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A Software for Thorax Images Analysis Based on Deep Learning

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ABSTRACT

People suspected of having COVID-19 need to know quickly if they are infected, so that they can isolate themselves, receive treatment, and inform those with whom they have been in close contact. Currently, the formal diagnosis of COVID-19 infection requires laboratory analysis of blood samples or swabs from the throat and nose. The lab test requires specialized equipment and takes at least 24 hours to produce a result. For this reason, in this paper, the authors tackle the problem of the detection of COVID-19 by developing an open source software to analyze chest x-ray thorax images. The method is based on supervised learning applied to 5000 images. However, deep learning techniques such as convolutional neural network (CNN) and mask R-CNN gives good results comparing with classic medical imaging. Using a dynamic learning rate, they obtained 0.96 accuracy for the training phase and 0.82 for the test. The results of our free tool are comparable to the best state of the art open source systems.

KEYWORDS

Chest X-Ray Thorax Images, Convolutional Neural Network (CNN), COVID-19, Deep Learning, Mask R-CNN, Open Source Software

1. INTRODUCTION

Progresses made in Artificial Intelligence (AI) have contributed remarkably in revolutionizing the world of healthcare. (Bourouis et al., 2020) pointed out that analyzing the medical images nowadays shows a vital role for numerous of clinical applications. Thus, many techniques and models have been developed to solve the problem of image classification or object detection and segmentation in medical images (Alroobaea et al., 2020). An example of the application

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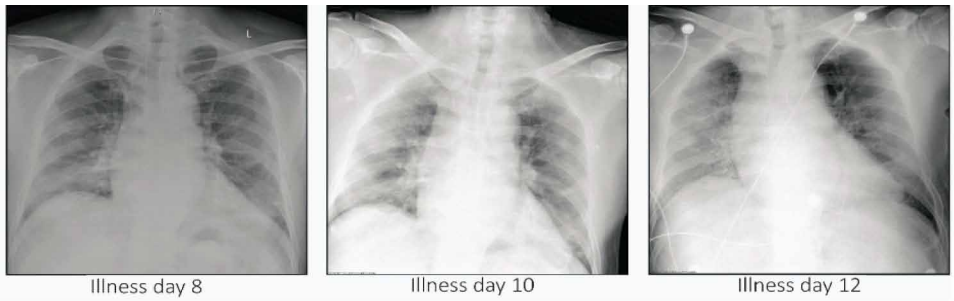
of Deep Learning (DL) in medical imaging is represented in this research work. In the last decades, segmentation has been intensively used in the processing of medical images (Bourouis et al., 2020). Thirteen billion cells in the human body includes a nucleus containing Deoxyribo Nucleic Acid (DNA), which is the genetic code responsible for programming each cell. Thus, the identification of the nuclei of cells is viewed as the main starting point of several medical analyses. It makes possible to isolate each individual cell from a sample and observe their reaction to various treatments. Therefore, it allows scientists to know the main biological processes and accelerate medical diagnosis. By accelerating the research progress and with the noticeably increased number of diseases, ranging from lung cancer to rare diseases. COVID-19 is a respiratory infection: People with COVID-19 could cough, have difficulty breathing, and in severe cases, could have pneumonia from COVID-19. Until November 12, 2020, COVID-19 has caused 1,290,016 million death tolls[1]. The life of thousands of people can be saved annually if their illnesses are diagnosed adequately at an early stage. Our motivation is about giving physicians an edge and allow them to act with more confidence while they wait for the analysis of a radiologist by having a digital second opinion confirm their assessment of a patient's condition. Also, these tools can provide quantitative scores to consider and use in studies. We opt, in this study, for techniques based on deep learning, such as CNN (Convolutional neural network) and Mask R-CNN (Region-CNN), for the prediction of COVID-19 cases, relying on thorax images. Such techniques are applied on an existing data set: the Coronahack-chest X-rays dataset (Paul et al., 2019). This data is collected in order to develop new tools based on Artificial intelligence to predict COVID19. Our results are comparable to the best state of the art methods with 96% precision on training and 82% precision on test. Figure 1 presents an example of thorax images of covid19 patients.

In comparison with other studies (section 3), Two major contributions describe our method:

- Our first contribution is based on The great strength of the Mask R-CNN which can distinguish between overlapping nuclei.
- Our second contribution consist in using a dynamic learning rate in order to optimize the learning rate according to the state of convergence of the model.

The rest of this manuscript is organized as follows. In Section 2 we present generalities about open sources software's. In Section 3, we show the related work. Then, in Section 4, we present the introduced methodology. In Section 5, we describe the performed experimentations. Finally, we end the paper with a brief conclusion.

Figure 1. Thorax analysis to predict COVID-19



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