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Semantic segmentation of chest X-ray images based on the severity of COVID-19 infected patients

D. Štifanić[1], J. Musulin[1,*], Z. Jurilj[2], S. Baressi Šegota[1], I. Lorencin[1], N. Anđelić[1], S. Vlahinić[1], T. Šušteršič[3,4], A. Blagojević[3,4], N. Filipović[3,4] and Z. Car[1]

[1]Faculty of Engineering, University of Rijeka, Vukovarska 58, 51000 Rijeka, Croatia
[2]Clinical Hospital Centre Rijeka, Krešimirova ul. 42, 51000 Rijeka, Croatia
[3]Bioengineering Research and Development Center (BioIRC), Prvoslava Stojanovića 6, 34000 Kragujevac, Serbia
[4]Faculty of Engineering, University of Kragujevac, Sestre Janjić 6, 34000 Kragujevac, Serbia

Abstract

INTRODUCTION: As a result of this global health crisis caused by the COVID-19 pandemic, the medical industry is searching for innovations that have the potential to automate the diagnostic process of COVID-19 and serve as an assistive tool for clinicians.
OBJECTIVES: X-ray images have shown to be useful in the diagnosis of COVID-19. The goal of this research is to demonstrate an approach for automatic segmentation of lungs in chest X-ray images.
METHODS: In this research DeepLabv3+ with Xception_65, MobileNetV2, and ResNet101 as backbones are used in order to perform lung segmentation.
RESULTS: The proposed approach was experimented on X-ray images and has achieved an average mIOU of 0.910, F1 of 0.925, accuracy of 0.968, precision of 0.916, sensitivity of 0.935, and specificity of 0.977.
CONCLUSION: Based on the obtained results, the proposed approach proved to be successful in terms of lung segmentation in chest X-ray images and has a great potential for clinical use.

Keywords: Artificial Intelligence, COVID-19, DeepLabv3+, Semantic segmentation, X-ray images.

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*Corresponding author. Email: jmusulin@riteh.hr

1. Introduction

Coronavirus (COVID-19) is an infectious disease caused by newly discovered SARS-CoV-2 in China [1]. Although the virus is derived from animals, currently available epidemiological data indicate that the virus spreads relatively quickly and easily among humans [2].

Various portals and researchers published numerous studies about the new coronavirus along with the consequences it has on human health, especially for the human respiratory system that is most exposed to this virus [3-6]. People with pre-existing comorbidities in particular lung disease are at much higher risk for severe symptoms of COVID-19 since they have reduced lung capacity and decreased saturation (SpO2) [7]. Early diagnosis of COVID-19 severity may be crucial in planning the patient's hospitalization site or securing respiratory aids [8]. For that reason, healthcare systems urgently require decision-making tools in order to assist clinicians in receiving proper information in real-time [9]. AI-based tools are commonly used in a variety of medical fields due to the possibility of automated medical diagnosis with high performance [10, 11]. Additionally, such tools can be used in other fields of science, economy, and technology [12-14].