Convolutional Neural Network Optimized by Genetic Algorithm for Detection of COVID-19 from Chest X-Ray Image

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Abstrak

Coronavirus Diseases 19 (COVID-19) kasus awalnya terjadi di kota Wuhan, China, pada penghujung tahun 2019 hingga kasusnya mencapai beberapa negara dengan kecepatan yang sangat cepat. Diagnosis dini COVID-19 diperlukan untuk mencegah penyebaran lebih lanjut, mengurangi jumlah kematian. Reverse Transcription Polymerase Chain Reaction (RT-PCR) adalah salah satu metode yang digunakan untuk mendeteksi COVID-19. Namun cara ini membutuhkan waktu yang lama sehingga diperlukan cara lain yang lebih cepat. Sebagai alternatif, foto rontgen dada dapat digunakan untuk mendeteksi gejala spesifik terkait COVID-19 dengan mengotomatiskan diagnosis. Convolutional Neural Network (CNN) banyak digunakan untuk deteksi penyakit berdasarkan citra medis berbantuan komputer. Pada penelitian ini diusulkan model klasifikasi untuk pendeteksian COVID-19 dengan menggunakan metode CNN, dimana bobot sinaptik dioptimasi oleh algoritma genetika. Hasil penelitian menunjukkan bahwa CNN yang dioptimasi oleh algoritma genetika dengan Adam optimizer memberikan performa terbaik untuk akurasi, F1-Score dan Area Under Curve (AUC) dengan nilai masing-masing 87,5%, 85,1% dan 86,8%.

Kata kunci: Covid-19, Rontgen Dada, Convolutional Neural Network, Algoritma Genetika.

Abstract

Coronavirus Diseases 19 (COVID-19) first appeared in the city of Wuhan, China, at the end of 2019 and spread to several countries at a very fast rate. An early diagnosis of COVID-19 is needed to prevent further spread, reduce the number of deaths. Reverse Transcription Polymerase Chain Reaction (RT-PCR) is one of the methods used to detect COVID-19. However, this method takes a long time so another faster method is required. As the alternative, Chest x-rays image can be used to detect specific symptoms related to COVID-19 by automating the diagnosis. Convolutional Neural Network (CNN) is widely used for disease detection based on computer-aided medical images. In this study, we proposed classification model for the detection of COVID-19 by using CNN method, in which the synaptic weight is optimized by genetic algorithm. The result show that, CNN optimized by genetic algorithm with Adam optimizer gives best performance for accuracy, F1-Score and Area Under Curve (AUC) with value 87.5%, 85.1% and 86.8% respectively.

Keywords: Covid-19, Chest X-ray image, Convolutional Neural Network, Genetic Algorithm.

A. Introduction

Background

In 2020, there has been a pandemic of Coronavirus Disease 19 (COVID-19) caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) which first appeared in the city of Wuhan, China, at the end of 2019 [1]. Until June, 2021, this disease spread fast and it has caused more than 180 million people to be infected and more than three million people died worldwide.

The current detection method most commonly used is the Reverse Transcription Polymerase Chain Reaction (RT-PCR) to treat the nucleic acid form of SARS-CoV-2 [2]. However, this method took a long time, while the number of suspected host increased everyday. For another method to detect COVID-19, the radiological image obtained from the COVID-19 case contains credible information to serve as an answer to the patient's diagnosis.

Several studies using this visual diagnosis method have found differences and changes in the images of the lungs on chest X-rays and CT-scans (Computerized Tomography scans) before the onset of symptoms in COVID-19 patients. Therefore, an automatic diagnostic method is needed that can help in predicting COVID-19 from early X-rays and CT-Scan images [3].

It is a very common things in a several study for an automatic diagnostic for disease detection based on medical images and non medical images using Convolutional Neural Network (CNN) [4-7]. CNN has been successfully implemented in many classification tasks, among several studies that have been done by V. Sirish