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A Review on Automatic Covid-19 Lung Infection Detection from Different Imaging Techniques

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Abstract: Corona Virus Disease-2019 commonly known as COVID-19 which has been defined by the Novel Corona Virus. It is a family of severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) and was first detected during respiratory outbreak. It was first reported to the World Health Organization on December 31, 2019. On January 30, 2020, the World Health Organization declared the COVID-19 eruption a global health emergency. As of 27-May-2021 169,095,283 confirmed cases have been reported in the world and 2, 73, 67, 935 cases in India. It is required to identify the infection with high precision rate but there are lots of deficiency in the diagnosing system that may resulted false alarm rate. Initially it could be detected through throat saliva but now it can also be identified thought the impairment in lungs from computerized tomographical imaging technique. This paper reviewed various researches over COVID-19 diagnosis approach as well as the syndrome in respiratory organs. There are so many imaging techniques through which lungs impairments can be detected that may diagnose COVID-19 with high level of accuracy. CT scan image is the best alternative for diagnosing COVID-19.
Keywords: COVID-19, Lesion Detection, Deep Learning, CT Scans, Segmentation, SARS, Lung Tomographical Image.

I. INTRODUCTION

There are very certain tools are available for diagnosing the COVID-19 with high precision. Due to that many countries are suffering from fewer appendages and deficiently approaches the diagnosis process that resulted inaccurate enumeration. Most of the people who are infected from COVID-19 suffer from moderate respiratory illness and may recover without any special treatment. Older people, those with medical conditions such as heart disease, diabetes, chronic lung or lung disease and cancers are at greater risk for serious illness [1].

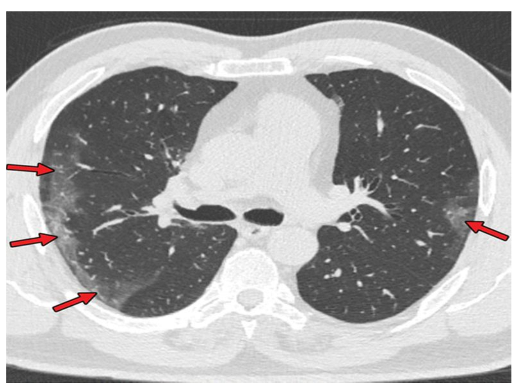


Fig. 1. Lungs Impairments [2]

COVID-19 directly affects the lungs and destroys the alveoli (small air sacs). The function of the alveoli is to supply oxygen to the blood vessels. These blood vessels or capillaries carry oxygen to the RBCs (red blood cells). RBCs eventually deliver oxygen to all the internal organs of the body. The virus works by damaging the wall and membrane of the alveoli and capillaries. Debris from damage builds up in the plasma protein alveoli wall and the lining thickens. As the walls thicken, the oxygen supply to the red blood cells weakens. When the wall is thick, it is very difficult to transfer oxygen to the red blood cells, which makes it difficult for the body to breathe due to lack of oxygen. Lack of oxygen to the internal organs leads to deficiency in the body and interferes with the functioning of the organs. During this time, the body struggles to raise oxygen levels. The body's first reaction is to destroy the virus and prevent its replication, but if the person has a weakened immune system the body will not resist the virus, which exacerbates the crisis. This causes impairment in lungs that can be visible either through CT scan images [3].

