Detection of Pulmonary Tuberculosis based on Convolutional Neural Networks

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Background: One of the diseases that occur in a critical thoracic area is pulmonary tuberculosis (PTB). Based on statistical data from the World Health Organization, it was found that roughly 1.6 million people had died from this disease. PTB was found in the lung area, called Lung Tuberculosis, most commonly features lesions that are formed at the upper lung range by a doctor. Diagnosis of preliminary PTB typically comes from the X-ray film. Machine learning is a technique used to analyze and find existing data relationships to get the most appropriate mathematical value in order to create a pattern for decision-making. Nowadays, there are many different research techniques that use Deep Learning, many of which are utilized for a variety of commercial and engineering applications. Convolutional Neural Network (CNN) is a form of deep learning consisting of a wide range of structures that connect to each other. Nowadays, image classification with CNN solutions is a technique that provides superior effectiveness.

Objectives: (1) To investigate the efficiency of CNN techniques for detecting the lesions indicative of pulmonary tuberculosis infection from digital x-ray images. (2) To compare the performance of CNN techniques utilizing VGG-13, Resnet-34 and Alexnet to increase the effectiveness of detection for lesions indicative of pulmonary tuberculosis infection.

Methods: This research studies the effectiveness of CNN techniques using different methods such as VGG-13, Resnet-34 and Alexnet for detecting lesions of pulmonary tuberculosis infection based on digital x-ray images, such as from http://www.aylward.org, which is a site providing open access to chest X-ray images. This research uses random sampling of digital x-ray images for experimentation with 4,400 images from 20,000 images. All images were rotated as developed by Python with Open CV framework and transform RGB image into Grey Scale to reduce the image size by training image 80% and testing images 20% from overall images. For CNN structures containing VGG-13, Resnet-34 and Alexnet, the Python with Tensorflow and Keras framework were used.

Results: The most effectiveness was found by CNN in this experiment. Consequently, the highest accuracy rate of 98% was found using Resnet-34, followed by the second highest accuracy rate of 95% for VGG-13 and the third rated accuracy rate of 90% for Alexnet. The highest speed was shown by Alexnet, while second was VGG-13 and third was Resnet-34.

Conclusions: From the experimental results in this research, it was found that Resnet-34 exhibited the most effectiveness in terms of CNN structure because it was able to train and remember repeat images from the training data better than VGG-13 and Alexnet. Despite the Resnet-34 validation accuracy, it was considerably more consistent than VGG-13 and Alexnet.

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