SURVEY ON PROBABILISTIC DETERMINATION OF CORONA VIRUS INFECTION

Sunanda Dixit*[1], Aman Rai[2], Afra[3], Arfa Noorain H[4], Abdullah Ali Hood Abdullah Ba Abbad [5]

[1]Associate Professor, Computer Science and Engineering Department, BMS Institute of Technology and Management, Bangalore, India

[2]Student, Computer Science and Engineering Department, BMS Institute of Technology and Management, Bangalore, India

ABSTRACT

One of the most morbid infections in recent times is Covid-19, having a potential to cause death in human beings. Covid-19 are a set of RNA viruses which lead to deadly disease in both birds and mammals. This pandemic already has led to tens of millions of deaths and infected several times more people worldwide. The exponential expansion in COVID-19 patients is overpowering medical care frameworks over the world. The death rate is increasing drastically as a result. An effective testing method is to conduct swab tests in order to determine if the person is infected with Covid-19. This becomes very handy in the medical field as diagnosis is rather quick and simple. However, medical image processing provides further information, and is an emergent field in recent times. We have proposed the use of modern Image Processing mechanism to detect COVID-19 patients using the dataset of CT (Computed Tomography) scan images in an automated manner. This dataset is used to perform a comparison between different CT scan images of COVID-19 positive cases together with Normal lung CT images.

Keywords:

machine learning, image processing, vgg-16 model, Covid-19, CT scan

I. INTRODUCTION

COVID-19, the deadly disease caused by the infamous Novel Coronavirus, originated in the wet markets of Wuhan, China somewhere around November 2019. The successor to SARS-Cov virus of 2003, the SARS-Cov-2, spread exponentially within a very short span of time. The World Health Organization had no option but to declare this spread as a global widespread in March 2020. The coronavirus has an affinity to the lung receptor cells of human beings and as such, results in pneumonia, which is easily identifiable on CT scan images. The better known manifestation of this illness are fever, dry cough and general fatigue. Other symptoms range from loss of taste, smell, difficulty breathing in severe cases, and body pain. Difficulty breathing and dry cough is caused due to lung damage caused by the virus. This damage is easily recognized by radiologists with the help of X-Rays or CT scan images. Such radiological examinations help not just diagnose, but also quantify and analyze the extent and nature of damage done by the virus. A quick comparison between standard X-Rays, and HRCT scans is useful to appreciate the benefits of CT scan images in certain classes of illness. Although X-Rays provide a quick and simple method to determine whether there is something wrong with the lungs, they fail to detect certain deeper anomalies. HRCT scan images however bring out the best details, which definitely helps doctors accurately study and classify lung damage, and prescribe the correct treatments for the same. Furthermore, HRCT scan images produce three dimensional images, whereas X-Rays product two dimensional images. The severely burdened healthcare systems across the world definitely benefit from the availability of these techniques in the diagnosis and treatment of patients. As of now, there is no definite treatment, and symptomatic treatment is administered to patients. In this work, we propose the use of CT scan to analyze and detect COVID-19 in patients in an automated manner. Giving the large scale of the infection across the globe, automated detection to preliminarily rule out nonCOVID-19 or otherwise normal CT scan images, promises radiologists more time to focus

on the patients who are in need of specialized evaluation and treatment. In this work we propose the use of CT scan images, image processing and machine learning methodologies to detect COVID-19 infection in the patients exhibiting manifestation.

II. LITERATURE SURVEY

Among 167 individuals, around 5 had in the start been negative on the RT-PCR test, yet CT scan had positive results with a trend in line with viral pneumonia. Subsequently, all the Covid diagnosed people were kept under isolation for COVID-19 pneumonia. Among the five patients with RT-PCR negative and CT results showing infection in the beginning, the CT score of involvement was 4(median) [1]. The greatest score for the same was 14, and the least was 2.High risk individuals for COVID19 infection, the CT chest scan pneumonia features (viral) can show before positive RT-PCR test results. Key Results were 5 patients infected showed negative results in the start at RT-PCR testing but showed positive CT results.

