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"A SYSTEMATIC LITERATURE REVIEW ON COVID-19 DISEASE CLASSIFICATION USING DEEP LEARNING"

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ABSTRACT

This paper provides a review of several research publications on the DL-based classification of COVID-19 through imaging modalities, including CXR and CT. It also highlights the current state-of-the-art advances in this area and discusses open challenges that need to be addressed. In addition, this article highlights the importance of telemedicine in mitigating the impact of COVID-19. With the rapid spread of the virus, the shift to virtual care delivery has become essential, and machine learning-based telemedicine applications can provide a strategy for controlling outbreaks. The use of smart triage and remote patient monitoring can be critical in reducing the spread of the virus and improving patient outcomes.

Overall, the review suggests that the use of deep learning algorithms in combination with telemedicine can play a crucial role in detecting and mitigating the spread of COVID-19. Further research in this area can lead to more accurate and efficient models and improve patient outcomes.

Key Words: *COVID-19, CRX, CT, Deep learning.*

I. INTRODUCTION

The World Health Organization (WHO) declared the spread of the coronavirus infection a pandemic in March 2020, which is called the coronavirus pandemic or COVID-19 pandemic. The coronavirus pandemic is caused by severe acute respiratory syndrome coronavirus 2 (SARS CoV 2). The outbreak originally started in Wuhan, China, and later spread to every country in the world [1]. The coronavirus spreads through respiratory droplets of the infected person that are produced through cough or sneeze. These droplets can further contaminate the surfaces increasing the spread. Coronavirus-infected persons may suffer from mild to severe respiratory illness and may require ventilation support [2]. Older people and people with chronological disorders are easily prone to coronavirus infection. Thus, many governments have closed their borders and locked down people to break the cycle and prevent the spread of the pandemic [3]. With the sequencing of ribonucleic acid (RNA) from the coronavirus, many vaccines are being developed worldwide. The developed vaccines use both traditional and next-generation technology with six vaccine platforms, namely, live attenuated virus, inactivated virus, protein or subunit, viral vector-based, messenger RNA (mRNA), and deoxyribonucleic acid (DNA). Although vaccines can reduce the rapid spread and facilitate the development of immunity via the production of suitable antibodies, the efficacy of the vaccines is still 95%. Many issues are encountered in administering the vaccine, such as supply chain logistical challenges, vaccine hesitancy, and vaccine complacency. A vaccine is a prevention measure rather than a cure [4]. Even with the availability of the vaccine, early detection of the coronavirus is important, as it can facilitate tracing of the people who were in contact directly and indirectly. By tracing these people, further spread of the pandemic can be avoided. COVID-19 infection manifests as lung infection, and computed tomography (CT) and chest X-ray (CXR) images are primarily used in the

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detection of lung infection of any type [5]. Along with doctors and clinical personnel, researchers and technologists are focusing their efforts on early detection of coronavirus infections. According to PubMed,755 academic articles were published with the search term "coronavirus" in 2019, and this number rose to 1245 in the first 80 days of 2020.

Convolutional Neural Networks -Convolutional neural networks, specifically artificial neural networks, are a branch of deep learning methods that are inspired by the natural visual perception mechanism of living organisms.CNNs are nothing but stacked multilayered neural networks. There are three major categories of layers, namely, convolutional layers, pooling layers and fully connected layers. The first layer of any CNN model is an input layer, where the width, height and depth of the input image are specified as the input parameters. Immediately after the input layer, convolutional layers are defined with the number of filters, filter window size, stride, padding and activation as the parameters. Convolutional layers are used to extract meaningful feature maps for the input location by calculating the weighted sum. Then, each feature map is passed through an activation function, and bias is added to form the output. Usually, rectilinear unit (ReLU) activation is used as the activation function [6] Pooling layers are used to reduce the size of the output from the convolutional layers. As the model increases in size with an increasing number of filters in the convolutional layer, the output dimensionality also increases exponentially, which makes it hard for computers to handle? Pooling layers are added to reduce the dimensions for easy computation and sometimes to suppress noise. The pooling layer can be a max pooling, average pooling, global average pooling, or spatial pooling layer. The most commonly used pooling layer is a max pooling layer .The output is flattened to form a single-array feature vector, which is fed to a fully connected layer. Finally, a classification layer is defined with activation functions such as sigmoid, softmax and tans functions.The number of classes is specified in this layer, and the extracted features are aggregated into class scores. Batch normalization layers are applied after the input layer or after the activation layers to standardize the learning process and reduce the training time. Another important parameter is the loss function, which summarizes the error in the predictions during training and validation. The loss is back propagated to the CNN model after each epoch to enhance the learning process.[7]

II. LITERATURE REVIEW

A short review of AI application for covid-19 is presented. In a review on the potential of using AI in developing countries is performed. A review on automatic detection and forecasting of covid-19 using DNN algorithms is performed in [8-10].a survey on epidemic models for the disease is presented. A discussion on how big data can help better manage the pandemic is presented in [11].

