AN INTELLIGENT CAD SYSTEM FOR AUTOMATED DETECTION OF THORAX REGION IN CT SCAN OF LUNG CANCER

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ABSTRACT

Lung cancer is a common cause of death among people throughout the world. Lung cancer detection can be done in several ways, such as radiography, magnetic resonance imaging (MRI) and computed tomography (CT). These methods take up a lot of resources in terms of time and money. However, CT has good for lung cancer detection, offers a lower cost, short imaging time and widespread availability. Early diagnosis of lung cancer can help doctors to treat patients in order to reduce the number of mortalities. This project presents an intelligent CAD system for automated detection of thorax region in CT scan of lung cancer. The primary aim of this research is to propose an intelligent, fast and accurate method for lung cancer detection. The proposed method involved the development of DCNN network architecture. It comprises the following steps which involves designed the convolution layer, activation function, max pooling, fully-connected layer and output size. We present three DCNN structures to find the most effective network for thorax and non-thorax region detection. All networks were trained using 12866 images and validate the performance using 5514 images. Simulation results showed that Deep Convolutional Neural Network were able to classify the thorax and non-thorax regions with good performance with an accuracy of 99.42%. This may be considered a promising aspect in realizing an intelligent, fast and accurate method for lung cancer detection.

Keywords: deep learning, thorax, non-thorax, CT scan images, lung cancer, classification

1. INTRODUCTION

Lung is one of the main causes of cancer death in the U.S and worldwide [1]. Based on the studies from [2], cancer is the second leading cause of death in the world and contributed to 8.8 million deaths in 2015. In Indonesia, lung cancer became the major cause of deaths for men in the year of 2014 [3]. In Malaysia, cancer is the fourth leading cause of death, accounting for 12.6% of all deaths in government hospitals and 26.7% in private hospitals [2]. Moreover, according to the latest World Health Organisation report released in April 2011, in Malaysia, the number one cause of death among men is lung cancer [4]. Based on previous studies, the most common way to detect lung cancer is by using CT image. CT has already become a necessity for humans in medical imaging throughout the world. The CT image is used to record images and for the radiologists to perform diagnosis. Based on CT scan image, the image will detect the overall parts of the body that include thorax and non-thorax parts. There are many slices that need to be evaluated and radiologists have to evaluate non-thorax as well. Therefore, there is a need to separate slices of thorax and non-thorax to automatically identify the correct region for further analysis. To the best of the authors' knowledge, no study has attempted to detect thorax and non-thorax slices from CT scan images prior to the process of lung cancer detection, which is the gap that this paper attempts to address by employing deep

learning method. This study proposes an intelligent, fast and accurate method for thorax and non-thorax detection using DCNN. The proposed method was developed using the MATLAB to identify the thorax and non-thorax regions.

2. METHODOLOGY

There are three major parts of this project which are i) ethical approval and data collection, ii) image classification of thorax and non-thorax using DCNN and iii) performance evaluation. The first part of this study is ethical approval and data collection of the sample collected from the Advanced Medical and Dental Institute (AMDI), Universiti Sains Malaysia (USM) database. The next part is image classification using DCNN, and the final part is performance analysis that was used to analyse the thorax region for lung cancer detection. Figure 1 shows the block diagram of the overall methodology. The details of the methodology are briefly described in the subsections below.

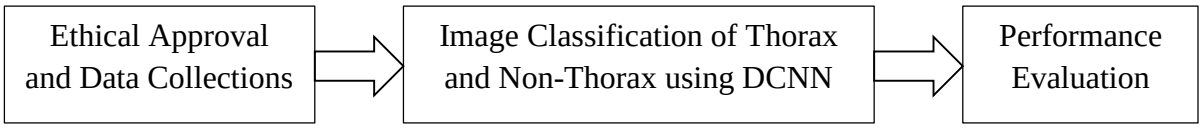

Figure 1. Block Diagram of the Overall Methodology

Figure 2 shows the DCNN training process structure for thorax and non- thorax region. Thorax region consists of lower thorax, middle thorax and upper thorax.

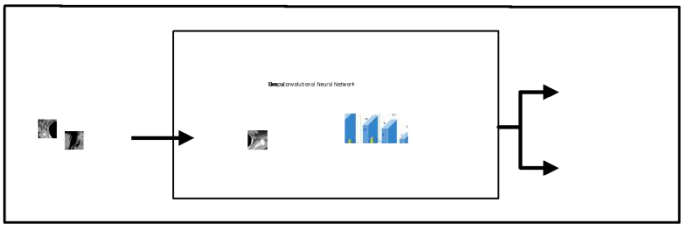

Figure 2. DCNN training process structure

3. RESULTS AND DICUSSION

This study was successfully carried out for the designation of thorax and non-thorax regions of CT scan images for lung cancer detection using deep learning method. The validation performance of different iteration numbers with minibatch size = 100 was performed to find the best iterations numbers for the DCNN models. All networks were trained using 12866 images and validate the performance using 5514 images. From the results, the best iterations from the previous simulations were chosen, which consisted of 768 iterations and analysis was done to find the best DCNN model when the learning rate was set to 0.001 and dropout=0.7. Simulation results showed that DCNN 2 and DCNN 3 were able to classify the thorax and non-thorax regions with good performance. The most efficient network is the DCNN with five-layer structure (DCNN 2). This DCNN model achieved an accuracy of 99.42% with moderate duration of training time. The results of the experiment found clear support for the next stage of this research. With the excellent result obtained here, future work is to apply the outcome from this work i.e., used the identified thorax

region only to classify the tumor for lung cancer detection purposes. This may be considered a promising aspect in realizing an intelligent, fast and accurate method for lung cancer detection.

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