Comparison to RT-PCR study involved 51 people with the mean age of people being 45 years. Swabs of the throat were taken and followed up by RT-PCR testing. Mean time between development of symptoms and CT scanning was 2-6 days. Among 51 patients, 36 in the start had RT-PCR results showing COVID-19. 12 among the 51 patients with two RT-PCR tests done tested positive for COVID19. Therefore in this study [[2] 50 of 51 patients or 98% was the detection rate for CT which was found to be more than that for RT-PCR, which was 36 out of 51 patients or about 70 percent.In a span of time, the RT-PCR gave positive, then negative, or negative and then positive tests[3]. This was compared with the nature of CT scan studies in the same period to determine the relative stability in the results as compared to RT-PCR. Surprisingly, 75 % of patients with false RT-PCR results, has positive CT Scan findings. Hence, CT scanning is highly sensitive at diagnosis Covid-19 and is a prime candidate for accurate diagnosis in badly hit areas.

Relationship to Duration of Infection" Symptomatic patients in China during Jan and Feb 2020 were examined for typical CT findings with regard to time between infection and first CT scan[4]. The particular features were bilateral and peripheral ground-glass opacities. Some patients even had normal lung features in early cases. The longer the duration between infection and CT scan, the more the features that were seen on the CT scan images, indicating more lung damage. Most patients with late state Coronavirus showed lung damage on both sides. Prediction models like LSTM were utilized to determine next-7 day trends of death, recovery etc. VGG16 based model were put to use in analyze X-ray images. It allows speedy detection of COVID-19, allowing an accuracy of up to 99 percent using augmented dataset. Concluded that high magnited infection areas have similar characteristics and disease spread is greater in coastal areas. Investigation into humidity, temperature and terrain can thus be undertaken [5].

A rapid review and meta-analysis proposed in [6] shows that utilizing RT-PCR as reference, the affectability of chest CT scan in COVID-19 is 99%, recommending that CT can possibly be utilized as a helping analytic instrument. The most well-known imaging indication of patients with COVID-19 is GGO, and the probability of respective contribution was 84%. Nonetheless, the nature of proof was low over all results. The main goal of the paper [7] was to compare the performance between radiologists and AI system on differentiating NCP from other common pneumonia and normal controls. Their AI system interpretation was entirely superior to that of junior radiologists and comparable to mid-senior radiologists.

Amalgamation of CT-Scan and RT-PCR test is more accurate in diagnosing Covid-19 in emergency settings, and also helps in preventing false negative reporting proposed in [8]. With respect to this journal, it is found that when a

subsequent RT-PCR test is carried out, in majority of patients who were previously tested negative were later tested positive for covid-19 infection. Thus, the amalgamation is helpful in diagnosing covid-19 accurately and mitigate false negative reports which helped them to isolate patients and prevent the spread of infection. [9] Researchers have started to implement deep learning and other algorithms to distinguish between COVID 19 and non-COVID-19 CT scans, assess the seriousness of the disease to direct the course of care, and explore various secondary COVID-19 applications in order to further the function of chest CT and the computer-aided process for detection. The purpose of this brief analysis is to encourage the advancement of image processing technology research to aid from the monitoring and diagnosis of COVID-19.

AI Intelligent Assistant Analysis System proposed in [10], a program focused on deep learning, was specifically designed for COVID-19 .This AI program has a neural network of modified 3D convolution and a hybrid V-Net with bottleneck structures. Chest CT combined with analysis by the AI Intelligent Assistant Analysis System was able to accurately evaluate pneumonia in COVID-19 patients [10]. Investigating whether instances of Covid-19 can be distinguished by applying AI and deep learning approaches on chest X-ray images is proposed in [11.Two different schemes were studied in this paper. COVID-19 and Normal image classification using eight separate pre-trained CNN models while training was conducted with and without augmentation of the image.

Three diagnostic guidelines and four treatment recommendations are included in the rapid guide covering patients with suspected or confirmed COVID-19 with varying degrees of disease severity from outpatient facility or hospital admission to home discharge in the care route[12]. The rapid guide provides implementation, tracking and assessment considerations and describes research needs. The guide will be applicable to physicians, hospital administrators and planners, policy makers, hospital architects, biomedical engineers, medical physicists, operations workers, and control officers involved in water/sanitation and infection prevention Third-world countries tend to have missing research and needs aid, in both technology and healthcare and the proper conglomeration of both these domains[13]. Novel techniques are being applied to imaging like pixel-based labeling. It's still too early to firmly establish when these methods will become mainstream. However, there have been huge leaps, especially with Coronavirus thrusting the medical and technological community to move ahead at a fast pace.