Jun Wang, Yiming Bao et.al. 2020[12] we propose a conceptually simple framework for fast COVID-19 screening in 3D chest CT images. The framework can efficiently predict whether or not a CT scan contains pneumonia while simultaneously identifying pneumonia types between COVID-19 and Interstitial Lung Disease (ILD) caused by other viruses. In the proposed method, two 3D-ResNets are coupled together into a single model for the two above-mentioned tasks via a novel prior attention strategy. We extend residual learning with the proposed prior-attention mechanism and design a new so-called prior-attention residual learning (PARL) block. The model can be easily built by stacking the PARL blocks and trained end-to-end using multi-task losses. More specifically, one 3D-ResNet branch is trained as a binary classifier using lung images with and without pneumonia so that it can highlight the lesion areas within the lungs. Simultaneously, inside the PARL blocks, prior-attention maps are generated from this branch and used to guide another branch to learn more discriminative representations for the pneumonia-type classification. Experimental results demonstrate that the proposed framework can significantly improve the performance of COVID-19 screening. Compared to other methods, it achieves a state-of-the-art result. Moreover, the proposed method can be easily extended to other similar clinical applications such as computer-aided detection and diagnosis of pulmonary nodules in CT images, glaucoma lesions in Retina fundus images, etc

Ashish Joshi (2022)[13] The advantages of the cloud environment for data processing and sharing are utilized by millions of people worldwide. A cloud system must inevitably provide data security and privacy. Users' widespread use and sharing of information creates security gaps. This study aims to discuss the cloud environment, its benefits, difficulties, and upcoming research trends pertaining to safe data processing and exchange. The widespread issue is caused by the increased adoption of cloud computing by several enterprises. As a result, utilizing any device to load and receive data from the cloud providers' facilities raises various security and privacy risks, such as data modification,

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data loss, and theft. Unauthorized access by insiders is one of the significant problems that might develop. Although there are various ways to prevent cloud administrators from gaining illegal access, such methods haven't been successful in keeping them from gaining access to client data in the cloud. The degree of protection a system may offer to the CIA triada paradigm that includes the information security qualities confidentiality, integrity, and availability is how information security is assessed. In this paper, we have analyzed such scenarios. This study analysis provided dangers to cloud data security, cloud assaults, and found vulnerabilities for several factors affecting cloud computing.

