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A Review of Deep Learning Techniques to Diagnose Covid-19 Disease

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***Abstract*—**In recent decades, a number of new diseases have emerged, among which include the Ebola virus, Zika virus, Nipah virus, and Coronavirus. Recently, a new type of viral infection emerged in Wuhan City, China, and preliminary genomic sequencing data for this virus do not coincide with previously sequenced COVs, suggesting a novel COV strain (2019-NOCV), Which is now called severe acute respiratory syndrome CoV-2 (SARS-CoV-2). Compared to previously known diseases caused by human COV, COVID-19 exhibits higher transmission capacity, as evident by the number of cases continuously increasing globally. In the last 2 years, many people have died all over the world since Covid-19. This disease is spreading rapidly and it is becoming very difficult to stop it. Nowadays deep learning techniques are evolving in medical science. In this paper, we will study various types of deep learning techniques to diagnose Covid disease in the early stage.

Keywords*—*Review, Deep Learning; Machine Learning; Algorithms; Covid-19; Diagnosis; X-ray;

I. INTRODUCTION

Covid-19 is the name given by the World Health Organisation on 11th February 2020 covid-19 started in Wuhan China in late 2019. Globally according to World Health Organisation (WHO) as of 18th November 2020, there have been 55,326,907 confirmed cases of covid-19 including 13,33,742 deaths reported to the World Health Organisation. Whereas in India at the same time, there have been 8,912,907 confirmed cases with 1,30,993 deaths.[9] Cases and deaths increase rapidly day by day. which is an appalling and painful situation. The coronavirus is a very harmful and transferable disease that belongs to the family of SARS-COV2 it can also cause damage to the lungs. Corona spread very quickly and firstly attacks your lungs and throat. Fever, dry cough, tiredness are the most common symptoms of covid 19, and conjunctivitis, loss of test and smell, sore throat, aches, and pains are less common symptoms. When the person is very serious this type of difficulty occurred, shortness of breath or difficulty breathing, chest pain or pressure loss of speech, or movement. Once inside the body, the virus comes and contact with cells in the throat nose, and lungs. An infected person talks or coughs or sneezes the virus-carrying droplets can land in your mouth or nose and then in their lungs that's why this is a transferable disease.

The virus contacts the healthy cell membrane, then with the help of Spikes, it merges receptor molecules. This action allows coronavirus to enter the cell and then specific flu viruses will travel from the nucleus to the cell membrane. Where the cell carries all its genetic material and on the other hand Corona is directly receiving parts of the host cell called ribosomes. Ribosomes use genetic information from viruses to make viral proteins, such as Spikes on the surface of the virus. A packaging structure in the cell then moves the Spikes into the vesicles, which merge with the cell membrane, the outer layer of the cell. All the parts needed to make a new virus, gather under the membrane of the cell. Then a new virus starts from the cell membrane. The structure of corona virus is shown in figure 1.

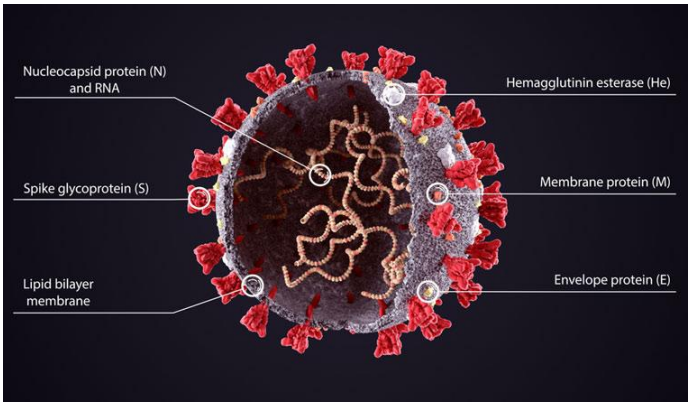

Fig. 1. Structure of Coronavirus

Each lung has separate sections, which are called lobes. Normally, as breath air moves freely through the trachea or windpipe. Then through large tubes called bronchi, through small tubes called bronchioles, and finally into tiny sacs, it is called alveoli. it is Airways and alveoli are flexible and polymorphic. When breath each air sac inflates like a small balloon and when exhaling the sacs shrink. The alveoli are surrounded by small blood vessels on all four sides the small blood vessels are called capillaries.The oxygen from the air breathe goes to capillaries, then the carbon dioxide from the body comes out of capillaries to the alveolar part, so that lungs get rid of it when exhaling. The airways hold the most germs in the mucus that pull bronchi, trachea, and bronchioles. In a healthy body, the hair-like cilia tubes continuously emit mucus and germs from the airways, where they provoke a cough. Normally, the cells of the immune system attack germs and viruses that make it past mucus and cilia and enter alveoli. If the immune system is weak such as in the case of virus infection, the virus can affect immune cells and bronchiole and alveoli, which causes your immune system to attack multiplying viruses. Inflammation fills the alveoli with fluid, making it very difficult for the body to get the oxygen, for which lobar pneumonia may develop, where one lobe of the lung is affected, or may have bronchophenia that affects multiple areas of both lungs. pneumonia make of chest pain difficulty breathing cough fever and chills headache pain and fatigue. It may cause a lot of serious complications. Respiratory failure occurs when breathing becomes so difficult that a machine called a ventilator is needed to help breathe. these are machines that save lives and medical device companies currently built ramps for production. Whether or

