1

An Effective Approach to detect Lung Cancer on CT scan image using Segmentation with Mask Region-based Convolutional Neural Networks

A project report submitted to propose the plan of executing the project by the award of the degree

**BACHELOR OF TECHNOLOGY In Electronics and Communication Engineering**

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2

**ABSTRACT**

Lung cancer is one of the most important deadly diseases in the world. The recent estimates provided by the World Health Organization (WHO) says that around 7.6 million deaths worldwide per year due to lung cancer. Moreover, humanity due to cancer are supposed to continue rising, to become around 17 million worldwide in 2030. Discovering lung cancer in the early stage is the only method for its cure. Different methods are available for diagnosis of lung cancer, namely, MRI, isotope, X-ray and CT. CT scan image are not easy to understand, but using CNN with Image Segmentation it is an easy approach to detect Lung cancer. Convolutional neural network (CNN) is one of the deep structured algorithms widely applied to analyze the ability to visualize and extract the hidden texture features of image datasets. The study aims to automatically extract the self-learned features using an end-to-end learning CNN and compares the results with the conventional state-of-art and traditional computer-aided diagnosis system’s performance.

First approach will be to build a simple 2D Conv. Network with optimized parameters using the reference of Taguchi method of using an Orthogonal Array (OA) for finding the optimum parameters, reference of an Article (“Using 2D CNN with Taguchi Parametric Optimization for Lung Cancer Recognition from CT Images”, by Cheng-Jian Lin, Shiou Jeng and Mei-Kuei Chen, Received: 13 March 2020; Accepted: 7April 2020; Published: 9 April 2020).

After the successful building of this basic 2D-CNN model for classification of Cancer, some more test are planned to do on the as me model which were not included in the previous article such as the depth of the model, use of dropout and some other methods and the results will be analyzed

3

using Tensor board and selection of the parameters and number of experimental runs will be done using Taguchi Parametric Optimization.

Next, will be the preprocessing of the input image and segmentation of the regions like lungs and the cancer areas for making the model more accurate for the processing and result finding,(Reference of a Journal Pre- proof is taken (“An effective approach for CT lung segmentation using mask region-based convolution neural networks” by Qinhua Hu, Lu ́ıs Fabr ́ıcio de F. Souza, Gabriel Bandeira Holanda, Shara S.A. Alves, Francisco H ́ercules dos S. Silva, Tao Han, Pedro P. Rebouc ̧as Filho) further more networks like the U-Net and Nested U-Net will also be used for the segmentation purpose.

At last both the trained and optimized model will be used and combined to make a complete final model for the classification of lung cancer. Taking reference of a paper “Deep learning for lung Cancer” by A. Asuntha & Andy Srinivasan.

For the input layer, lung nodule CT images are used and being collected for various steps of project. The sources of the datasets will be mentioned in the final project submission report. Images are pre-processed to uniquely segment the nodule region of interest (NROI) in correspondence to four radiologists’ annotations and markings describing the coordinates and ground-truth values.

4

**TABLE OF CONTENTS**

**Title Page no.**

**ABSTRACT 2 1. Introduction 2. Related Work 3. Taguchi method and use in 2-D CNN 4. Result of Lung cancer Detection Algorithm Comparison 5. Image Segmentation with U-Net 6. Deep Convolution Neural Network 7. Reference**

5

**1.Introduction**

A cancer that begins in the lungs and most often occurs in people who smoke. Two major types of lung cancer are non-small cell lung cancer and small cell lung cancer. Causes of lung cancer include smoking, second- hand smoke, exposure to certain toxins and family history. Symptoms include a cough (often with blood), chest pain, wheezing and weight loss. These symptoms often don't appear until the cancer is advanced. Lung cancer is one of the most important deadly diseases in the world. The recent estimates provided by World Health Organization (WHO) says that around 7.6 million deaths worldwide per year due to lung cancer. Moreover, humanity due to cancer are supposed to continue rising, to become around 17 million worldwide in 2030.Early detection can help in curing. Early cancer Detection can be possible by applying deep learning models on CT scan Images.