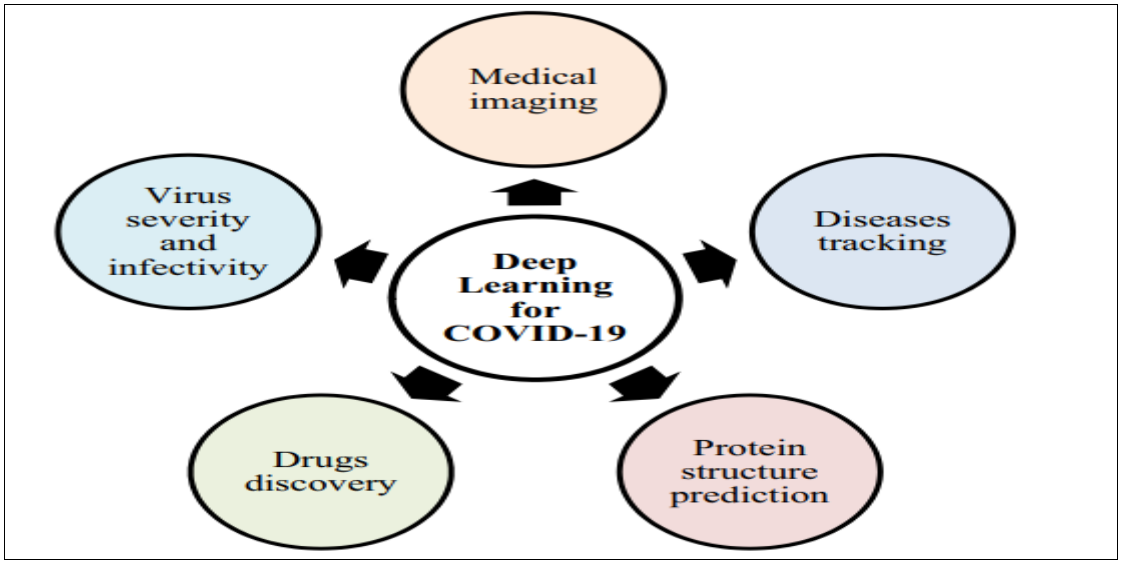

Fig 2.1 deep learning techniques to control COVID

Xinggang Wang et.al (2020)[14] Accurate and rapid diagnosis of COVID-19 suspected cases plays a crucial role in timely quarantine and medical treatment. Developing a deep learning-based model for automatic COVID-19 diagnosis on chest CT is helpful to counter the outbreak of SARS-CoV-2. A weakly-supervised deep learning framework was developed using 3D CT volumes for COVID-19 classification and lesion localization. For each patient, the lung region was segmented using a pre-trained UNet then the segmented 3D lung region was fed into a 3D deep neural network to predict the probability of COVID-19 infectious; the COVID-19 lesions are localized by combining the activation regions in the classification network and the unsupervised connected components. 499 CT volumes were used for training and 131 CT volumes were used for testing. Our algorithm obtained 0.959 ROC AUC and 0.976 PR AUC. When using a probability threshold of 0.5 to classify COVID-positive and COVID-negative, the algorithm obtained an accuracy of 0.901, a positive predictive value of 0.840 and a very high negative predictive value of 0.982. The algorithm took only 1.93 seconds to process a single patient's CT volume using a dedicated GPU. Our weakly-supervised deep learning model can accurately predict the COVID-19 infectious probability and discover lesion regions in chest CT without the need for annotating the lesions for training. The easily-trained and high-performance deep learning algorithm provides a fast way to identify COVID-19 patients, which is beneficial to control the outbreak of SARS-CoV-2.

Mohamed Almansoor et.al (2020) [15] COVID-19 is a global pandemic that hit the world in 2019-2020 and caused massive losses. Every day, hundreds of thousands of tests are being done on possible infected cases. It usually takes several hours to get the results of virus test in advanced countries, whereas in other countries might take days. The aim of this study is to investigate whether normal blood medical tests help in detecting covid-19 using various machine learning approaches. If true, this would give an indication to people who should undergo the virus test. In this paper we independently use machine learning algorithms including support vector machines, adaptive boosting, random forest and k-nearest neighbors. These algorithms are then merged to form ensemble learning which leads to the classification. The results show that the ensemble learning is having the highest true positive rate of 30%. The obtained results show that normal blood tests do not help much in giving right indications about detecting COVID-19.

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Ryan Yixiang et.al (2020) [16] Machine learning (ML) based forecasting mechanisms have proved their significance to anticipate in preoperative outcomes to improve the decision making on the future course of actions. The ML models have long been used in many application domains which needed the identification and prioritization of adverse factors for a threat. Several prediction methods are being popularly used to handle forecasting problems. This study demonstrates the capability of ML models to forecast the number of upcoming patients affected by COVID-19 which is presently considered as a potential threat to mankind. In particular, four standard forecasting models, such as linear regression (LR), least absolute shrinkage and selection operator (LASSO), support vector machine (SVM), and exponential smoothing (ES) have been used in this study to forecast the threatening factors of COVID-19. Three types of predictions are made by each of the models, such as the number of newly infected cases, the number of deaths, and the number of recoveries in the next 10 days. The result produced by the study proves it a promising mechanism to use these methods for the current scenario of the COVID-19 pandemic. The results prove that the ES performs best among all the used models followed by LR and LASSO which performs well in forecasting the new confirmed cases, death rate as well as recovery rate, while SVM performs poorly in all the prediction scenarios given the available dataset

Richard F. Sear et.al (2020)[17] a huge amount of potentially dangerous COVID-19 misinformation is appearing online. Here we use machine learning to quantify COVID-19 content among online opponents of establishment health guidance, in particular vaccinations ("anti-vax"). We find that the antivax community is developing a less focused debate around COVID-19 than its counterpart, the pro-vaccination ("provax") community. However, the anti-vax community exhibits a broader range of "flavors" of COVID-19 topics, and hence can appeal to a broader cross-section of individuals seeking COVID-19 guidance online, e.g. individuals wary of a mandatory fast-tracked COVID-19 vaccine or those seeking alternative remedies. Hence the antivax community looks better positioned to attract fresh support going forward than the provax community. This is concerning since a widespread lack of adoption of a COVID-19 vaccine will mean the world falls short of providing herd immunity, leaving countries open to future COVID-19 resurgences. We provide a mechanistic model that interprets these results and could help in assessing the likely efficacy of intervention strategies. Our approach is scalable and hence tackles the urgent problem facing social media platforms of having to analyze huge volumes of online health misinformation and disinformation.