not these symptoms will develop depends on many factors such as age and whether there is a pre-existing condition. While it all sounds scary, the push to develop a coronavirus vaccine is at a rapid pace. studies from other coronavirus have led most researchers to assume that people who have recovered from SARS COV-2 infection can be protected from relapse for some time. but that assumption must be supported by empirical evidence and some studies suggest otherwise. There are several different approaches to a potential vaccine against coronavirus. The structure of lungs shown in figure 2.

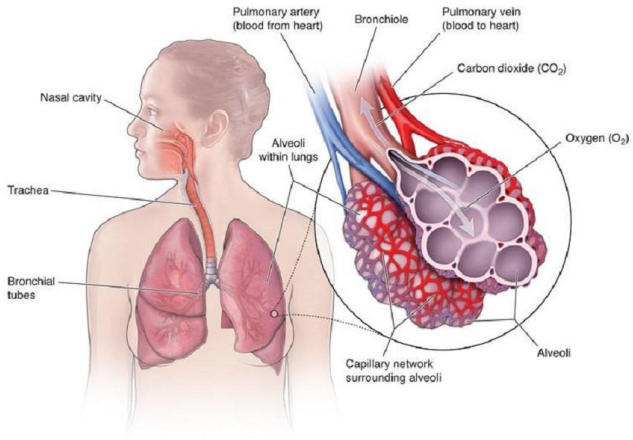

Fig. 2. Structure of Lungs

Chest X-ray is an important, non-invasive diagnostic adjunct that plays an essential role in detecting such visual responses associated with SARS-COV-2 infection. However, the limited availability of specialist radiologists to interpret X-ray images of the chest and the microscopic presence of disease radiographic responses remain the biggest bottleneck in manual diagnosis. In this paper, we study different automatic COVID screening systems and algorithms that use radiographic texture descriptors extracted from Chest X-Ray images to identify the normal, suspected, and COVID-19 infected patients.

II. Problem Formulation

Coronaviruses belong to an RNA virus (+ssRNA) family that can be isolated in different animal species. It has been identified in recent times as Coronavirus or Covid-19. Its structure is complex and has been found to produce a variety of unusual strategies to maintain a complex program of gene expression at the molecular level. It usually takes about 3-7 days for a patient to show signs and symptoms of COVID-19 and sometimes it takes up to 14 days. Manually classifying COVID-19 from CT is very laborious and extremely hard. So to reduce the load on the operator, a mechanized over strategy is made by classifying COVID-19 to produce satisfactory results. The most common symptoms of COVID-19 illness are cold, dry cough, fever, and irregular fatigue. Other symptoms of the disease that are less common and may affect some patients include regular pain, difficulty in breathing, headache, conjunctivitis, sore throat, diarrhea, loss of taste or odor or skin rash, or fingers or feet. Includes discoloration of fingers.Generally, these symptoms are light and begin gradually. for this reason, Some people become infected. Most people are cured of this disease by first aid. But Around 1 out of every 5 people who suffer COVID-19 becomes seriously ill and that patient gets difficulty of breathing. There is a higher risk of developing this serious disease in those who already have underlying medical problems such as high blood pressure, heart, and lung problems, diabetes, or cancer. However, everyone may be affected by COVID-19 and become seriously ill. People of all ages who are associated with fever and/or cough with shortness of breath, chest pain/pressure, or speech problems, should seek medical attention immediately and if possible call a health care provider immediately It is recommended. Therefore the patient can be directed to the right clinic.

III. Literature Searevay

In current years, automated disease classification is one of the very necessary and important tasks in deep learning. deep learning technology for medical diagnosis has got a strong boost due to valuable research activities in big data. Several researchers have highlighted the potential of predictive classification to provide decision support for doctors and medical professionals.Over the past few time, there has been excellent research and analysis on a completely different data set for the predictive COVID-19. The following is some research review of the same field. Following are some researches which have been reviewed for the proposed system as shown in table1:--

TABLE I. Different Types of Deep Learning Techniques

S. No	Author	Model Used	Result
1	Jin et al. [1]	U-Net++, ResNet50	97.4% (Sens.) 92.2% (Spec.)
2	Xu et al. [2]	V-NET, ResNet-18	86.7% (Acc.)
3	Zheng et al. [3]	U-Net, CNN	90.7% (Sens.) 91.1% (Spec.)
4	Chen et al. [4]	U-Net++	95.2% (Acc.) 100% (Sens.) 93.6% (Spec.)
5	Ying et al. [5]	ResNet-50	86.0% (Acc.)
6	Ghoshal et al. [6]	CNN	92.9% (Acc.)
7	Shi et al. [7]	VB-NET, RF	87.9% (Acc.) 90.7% (Sens.) 83.3% (Spec.)
8	Wang et al. [8]	CNN	82.9% (Acc.) 84.0% (Sens.) 80.5% (Spec.)