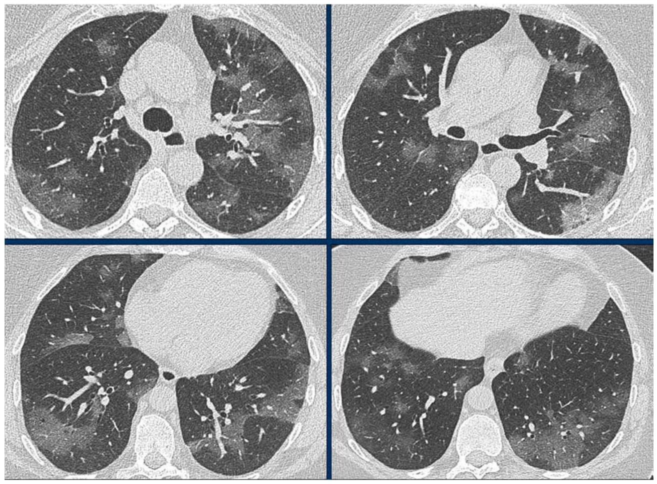


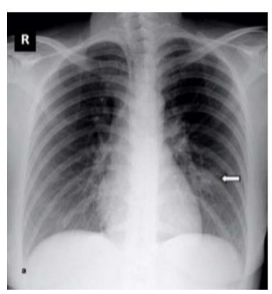
Fig. 2. Impairments over CT Image [4]

Fig. 2 shows the impairments inside the lungs that gradually increases day by day due to virus attack severly. These reflections can be identified by computerized tomographical image either by medical professionals or by intellectual machines. This paper is looking forward those machines that can automatically detect the impairments and result accordingly.

II.LITERATURE REVIEW

A. Related Works

Mohamed Abdel-Basset et al. [4] proposed a system which is based on marine predators algorithm. In this paper, authors proposed a new hybrid model to identify COVOD-19 using the Improved Marine Predators Algorithm (IMPA) and Rank Reduction strategy. In successive iterations, this model works on X-ray images to capture such small areas in an attempt to obtain areas with COVID-19. Capturing these areas is considered an image segmentation problem. The proposed IMPA algorithm performance is compiled with five advanced algorithms - Whale Optimization Algorithm (WOA), Synacosine Algorithm (SCA), Salpswam Algorithm (SSA) and Harris Hawks Algorithm. A set of chest X-ray images with entry levels between 10 and 100 is used. It shows the performance of specific IMPA algorithm to bypass fitness values. In addition, the performance of our specific model and EO has been shown to be consistent across all ranges of SSIM and UQI dimensions. In future operations, the proposed algorithm may be applied to color image separation and to various medical applications.



a) b)

Fig. 3. a) X-Ray Image [4]

Mazin Abed Mohammed et al. [5] proposed a system which is based on Entropy and TOPSIS models. In this paper, authors described the process of developing a specific methodology. They construct a decision matrix to combine twelve different COVID-19 diagnostic models with ten evaluation criteria. Entropy and topsis are linked to the specific patterns. The final weight results from the entropy stages were presented, showing the importance of the analysis model criteria. Subsequently, the TOPSIS approach was used to rank and select the best COVID-19 diagnostic models according to the measurement data of the significant criteria. Although a comprehensive evaluation and significant results that have been presented compared to the study, the benchmark study has several problems.

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First, no such mechanism has been adopted to define the importance of evaluation criteria. Second, ranking and selecting the best ML model based on multiple evaluation criteria is not so easy and solve the problem of discrepancy between these criteria. However, this study resolved all the problems mentioned based on the proposed integrated platform. Finally, the results ensure that the hybridization of entropy and topaz can effectively address the selection challenge of COVID-19 diagnostic models. The ranks of the COVID-19 diagnostic models obtained from Topsis showed that the best diagnostic model was SVM (linear) and worst SVM (polynomial). However, the values of the models used may vary depending on the type and size of data available. From a practical point of view, the large number of ML study models poses a great challenge to the administrative divisions of medical institutions to select the largest organization, which is considered to be the main problem of this study. Furthermore, improper selection of the diagnostic model for COVID-19 can be costly for medical institutions, especially when there is a high demand for a more accurate and rapid diagnostic model. This method allows them to evaluate and benchmark a variety of COVID-19 diagnostic models to save time and money by choosing a model that meets the needs of the healthcare organization and following a reliable method of selecting ML models. In addition, this methodology can be applied to benchmarking diagnosis models based on CT images, allowing administrative departments of medical institutions to select the best COVID-19 diagnostic model.