Examining the role of CT scan as primary imaging method for diagnosis is proposed in [14]. They concluded that certain issues plague the community such as bad research design, partial method sections with improper description of biased patient cohorts, no gold standard establishment, and sparse discussion. The paper is a warning about the results of hurried review process in the scientific community.

[15] The detection model for COVID-19 was created given the difficulties that prevail in the field of detection of COVID-19 using data adopted from multiple sources. In a holistic approach, this paper had visualized taking into consideration the crucial problems that are overwhelming about the domain. For all peculiar ones, the outcomes were reasonably consistent. [16] Studies have shown that CT is quite sensitive to diagnose CT when used in place of RT-PCR. However, this is contrary to some societal guidelines. This study aims to determine whether CT-scan should be used solely, or in combination with RT-PCR, or not at all, especially in areas where RT-PCR might not be available. One limitation is the fact that most studies are outdated and perform poor evidence regarding the role of CT imaging in diagnosing Covid-19. Hence, stronger correlations must be made.

For large-scale image classification, they assessed very deep convolutional networks (up to

19 weight layers) in the work proposed in [17]. It was shown that the depth of representation is advantageous for the accuracy of the classification. They have also demonstrated that their models generalize well to a broad range of tasks and datasets, matching or exceeding more complex pipelines of recognition built around less deep image representations.

Finding the accuracy of diagnosis of frequent imaging methods, Chest X ray and CT, for diagnosis of COVID-19 in the general emergency populace in the UK and to find out the relation among imaging features and final results among these patients is proposed in [18]. A detailed analysis was conducted for checking the association between CXR and CT scan. It was observed that CXR discoveries were not significant statistically or meaningfully clinical, but on the other hand,CT has considerably improved diagnostic execution over CXR in COVID-19. Deep learning method is proposed in [19], they retrospectively collected 5372 patients from 7 cities or provinces with computed tomography images. The deep learning system achieved good success in distinguishing COVID. The deep learning system automatically focused without human assistance on irregular areas that displayed compatible characteristics with recorded radiological findings from other pneumonia in the 4 external validation sets.

A deep learning model, the COVID-19 detection neural network (COVNet), was developed in this retrospective and multicenter study to extract visual features from volumetric chest CT scans for COVID-19 detection. To assess the robustness of the model, CT scans of community-acquired pneumonia (CAP) and other non-pneumonia anomalies were included. It was concluded that A deep learning model would reliably recognize and distinguish coronavirus 2019 from community-acquired pneumonia and other lung conditions[20].

The following table shows the different methods employed for Corona Virus detection.

Sl. No	Year	Authors	Title	Pros	Cons
1.	2020	Xie X et al	*"Chest CT for typical coronavirus disease 2019 (COVID-19) pneumonia: Relationship to negative RT-PCR testing"*	Chest CT proof of viral pneumonia will precede positive reverse-transcription polymerase chain reaction test findings in patients at high risk for coronavirus disease 2019 (COVID-19) infection.	CT scans are more costly than RT-PCR, however has restricted access to RT-PCR in different regions.
2.	2020	Fang Y et al.	"*Sensitivity of chest CT for COVID-19: comparison to RT-PCR"*	The results of this paper reinforce the use of chest CT in patients with clinical and epidemiologic features consistent with COVID-19 infection to screen for COVID-19, especially when the results of RT-PCR tests are negative.	The RT-PCR test showed low efficiency and the reasons for the low efficiency of viral nucleic acid detection may include immature development of nucleic acid detection technology,