- Jin et al. [1] Proposal of AI system for rapid COVID-19 diagnosis. The input of the classification model is a CT slice that is segmented by a segmentation network. They used chest CT images of 1136 cases in the study. Their proposed model includes the UNet++ based segmentation model and the ResNet50 based classification model. The segmentation model is used to uncover lesion areas for classification models. In the experiment, sensitivity and specificity are 97.4% and 92.2%, respectively, using the proposed UNet++ and Resnet 50 combined models
- Xu et al. [2] proposed in Deep learning system to screen Coronavirus disease 2019 pneumonia. They use chest images from 219 patients with COVID-19, 236 patients of influenza-A, and 175 healthy persons. A deep learning model based on V-NET has first used to segment infected regions. The patches of infection regions are sent to ResNet-18 based classifier with features of relative infection distances from the edge, and the output is one of these three groups. The model achieves an overall accuracy of 86.7%.
- Zheng et al. [3] is proposed to use an unsupervised method to generate a pseudo-segmentation mask for images. Since the lack of annotated medical images is common in lung segmentation, unsupervised and semi-supervised methods are highly sought after COVID-19 studies. They proposed U-Net+3D CNN-based model called DeCoVNet. The U-

NET is used for lung segmentation, and the segmentation result is used as an input to the 3D CNN to predicting the probability of COVID-19. Chest CT images of 313 with COVID-19 subjects and 229 without COVID-19 subjects are used as training and testing data. The model achieves a AUC of 0.959, a sensitivity of 90.7%, and a specificity of 91.1%.

- Chen et al. [4] proposed, the UNet++ based segmentation model to train with chest CT images of 51 COVID-19 patients and 55 non-COVID-19 patients. This model is used for segmenting COVID-19 infected lesions. The final classification is determined based on segmented lesions. The evaluation results of the COVID-19 classification using the proposed model have an accuracy of 95.2%, a sensitivity of 100%, and a specificity of 93.6%.

- Ying et al. [5] proposed a deep learning-based CT COVID-19 diagnosis system called DeepPneumonia, to detect patients with COVID-19 from bacterial-pneumonia patients and healthy people. Chest CT images of 88 patients with COVID-19, 101 patients with bacterial pneumonia, and 86 healthy individuals are used as training and testing data. Complete lung slices are obtained from chest CT images, which are input for DeepPneumonia. The model achieves an accuracy of 86.0% for COVID-19 classification.

- Ghoshal et al. [6] proposed a Bayesian Conventional Neural Network in their paper "Estimating uncertainty and interpretability in deep learning for coronavirus (COVID-19) detection", to estimate the uncertainty of diagnosis in the prediction of COVID-19. The results show that the Bayesian Conventional Neural Network improves the detection of COVID-19 accuracy of the VGG16 model from 85.7% to 92.9%.

- Shi et al. [7], In the preprocessing phase, a VB-NET is used to segment the image into the left / right lung, 5 lung lobes, and 18 pulmonary segments. They used a total of 2685 CT images, of which 1658 COVID-19 patients and 1027 are common pneumonia patients. Many handmade features are calculated and used to train a random forest model. The model archives the sensitivity of 90.7%, specificity of 83.3%, and accuracy of 87.9%.

- Wang et al. [8] proposed a CNN model to classify between COVID-19 and typical viral pneumonia. They used 453 Chest CT images of COVID-19 and viral pneumonia patients. Slices obtained from each 3D CT image are used as the input of the proposed CNN. The validation dataset shows the accuracy of 82.9%, specificity of 80.5%, and sensitivity of 84.0%.

IV. FUTURE WORK

We only have the RT-PCR method for test if the person gets COVID positive. RT-PCR test is time-taking, which consume a minimum of 1 to 3 days, that is very harmful to COVID patient. Also, the existing system does not accurate enough which is very risky for COVID patients. In this paper, we analyze several techniques in the field of deep learning for covid diagnosis. In future research, these techniques are required to be more accurate. Some of the following are the scope of improvement in the system.

- For making the complete system, it mandatory to improvise the algorithm. So continuously, increase the accuracy of the algorithm.
- It is necessary to make an extensive and safeguard Healthcare diagnosis system to be used in research.
- Several more aspects to handle covid-19 even more.

CONCLUSION

In our depth analysis of a literature survey, we acknowledge that the action has done earlier did not use a large data set. The large data set ensures a better prediction. The prediction will be done with the help of Data augmentation to increase the amount of Data set. The techniques need to be more accurate using the state of the art deep learning models. We will improve the system in our future researches.

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