of different classifiers for lung nodule detection.

The comparision that were represented in table 1 is also depicted in figure 4.

Figure 4: Comparison chart of Lung Cancer Classifiers.

Conclusion

Several other machine learning and deep learning algorithms has been applied in lung cancer diagnosis, detection and classification. However, the researcher proposed an efficient approach of computer-assisted diagnosis for the early identification of lung cancer to be created. CT scans were employed in this instance to provide data for the proposed model. The goal of this study was to create and improve CNN deep learning model capable of detecting and classifying lung cancer nodules. The resulting model scored 94.13%accuracy, while the MLP model only achieved 79.67% accuracy.

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