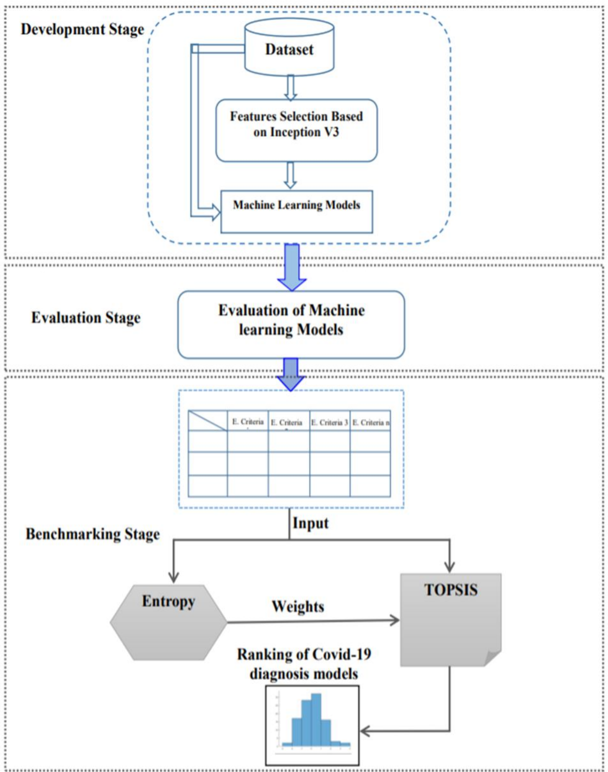

Fig. 4. Benchmarking Methodology for COVID19 Diagnosis Models [5]

M. B. Jamshidi et al. [6] proposed a system which is based on Deep Learning approach for diagnosing the COVID-19. This paper studies the conceptual structures and platforms presented in the field of research on AI-based technologies suitable for dealing with COVID-19 problems. Various technologies that have been developed till now to integrate the COVID-19 diagnostic systems such as RNN, LSTM, GAN and ELM are now vulnerable for better treatment. The main issues of COVID-19 are geographical issues, high-risk individuals, identification and radiology, which have been studied and discussed in this work. In addition, they have shown a mechanism for selecting appropriate models for estimating and estimating the required parameters using several clinical and non-clinical datasets. Observation of these platforms allows AI professionals to set up large datasets, train engines, algorithms, or optimize analyzed data to handle viruses with greater speed and accuracy. They discussed how AI professionals and physicians can work for years because they have the potential to create a workspace. However, as AI accelerates its efforts to overcome COVID-19 and has not yet reached a full understanding of the advantages and limitations of AI-based methods for COVID19, real experiments must take place and new approaches to address issues of this level of complexity.

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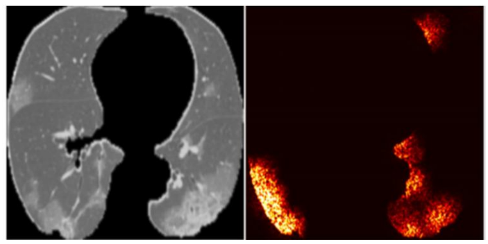
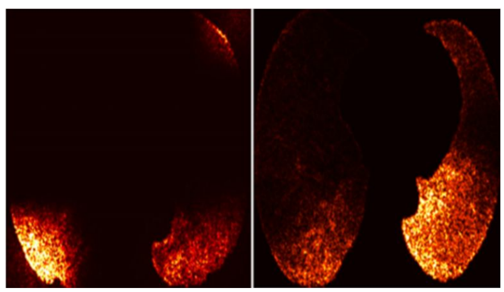
Success in the final phase of the fight against COVID-19 will depend on building an arsenal of platforms, methods, approaches and tools that will help achieve the desired goals and save more lives. Shaoping Hu et al. [7] proposed a system which is based on Deep Learning for COVID-19 infection classification. In this study, authors developed a poorly monitored in-depth study framework to quickly and fully automate the detection and classification of COVID-19 infection using pre-collected CT images from multi-scanners and multi-centers. This framework can accurately detect COVID-19 cases from CAP and NP patients. It can also determine the exact location of the ulcer or inflammation caused by COVID-19 and therefore guide the following treatment and suggestions based on the patient's severity. Experimental results suggest that specific model classification achieves high accuracy, precision and AUC, as well as provides qualitative visualization for lesion results. Based on these results we can imagine a large scale expansion of the developed framework.



