Deep Learning Techniques for COVID-19 Detection Based on Chest X-ray and CT-scan Images: A Short Review and Future Perspective

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ABSTRACT— ***Today, humans live in the era of rapid growth in electronic devices that are based on artificial intelligence, including the significant growth in the manufacture of machines that perform intelligent human tasks to solve complex situations. Artificial intelligence will significantly influence the development of many domains, especially the medical domain, which relies heavily on artificial intelligence techniques in diagnosing disease data and manufacturing drugs and vaccines. Artificial intelligence has unexpectedly advanced in helping physicians and healthcare workers save many lives, especially during the spread of the COVID-19 virus. This article reviews some literature that have applied deep learning techniques to detect COVID-19 based on chest x-rays and CT-scans images. This article concluded that deep learning techniques have a fundamental and significant role in diagnosing a big dataset of images and assisting specialists in determining whether a person is infected (positive cases).***

Keywords— COVID-19, Deep Learning, Machine Learning, Artificial Intelligence, Chest X-ray, CT-scan.

1. INTRODUCTION

With the increasing problem of the huge population density all over the world, people's health concerns are increasing significantly and thoughtfully, as diseases have become an inseparable part of our lives [1][2]. Medical devices are developing day by day and keep pace with the development of diseases [3-5]. People have faced many diseases and pandemics that cannot be seen, the most well-known of which is the COVID-19 pandemic, which began spreading at the end of 2019 from China [6-12]. Respirators play a significant role in treating COVID-19 patients who lack oxygen in their lungs [12-14]. Companies are constantly working on designing medical devices, as today, these devices have the ability to treat many diseases that were difficult or impossible to treat in the past [15-17]. One of the factors of this development is artificial intelligence, which has become a large part of the growth of the medical domain [18-25]. Physicians and healthcare workers utilise artificial intelligence techniques to analyse, diagnose, predict, and track the spread of diseases, especially the COVID-19 pandemic [26-31]. One of the most famous of these techniques is the application of deep learning in medical devices [32-36]. Deep learning is a form of machine learning that is widely used in medical fields that is applied to data classification and phenotyping of new diseases [37-42]. This article reviews the essential literature that employs deep learning methods published between 2020 and 2021 to detect COVID-19.

2. DEEP LEARNING

In the literature, artificial intelligence is described as the ability of computers to achieve human tasks, i.e. tasks that require logic, for instance, drawing conclusions, finding solutions no matter how complex, understanding the nature of

the issue, and learning from past mistakes [43-51]. This process essentially requires transferring human intelligence to computers. In brief, artificial intelligence is a science that tries to make the computer work in the areas in which humans work and become a large part of human life that can never be missed [52-57]. Artificial intelligence includes machine learning, deep learning, and other techniques (see Figure 1) [58-61]. Since the emergence of the COVID-19 pandemic, artificial intelligence has an influential role in tracking the spread of this pandemic, monitoring its behaviour, knowing the number of cases of infection, and helping in the manufacture of vaccines [62-64]. Deep learning is a machine learning method identified through artificial neural networks, which is inspired by the principle of the work of neurons in the human brain [65[66].

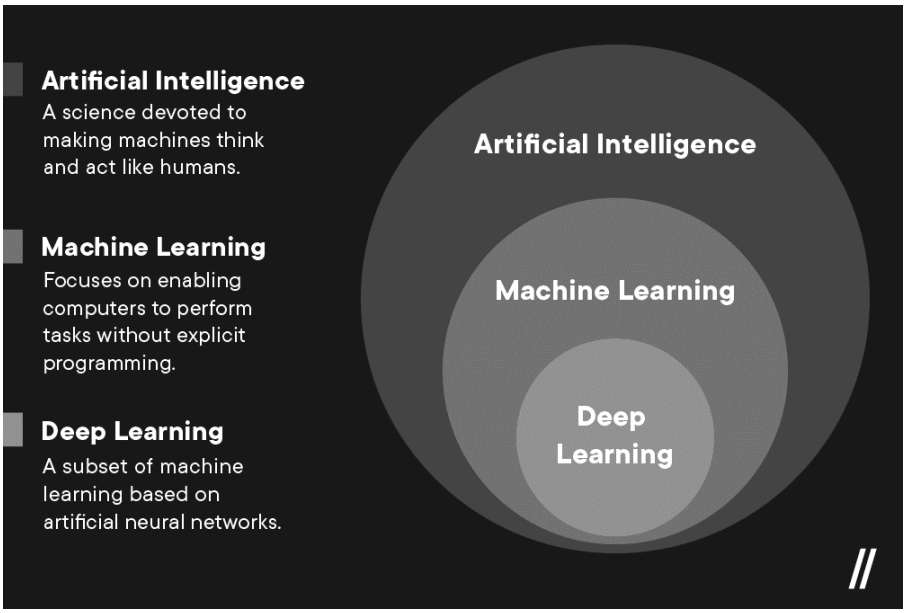

Figure 1: The difference between artificial intelligence, machine learning, and deep learning [66].