Ekta Gambhir et.al (2020)[18] the outbreak of the Novel Coronavirus or the COVID-19 in various parts of the world has affected the world as a whole and caused millions of deaths. This remains an ominous warning to public health and will be marked as one of the greatest pandemics in world history. This paper aims to provide a better understanding of how various Machine Learning models can be implemented in real-world situations. Apart from the analysis done on the world figures, this paper also analyzes the current trend or pattern of Covid-19 transmission in India. With the help of datasets from the Ministry of Health and Family Welfare of India, this study puts forward various trends and patterns experienced in different parts of the world. The data to be studied has been obtained for 154 days i.e. from January 22, 2020, till June 24, 2020. For future references, the data can be further analyzed, and more results can be obtained.

Public Imaging Datasets for COVID-19-Detection In all, about 35 public datasets (CXR and CT images) have been referred to and used by researchers to validate the algorithms in the articles reviewed in this work. The details are listed in Table 2. Some of these datasets contain CXR images and CT-scan images of COVID-19, while others include those of normal subjects and different pulmonary diseases. The reason for using the latter type of datasets is to create more generalizable algorithms that can detect COVID-19 from a pool of more diverse radiography images.[19]

Open issues-This section covers a wide range of important issues and challenges that will require future research. AI-based ML and DL researchers have a background in computer science. Still, To include other medical information into the COVID19 war's utilization of ML and DL, a significant specialty in medical imaging, bioinformatics, virology, and other relevant disciplines. To cope with COVID-19, specialists from many disciplines must collaborate, and results from different research must be included. Also, it can be difficult to work with ambiguous and incorrect information in text descriptions. Large amounts of data from various sources can be incorrect. Furthermore, excessive data makes it impossible to extract valuable pieces of information. Attempting to deal with unbalanced datasets because of insufficient medical imaging and a long training period knowledge from COVID-19 and unable to explain the findings. By creating social networks and knowledge graphs, an AIbased ML and DL system can monitor and track the features of people living near COVID-19 patients, accurately predicting and monitoring the disease's potential spread.

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Furthermore, AI-based ML and DL systems can identify potential drugs and vaccines and mimic drug-protein and vaccine-receptor interactions, predicting future drug and vaccine reactions in people with various COVID-19 patients. In the context of biological research, AI-based ML and DL systems can be used to accurately analyze biomedical knowledge, such as significant protein structures, genetic sequences, and viral trajectories, to identify protein composition and viral factors. Here are some ideas for future research studies [20].

III. CHALLENGES OF DISESEAS DETECTION

While the use of deep learning algorithms and telemedicine has shown promising results in mitigating the impact of COVID-19, several challenges still need to be addressed.

Firstly, the quality and size of the dataset used for training the deep learning algorithms can significantly affect their performance. Ensuring that the dataset is diverse and representative of different populations can improve the accuracy of the models. Secondly, the lack of standardization in imaging protocols and variations in imaging quality can affect the accuracy of COVID-19 diagnosis using chest X-ray and CT imaging. Addressing these variations and ensuring standardized protocols can improve the reliability of the models. Thirdly, there is a need to address issues related to data privacy and security when using telemedicine applications. Ensuring the secure transmission of patient data and complying with privacy regulations can help build trust in these applications and encourage their widespread adoption. Fourthly, there is a need to address issues related to the equitable distribution and access to telemedicine services. Ensuring that all individuals, regardless of socioeconomic status or geographic location, have access to these services can improve their effectiveness in controlling outbreaks and reducing the spread of COVID-19. Finally, continued research and development are necessary to improve the performance of deep learning algorithms and their integration with telemedicine applications. Further studies are needed to address these challenges and improve the effectiveness of these technologies in mitigating the impact of COVID-19.

IV. CONCLUSION

This study is most significant for new practitioners and researchers who plan to develop an AI/ML model or drug for COVID-19. They can reuse existing models and drugs rather than design from scratch and save time for doing potential research and future studies. Besides, this research provides a backbone for different aspects such as disease diagnosis and detection, drug and vaccine development, AI/ML models and techniques. The conducted literature provides comprehensive details of AI's potential and existing contribution to combating the pandemic. As it is understood from the literature review, many researchers applied CNN models. The main reason can be that they are powerful for the spatial coherence or local pixel correlations in medical images. CNN technique was usually applied for either classification or diagnosis. However, authors should remind aforementioned drawbacks before applying CNN for COVID-19 studies

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