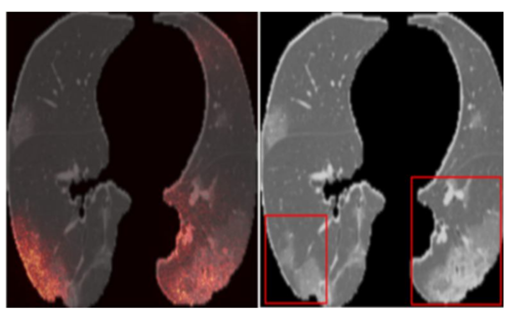
a) b)

Fig. 5. a) Input Image b) Conv3 Saliency [7]



c) d)

Fig. 6. c) Conv4 Saliency d) Conv5 Saliency [7]



e) f)

Fig. 7. e) Joint Saliency f) Bounding Box [7]

Feng Shi et al. [8] reviewed a system based on AI techniques for image data acquisition, segmentations and diagnosis. This paper explained how an AI provides secure, accurate and an efficient imaging solution for COVID-19 applications. Intensive review of intelligent imaging platforms, clinical diagnosis and pioneering research, including the entire pipeline of AI-enabled imaging applications in COVID-19. Two X-ray and CT imaging techniques are used to demonstrate the effect of AI-enabled medical imaging for COVID-19. It should be noted that imaging provides only partial information about patients with COVID-19. Therefore, it is important to integrate imaging data with clinical manifestations and laboratory test results to facilitate better screening, detection, and diagnosis of COVID-19. In this context, we believe that AI demonstrates the natural ability to integrate information from this multi-source data with accurate, effective analytics, analysis and adaptation.

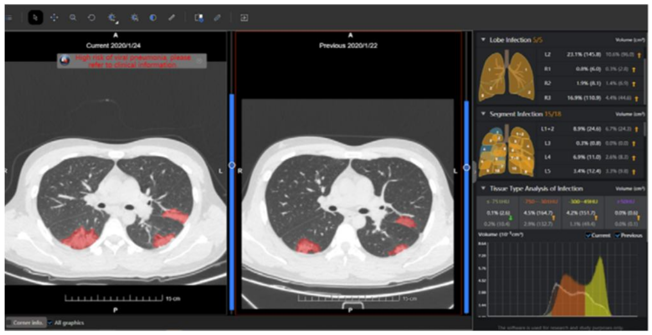


Fig. 8. The follow-up measurement for a COVID-19 patient [8]

Di Dong et al. [9] reviewed the role of imaging technique in the field of detecting COVID-19. The results of this review suggest that the diagnosis of COVID-19 should be based on epidemiological history, nucleic acid detection, CT imaging, clinical signs and symptoms, and laboratory results. The combined use of AI and CT imaging can overcome the limitations of medical resources as well as support the rapid diagnosis and prognosis of COVID-19. Future studies of integrated AI and CT imaging with large and external evaluation data sets are required. Although follow-up CT studies for COVID-19 are still limited, a generally changing pattern of lung lesions can still be observed, relatively in the early stages of GGO and associated with disease progression. During the healing process, recovery methods are clearly visible in wound absorption. CT scans have proven to be an effective clinical tool for assessing lung progression and for resolving COVID-19 infection. Large sample-sized multi-core studies are still needed to find current results. Hengyuan Kang et al. [10] proposed a system which is based on Structured Latent Multi-View Representation Learning. In this study, authors proposed a new automatic diagnosis pipeline for COVID-19 that can make full use of various features extracted from CV images. They explored these different types of features and found that they complemented each other. Using the proposed multi-view representation learning technology, the analytical performance was increased to 95.5%, 96.6% and 93.2%, respectively, based on accuracy, sensitivity and specificity. Most importantly, compared to the original features, the learned Lawton representation is likely to be used in different classifiers. In the future, they will look at the diagnosis of two types of disease (i.e., COVID-19, CAP) with higher grades (i.e., different, different COVID-19 severities, CAP). Furthermore, the clinical features of the patients are useful for diagnosis, which are simply integrated into our framework for performance promotion.