Deep neural networks are trained regularly to be able to read, classify, diagnose, and make appropriate decisions with high accuracy [68-75]. Deep learning depends on data representation and provides advantages in many applications and learns from the amount of data [76][77]. The more data increases, the more the ability of deep learning in execution will grow, unlike other machine learning techniques. In addition, deep learning has the advantage of building very deep structures to learn more abstract information. The quality of deep learning techniques is that they learn feature representations automatically, thus increasing performance speed in a shorter time. Types of deep learning architectures: deep neural networks (DNN) [78], convolutional neural networks (CNN) [79-81], recurrent neural networks (RNN) [82], which are the basic architectures of deep learning, and finally long short-term memory (LSTM) [83].

3. DEEP LEARNING VS. COVID-19

COVID-19 is one of the coronaviruses that attacks the human respiratory system and may lead to death [84-86]. More than two years after the spread of this virus, which is still growing daily, infecting, and destroying many lives. Machine learning and deep learning techniques are utilised in analysing chest X-ray images and computerised tomography (CT-scan) images to know the spread of the disease within the patient's lung (see Figure 2) [87-89]. In this section, some pieces of literature that have applied deep learning techniques in analysing these images are reviewed. Table 1 illustrates these literature published between 2020 and 2021 that used deep learning techniques to analyse and diagnose x-ray and CT-scan images.

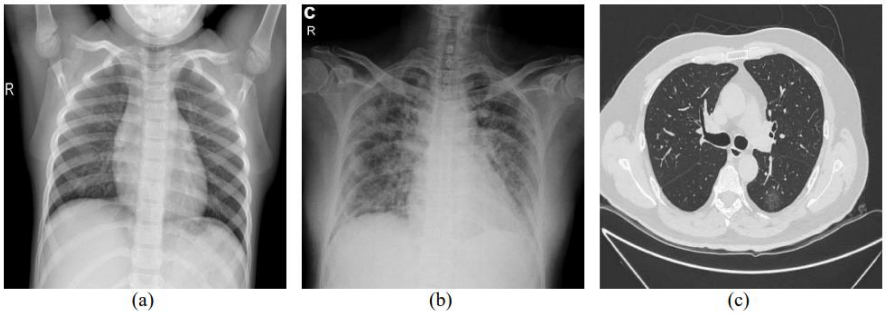

Figure 2. (a) Chest x-ray normal, (b) Chest x-ray COVID-19, and (c) CT-scan COVID-19 [90].

Table 1: The literature that employed deep learning techniques in analysing COVID-19.

Literature	Dataset	Techniques	Best Accuracy	Year
Wang et al. [91]	Chest X-ray images	VGG-19, RestNet-50, COVID-Net	98.90%	2020
Oh et al. [92]	Chest X-ray images	U-net, FC-DenseNet67, FC-DenseNet103	88.9%	
He et al. [93]	CT-scan images	VGG-16, ResNet-18, ResNet-50, DenseNet-121, DenseNet-169, EfficientNet-b0, EfficientNet-b1, and CRNet	83%	
Vaid et al. [94]	Chest X-ray images	VGG-19	96.3%	
Jain et al. [95]	Chest X-ray images	Inception V3, Xception, and ResNeXt	97.97%	
Mijwil and Al-Zubaidi [96]	CT-scan images	InceptionV1	84.14%	2021
Ismael and Şengür [97]	Chest X-ray images	ResNet18, ResNet50, ResNet101, VGG16, and VGG19	94.7%	
Shah et al. [98]	CT-Scan images	DenseNet-169, VGG-16, ResNet-50, InceptionV3, and VGG-19	94.52%	
Serte and Demirel [99]	CT-Scan images	ResNet-50	96%	
Zhou et al. [100]	CT-scan images	AlexNet, GoogleNet, and ResNet.	99.47%	

4. CONCLUSIONS

Diagnosing COVID-19 from chest x-ray and CT-scan images utilising deep learning techniques is a popular approach. However, the number of articles is increasing day by day due to the high success rates in diagnosing diseases using these techniques. This article concluded that deep learning techniques have a great and influential role in the future, especially the convolutional neural network architecture, which is widely applied in many studies. In the future, more will be done about the effects of artificial intelligence techniques in analysing and diagnosing medical data.

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