					detection rate variance from various suppliers, low viral load of patients, or incorrect clinical sampling.
3.	2020	Ai T et al.	*"Correlation of chest CT and RT-PCR testing for coronavirus disease 2019 (COVID-19) in China: A Report of 1014 cases"*	Chest CT is particularly susceptible to the 2019 coronavirus disease diagnosis (COVID-19). For the existing COVID-19 identification in epidemic areas, chest CT can be regarded as a foremost instrument.	Since COVID-19 is highly infectious, it is a significant threat for healthcare professionals and other patients to use imaging equipment on COVID-19 patients. Huge and complex pieces of equipment are CT scanners.
4.	2020	Adam Bernheim et al.	*"Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection"*	CT scans are good at predicting coronavirus infection that has occurred many days prior.	Ct scans might fail to detect coronavirus early on in the infection as this isn't enough time for the virus to make significant change in the lungs
5.	2020	Moutaz Alazab et al	*"COVID-19 Prediction and Detection Using Deep Learning"*	To identify the presence of COVID-19 using chest X-ray images, a diagnostic model using VGG16 was suggested. The model allows the rapid and reliable detection of COVID 19, enabling it to achieve an F-measure of 99% using an augmented dataset.	Special attention must be paid to the avoidance of over fitting in the un-augmented dataset, especially when increasing the epochs as the validation slowly improves in the beginning and then stops improving when the epochs are increased.
6.	2020	Meng L Y et al	*"Chest computed tomography for the diagnosis of patients with coronavirus disease 2019 (COVID-19): a rapid review and meta-analysis"*	This suggests that in the early stage, chest CT scanning will efficiently capture lung lesions. GGO is the most common imaging manifestation	Because of most studies performed in China, the paper only included case series and case reports, case collection of

				of COVID-19 patients, and the likelihood of bilateral involvement was 84%.	included studies that could add bias, some cases may be overlapping between studies, and there was also great variability between included studies.
7.	2020	Zhang K et al	*"Clinically applicable AI system for accurate diagnosis, quantitative measurements, and prognosis of COVID-19 pneumonia using computed tomography"*	To avoid a potential memorization bias, the follow-up AI-assisted diagnostic test by junior radiologists was performed 2 weeks after the initial test. The performance was significantly improved compared to the previous one and was comparable to that of the senior radiologists	It is also important to distinguish NCP from common influenza or other forms of pneumonia, such as viral pneumonia and bacterial pneumonia, because seasonal flu also causes viral pneumonia.
8.	2020	Daniël A et al.	*"Added value of chest computed tomography in suspected COVID19: an analysis of 239 patients"*	The paper recommend the use of chest CT in combination with RT PCR testing in patients with suspected COVID-19 in emergency departments, provided that adequate infection control protocols in CT suites are in place.	Because There is currently no solid reference standard for COVID-19, it was necessary to depend on ruling-out other hypothesis and multidisciplinary agreements in patients with RT-PCR results that were negative, which could have led to false-positive CT scan results.
9.	2020	Molly D et al.	*"The role of chest computed tomography in the management of COVID-19: A review of results and recommendations"*	Chest CT offers more precise results when it is critical to initiate care as well as isolate the patient to prevent the virus from spreading.	CT not be used for diagnosis, but that recommendation has been revised due to the lack of widespread availability of laboratory COVID-19 testing and sensitivity problems.

10.	2020	Hai-tao Zhang et al.	*"Automated detection and quantification of COVID-19 pneumonia: CT imaging analysis by a deep learning-based software"*	Pneumonia in COVID-19 patients can be correctly diagnosed by Chest CT combined with examination by the uAI Intelligent Assistant Analysis System.	Many critically ill patients are unable to perform CT exams because of hypoxemia and the inability to move. Secondly, when detecting atypical lesions, there was a need to change the AI Intelligent Assistant Analysis System manually.
11.	2020	Muham mad E. et al.	*"Can AI Help in Screening Viral and COVID-19 Pneumonia?"*	Artificial intelligence exhibits an excellent performance in classifying COVID-19 pneumonia given that the system is essentially trained from a big dataset and significantly improve the efficacy in the screening of COVID-19 positive cases.	The algorithm fails if no obvious light focus edge function occurs in the deep layer and other techniques have to validate this type of COVID-19 cases.
12.	2020	Elie A et al.	*"Use of Chest Imaging in the Diagnosis and Management of COVID 19: A WHO Rapid Advice Guide"*	There is development based on standard methodology, the consideration of contextual factors, its reporting according the RIGHT statement, and the consideration of stakeholder's views.	Finally, studies addressing contextual factors, including cost, cost effectiveness, equity effects, acceptability and viability of the various modalities of imaging, are required.
13.	2020	Hanan Farhat, George E. Sakr, and Rima Kilany.	*"Deep learning applications in pulmonary medical imaging: recent updates and insights on COVID 19"*	Basically, CNNs were used to segment lungs, U-Nets were used to extract characteristics, and most of the contributions emphasized comparing the effectiveness of common architectures and detect covid-19.	Shortage of health institutions, medical personnel and PACs.
14.	2020	Michael	*"Chest Computed*	It was concluded in	CT scan rooms must