6

**2. Related Work**

In medical field, it is hard and complex to detect specially on CT scanned Images. But methods using CNNs have been widely explored in various studies for the detection and pre-diagnosis of pathologies. Wang used a CNN-based segmentation method in 2D and 3D images on lung CT scans for the diagnosis of diffuse pulmonary disease. Studies to predict survival time among lung cancer patients were carried out, and CNN was used to detect anomalies by scanning the pixels in CT images. Furthermore, the classification and segmentation of the thoracic region was demonstrated and CNNs have been used to automatically detect and segment lung nodules in CT images. Kasi Nathan introduced multi-scale Gaussian filters into his model to detect lung tumors by active contouring using CNN and achieved good results with evaluation metrics of 89.0% for Sensitivity and 91% for Specificity. Liu presented a semi-supervised method for the detection of pulmonary nodules by a convolutional transfer neural network based on data analysis using a modified U-Net model.

7

**3. Taguchi method in 2-D CNN**

Currently used Taguchi method which will be used as reference.

In it a L36(211,312) Orthogonal Array is used as experimental design, and 36 experimental runs were generated by Minitab® 19 (Scientific Formosa Inc, Taipei, Taiwan) are given in Table.

8

9

The important results generated from the experimental runs are:

10

11

**4. Result of Lung cancer Detection Algorithm Comparison**

**1) Segmentation approaches:**

12

**2) Feature Extraction using Open-CV /IP**

13

14

**3) Future Extraction Using ML/DL**

15

16

**5. Image Segmentation with U-Net**

U-Net is a fully convolutional network (FCN) that does image segmentation. Its goal is to predict each pixel's class. U-Net is built upon the FCN and modified in a way that it yields better segmentation in medical imaging. U-Net architecture has three parts Down sampling ,

Up sampling and Bottleneck. The U-Net combines the location information from the down sampling path to finally obtain a general information combining localization and context, which is necessary to predict a good segmentation map. No Dense layer is used, so image sizes can be used.

17

**U-Net Architecture -**

Advanced Version Of U-net will also be tested for segmentation like U-net+ +/Nested U-Net, and Attention U-Net.

18

**6. Deep Convolutional Neural Network-**

**In deep learning, a convolutional neural network (CNN, or Conv-Net) is a class of deep neural networks, most commonly applied to analyzing visual imagery. They are also known as shift invariant or space invariant artificial neural networks (SIANN), based on their shared-weights architecture and translation invariance characteristics. They have applications in image and video recognition, recommender systems, image classification, medical image analysis, natural language processing, and financial time series.** The study aims to automatically extract the self-learned features using an end-to-end learning CNN and compares the results with the conventional state-of-art and traditional computer-aided diagnosis system’s performance. For the input layer, lung nodule CT images are acquired from the Lung Image Database Consortium public repository having 1018 cases. Images are pre-processed to uniquely segment the nodule region of interest (NROI) in correspondence to four radiologists’ annotations and markings describing the coordinates and ground-truth values.

Architecture -

19

**7. Reference –**

1. ROI-based feature learning for efficient true positive prediction using convolutional neural network for lung cancer diagnosis.

Supriya Suresh1 • Subaji Mohan2

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https://sci-hub.tw/downloads-ii/2020-03-06/92/10.1007@s00521-020-04787-w.pdf#view=FitH

2. Deep learning for lung Cancer detection and classification

A. Asuntha1 & Andy Srinivasan2

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https://sci-hub.tw/downloads-ii/2020-01-03/dc/10.1007@s11042-019-08394-3.pdf#view=FitH

3. Journal Pre-proof

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https://sci-hub.tw/downloads-ii/2020-01-10/69/10.1016@j.artmed.2020.101792.pdf#view=FitH

4. Article Using2DCNNwithTaguchiParametricOptimization for Lung Cancer Recognition from CT Images

20

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https://www.researchgate.net/publication/ 340567244\_Using\_2D\_CNN\_with\_Taguchi\_Parametric\_Optimization\_for\_Lung\_Cancer\_Recog nition\_from\_CT\_Images