



Binary Classification of COVID-19 CT Images Using CNN: COVID Diagnosis Using CT

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ABSTRACT

The COVID-19 pandemic has hit the world with such a force that the world's leading economies are finding it challenging to come out of it. Countries with the best medical facilities even cannot handle the increasing number of cases and fatalities. This disease causes significant damage to the lungs and respiratory system of humans, leading to their death. Computed tomography (CT) images of the respiratory system are analyzed in the proposed work to classify the infected people with non-infected people. Deep learning binary classification algorithms have been applied, which have shown an accuracy of 86.9% on 746 CT images of chest having COVID-19-related symptoms.

KEYWORDS

Convolutional Neural Network, COVID-19, CT Images, Deep Learning, Image Classification

INTRODUCTION

In the current decade, medical facilities are increasing day by day for the betterment of human beings. Medical facilities help human beings prevent and recover from life-threatening diseases (Rajinikanth et al., 2020). Globally, health ailments have been faced with incommunicable and chronic diseases due to various uncontrolled and unavoidable reasons (Chen et al., 2020). Most diseases can be cured through different diagnosis practices if they are identified at their early stage (Krishnan et al., 2010). Diagnosis of the problem can be made through an additional diagnostic method like blood count, CT scan, X-ray, and other tests (Rajpurkar et al., 2017);(Bhandary et al., 2020) to cure or control that disease. But in some scenarios, these tests cannot find the exact problem, and that particular diseases are declared as pandemic diseases. In the different studies, it has been concluded that the lungs are one of the most important organs which help humans to breathe, and infection related to the lungs has an effect on the human body respiratory system, which further leads to death (Syrjala

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et al., 2017). Tuberculosis, Asthma, Chronic Obstructive Pulmonary Disease, Chronic Wound, Lung Cancer, and many more are some significant diseases (Chakraborty, 2017), affecting the human body, lungs, and respiratory system (Zech et al., 2018). In the current instance, the whole world is dealing with a pandemic disease named COVID-19, which is declared a contagious disease. COVID-19 is declared a pandemic disease by the World Health Organization (WHO) in March 2020 after the different countries' infected and death rate data (Karim et al., 2020). COVID-19 started its journey by reporting cases with unknown cause from the Wuhan city of China on 31st December 2019 and later became pandemic throughout the world (F. Wu et al., 2020);(Huang et al., 2020);(Organization et al., 2020). This virus is from the corona family, which is termed as SARS-COV-2, and disease-related to this virus is named COVID-19 (Z. Wu & McGoogan, 2020). As of October 29, 2020, there have been 43,766,712 confirmed cases of COVID-19, including 1,163,459 deaths (WHO, 2020). The COVID-19 is human to human transmission disease or communicable disease spreading very fast among the community (Tan et al., 2020);(Zhu et al., 2020);(Li et al., 2020). According to different researchers and doctors, it is becoming difficult to control this pandemic as its transmission medium is still theorized (Qiu et al., 2020). Patients of COVID-19 are assumed to be infected through common symptoms like fever, cold, cough, difficulty in breathing (D. Wang et al., 2020). Medical facilities have increased with time, but still, countries and hospitals are frenzied in improving the facilities to accommodate the COVID-19 patients (Karim et al., 2020). The state-of-art test for COVID-19 is the reverse transcriptase-polymerase chain reaction (RT-PCR) test which is tested through specialized kits in particular laboratories (Ozturk et al., 2020).

The detection of the presence of the COVID-19 virus is a time-consuming task as it is done currently in clinical laboratories. The kits used for the tests are giving inaccurate results or taking more than 24 hours to provide the products. The number of cases being tested is enormous, resulting in the delay of test results. This delay proves fatal at times as a crucial period of treatment is lost. Using the available CNN techniques to classify the CT images for the presence or absence of the virus is less time consuming and tedious than the clinical tests.

The contributions of the proposed work in the area of detection of COVID-19 using the CT images are as follow: (i) A systematic analysis of relevant studies on the state-of-the-art techniques for detecting COVID-19 has been carried out. (ii) Material and methods used for implementation have been discussed in detail. (iii) Binary classifications on the hyperparameters have been used for improving the accuracy of detection. (iv) Applying the algorithm on various epoch size, batch size improved the accuracy of the detection. (v) Integrating the optimizer algorithm, activation function, and loss function with Binary classification using CNN has further improved the detection rate of COVID-19 cases using the CT images, and the findings obtained were analyzed. (vi) The accuracy obtained in the proposed work is better than the existing research work done on the same dataset using various CNN deep learning algorithms (Shalbaf et al., 2020);(Ewen & Khan, 2020). (vii) Numerous problems and concerns with the applied methodology and scope of future work have also been discussed. COVID-19 detection in clinical labs is a tedious and time-consuming process. The proposed technique can provide the detection of COVID -19 in patients in real-time, and the time taken for the process is less than what the lab tests are taking in the present scenario.

The paper is structured as: In related work section it has been summarized the existing work done for COVID-19 detection, the next section describes the material and methods used in the current work for implementation. The result and analysis of implemented work has been discussed in the result analysis and discussion section. Furthermore the challenges of present work and conclusion along with future prespective has been discussed.

RELATED WORK

Bassi et al. has conducted their study on chest X-ray images using the dense CNN classification method. They classify the images in three tags named COVID-19, regular, and pneumonia. The

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