		D et al.	*Tomography for Detection of Coronavirus Disease 2019 (COVID-19): Don't Rush the Science"*	this paper that in epidemic areas, chest CT can be used as a foremost method to detect COVID-19.	be thoroughly washed, and the air must be recirculated because COVID-19 infection may be transmitted to other patients or personnel in imaging departments even though all procedures are followed.
15.	2020	Varalakshmi Perumal et al.	*"Detection of COVID-19 using CXR and CT images using Transfer Learning and Haralick features"*	VGG16 takes less time because it is just 16 layers deep, The VGG16 model recognizes the data from COVID-19 with a misclassification rate of 0.012.	For detection of this virus infection, analysis of unusual features in the images is needed. More data can be assimilated for better outcomes in future work.
16	2020	Constantine A et al.	*"CT and Coronavirus Disease (COVID-19): A Critical Review of the Literature to Date"*	High quality CT evidence will ideally emerge as the medical community gains expertise in the care of patients with COVID-19 and will promote a more extended role for CT.	These risks include overuse of hospital resources, that is limited but is needed to conduct CT studies safely, in imaging departments, thereby potentially raising the risk of disease transmission and exposure.
17	2020	Karen Simonyan et al.	*"VERY DEEP CONVOLUTIONAL NETWORKS FOR LARGESCALE IMAGE RECOGNITION"*	It was shown that state-of-the-art efficiency can be achieved using a traditional ConvNet architecture with significantly improved depth on the ImageNet challenge dataset.	The models are very large, 550 MB + weight size, and they have so many weight parameters. Which also means long periods of inference.
18.	2020	Aditya Borakati et al.	*"Diagnostic accuracy of X ray versus CT in COVID 19: a propensity-*	CT scanning has demonstrated excellent sensitivity	This has to be balanced, where capability allows,

			matched database study"	and should strongly be considered in the initial evaluation for COVID 19, during the pandemic.	against the risk of excess CT radiation.
19.	2020	Wang S et al.	*"A fully automatic deep learning system for COVID-19 diagnostic and prognostic analysis"*	The DL method estimates its prognostic condition if the patient is diagnosed as COVID-19, which can be used to classify potential high-risk patients who need special care and urgent medical services.	There are other end of-stage prognostic cases, such as death or admission to the icu, and this research did not recognize them. On the other hand, this analysis included CT images various thicknesses of slices.
20.	2020	Li L et al.	*"Using artificial intelligence to detect COVID-19 and community acquired pneumonia based on pulmonary CT: Evaluation of the diagnostic accuracy"*	Study has successfully applied deep learning techniques for pediatric chest radiographs to distinguish bacterial and viral pediatric-chest pneumonia radiographs.	In this study, we were unable to choose other viral pneumonias for comparison due to the lack of laboratory confirmation of origin for each of these cases.

Table 1: Different methods for Corona Virus Detection.

III. CONCLUSION

Our project aims to efficiently teach a machine learning model that is capable of predicting Covid-19 cases, with the percentage probability that it is indeed a Covid-19 infection. The training dataset of Covid-19 cases is used to make the algorithm learn which HRCT images are Covid-19 and which are not. Subsequently, the test data set is used to determine the true efficiency of the machine learning model in predicting Covid-19. We aim for high efficiency and consistent performance across various Covid-19 and non Covid-19 cases, and a quick analysis time.

REFERENCES

[1] Xie X, Zhong Z, Zhao W, Zheng C, Liu J, Wang F: "Chest CT for typical coronavirus disease 2019 (COVID-19) pneumonia: Relationship to negative RT-PCR testing" in February 12 , 2020 . Available: https://pubs.rsna.org/doi/10.1148/radiol.2020200343

[2] Fang Y, Zhang H, Xie J, Lin M, Ying L, Pang P , Ji W: "Sensitivity of chest CT for COVID-19: comparison to RT-PCR" in February 19, 2020. Available: https://pubs.rsna.org/doi/full/10.1148/radiol.2020200432

[3] Ai T, Yang Z, Hou H, Zhan C, Chen C, Lv W, Tao Q, Sun Z and Xia L: "Correlation of chest CT and RT-PCR testing for coronavirus disease 2019 (COVID-19) in China: A Report of 1014 cases" in February 26, 2020. . Available:https://pubmed.ncbi.nlm.nih.gov/32101510/

[4] Adam Bernheim, Xueyan Mei , Mingqian Huang,Yang Yang, Zahi A. Fayad ,Ning Zhang,Kaiyue Diao, Bin Lin, Xiqi Zhu, Kunwei Li, Shaolin Li, Hong Shan, Adam Jacobi, Michael Chung "Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection" in February 2020. Available:https://www.researchgate.net/publication/339393396_Chest_CT_Findings_in_Coronavirus_Disease19_COVID 19_Relationship_to_Duration_of_ Infection

[5] Moutaz Alazab, Albara Awajan, Abdelwadood Meseleh, Ajith Abraham, Vansh Jatana, and Salah Alhyari "COVID-19 Prediction and Detection Using Deep Learning" under Project: Supply chain management integration on May 2020. pg 168-181. Available: https://www.researchgate.net/publication/341980921_COVID19_Prediction_and_Detection_Using_Deep_Learning

[6] (May 2020) Meng Lv, Mengshu Wang, Nan Yang, Xufei Lou, Wei Li, Xin Chen, Yunlan Liu, Mengjuan Ren, Xianzhou Zhang, Ling Wang, Yanfang Ma, Junqiang Lei, Toshio Fukuoa, Hyeong Sik ahn, Myeong Soo Lee, Zhengxiu Luo, Yalong Chen, Enmei Liu, Jinhui Tian, Xiaohui Wang "Chest computed tomography for the diagnosis of patients with coronavirus disease 2019 (COVID-19): a rapid review and meta-analysis" PMID: 32566559 Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7290647/

[7] Zhang K, Liu X, Shen J, Sang Y, Wu X, Zha Y, Liang W, Wang C, Wang K "Clinically applicable AI system for accurate diagnosis, quantitative measurements, and prognosis of COVID-19 pneumonia using computed tomography" on May 2020. PMID: 32416069 PMCID: PMC7196900 Available:https://pubmed.ncbi.nlm.nih.gov/32416069/

[8] "Added value of chest computed tomography in suspected COVID-19: an analysis of 239 patients" by Daniel A. Korevaar, Ruud S.Kotte, Lock P.Smits, Joost G.van den Aardweg, Peter I Bonta, Janke Schinkel, Rene M. Vigeoveno, Inge A.H.van den Berk, Maeke J.Scheerder, Bregtje A.Lemekes, Abraham Goorhuis, Ludo F.M. Beenen, Jouke T Aesema on June 24, 2020. European Respiratory Journal 2020 56: 2001377; DOI: 10.1183/13993003.01377-2020 Available:https://erj.ersjournals.com/content/56/2/2001377

[9] Molly D Wong, Theresa Thai, Yuhua Li, Hong Liu "The role of chest computed tomography in the management of COVID-19: A review of results and recommendations" on June 26 ,2020. Available:https://journals.sagepub.com/doi/full/10.1177/1535370220938315

[10] Hai-Tao Zhang, Jin song Zhang, Hai-hua Zhang, Yan-dong Nan, Ying Zao, En-qing Fu, Yong hong Xie, Wei liu, Wang ping Li, Hong jun Zhang, Hua Jiang, Chun mei Li, Yan yan Li, Ruin a Ma, Shao kang Dang, Bo bo Gau, Xi jing Zhang & Tao Zhang "Automated detection and quantification of COVID-19 pneumonia: CT imaging analysis by a deep learning-based software" published on July 14, 2020. Available: https://link.springer.com/article/10.1007/s00259-020-04953-1

[11] Muhammad E. H. Choudhry, Tawsifur Rahman, Amith Khandakar, Rashid Mazhar, Muhammad Abdul Khadir, Zaid bin Mahbub, Khandakar Reajul Islam, Muhammad Salman Khan, Atif Iqbal, Nasser AL Emadi, Mamun Bin Ibne Riaz and Mahammad Tariqul Islam "Can AI Help in Screening Viral and COVID-19 Pneumonia?" published on July 20, 2020.

Available:https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9144185

[12] Elie A. Akl, Ivana Blazic, sally Yaccoub, Guy Frija, Roger chou, John Adabie Appaih, Mansoor Fatehi, Nicola FLor, Eveline Hitti, Hussain Jafri, Zheng Yu Jin, Hans Ulrich Kauczar, Michaek kawooya, Ella Annabelle Kazerooni, Jane P. Ko, Rami Mahfouz, Valdair Mughlia, Rose NyabandMarcelo Sanchez, Priya B. Shete, Marina ulla, Chaunseng Zheng, Emilie Van Deventer and Maria Del Rosario Perez "Use of Chest Imaging in the Diagnosis and Management of COVID 19: A WHO Rapid Advice Guide" published on July 30, 2020. Available: https://pubs.rsna.org/doi/10.1148/radiol.2020203173

[13] (July 2020) Hanan Farhat, George E. Sakr and Rima Kilany "Deep learning applications in pulmonary medical imaging: recent updates and insights on COVID-19" PMID: 32834523 Available:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7386599/

[14] (July 2020) Michael D.Hope, Dr. Constantine A Rapatis, Dr Travis S. Henry "Chest Computed Tomography for Detection of Coronavirus Disease 2019 (COVID-19): Don't Rush the Science" Available:https://www.acpjournals.org/doi/10.7326/M20-1382

[15] Varalakshmi Perumal, Vasumathi Narayanan, Sakthi Jaya Sundar Rajasekar "Detection of COVID-19 using CXR and CT images using Transfer Learning and Haralick features" on 12 August 2020. Available: Detection of COVID-19 using CXR and CT images using Transfer … (springer.com)

[16] (October 2020) Constantine A.Raptis, Mark M. Hameer, Ryan G.Short, Amar Shah, Sanjeev Bhalla, Andrew J. Beirhals, peter D.Filev, Michael D. Hope, Jean Juedy, Seth J. Kligerman and Travis S.Henry "CT and Coronavirus Disease (COVID-19): A Critical Review of the Literature to Date" Available:https://www.ajronline.org/doi/full/10.2214/AJR.20.23202

[17] "VERY DEEP CONVOLUTIONAL NETWORKS FOR LARGE SCALE IMAGE RECOGNITION" by Karen Simonyan and Andrew Zisserman. Available: https://arxiv.org/pdf/1409.1556.pdf

[18] "Diagnostic accuracy of X-ray versus CT in COVID-19: a propensity matched database study" by Aditya Borakati, Adrian Perera, Tara Sood, and James Johnson. Available: https://bmjopen.bmj.com/content/10/11/e042946

[19] Wang S, Zha Y, Li W, Wu Q, Li X, Niu M, Wang M, Qiu X, Li H, Yu H: A fully automatic deep learning system for COVID-19 diagnostic and prognostic analysis. Eur Respir J. Available: https://erj.ersjournals.com/content/early/2020/05/19/13993 003.00775-2020.abstract

[20] Li L, Qin L, Xu Z, Yin Y, Wang X, Kong B, Bai J, Lu Y, Fang Z, Song Q : Using artificial intelligence to detect COVID-19 and community-acquired pneumonia based on pulmonary CT: Evaluation of the diagnostic accuracy. Available: https://pubs.rsna.org/doi/10.1148/radiol.2020200905