Xinggang Wang et al. [11] proposed a system which is based on Weakly-supervised Framework Lesion localization. An in-depth study framework was developed with poorly monitoring of 3D CT volumes for COVID-19 classification and wound localization. For each patient, lung area was classified using a pre-trained unit. The 3D lung zone was divided into 3D deep neural networks to assess the risk of COVID-19 infection; COVID19 lesions are localized in the classification network by a combination of active areas and un-operated connective components. 499 CT volumes and 131 CT volumes were used for training. This algorithm obtained 0.959 ROC AUC and 0.976 PR AUC. When a probability limit of 0.5 is used to classify COVID positive and COVID-negative, the algorithm achieves an accuracy of 0.901, with a positive reference value of 0.840 and a very negative negative value of 0.982. The algorithm took only 1.93 seconds to process a single patient's CT volume using a dedicated GPU. This poorly monitored in-depth study model can accurately assess the risk of COVID-19 infection and identify lesion areas on the chest CT without understanding the injury for training. In conclusion, without the need to describe COVID-19 lesions in CT volumes for training, our poorly monitored in-depth learning framework achieved strong COVID-19 classification performance and excellent wound localization results. Therefore, our algorithm has great potential to be applied in clinical application for accurate and rapid diagnosis of COVID-19, which is very helpful to leading medical personnel and is important in controlling this infection worldwide. Deng-Ping Fan et al. [12] proposed a system which is based on Inf-Net. In this paper, authors proposed the COVID-19 Lung CT Infection Segmentations Network, also known as Inf-Net, which uses clear contrast and clear edge-focus to improve the identification of diseased areas.

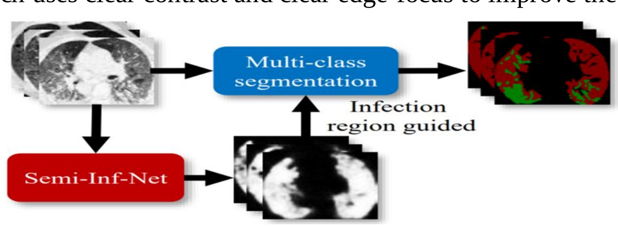


Fig. 9. Illustration of infection region guided multi-class segmentation for multi-class labeling task [12]

In addition, they have provided a semi-supervised solution Semi-Infinite to address the shortage of high quality label data. Extensive experiments in our COVID-SemiSeg dataset and original CT volumes have shown that they can outperform specific in-net and semi-in-net cutting-edge models and improve cutting-edge performance. This system has great potential in diagnosing COVID-19, e.g., assessing diseased areas, monitoring longitudinal pathological changes, and mass screening processing. Note that the specific model can detect low-intensity objects between infections and normal tissues. This phenomenon often occurs in objects hidden in nature.

Table No. I Result Comparison

	Method	Accuracy in %
M. A. Mohammed [5]	TOPSIS	97.50
S. Hu [7]	DNN	87.90
H. Kang [10]	NN	87.60
X. Wang [11]	DNN	95.90

III.LIMITATION OF CURRENT SCENARIO

Most of the diagnosing system uses Deep Learning models for segmenting lesion. But there is no statistical impairment that can define the input layers over a CT lung image. It is required to obtain the lesion feature for creating templates for diagnosing. K-means clustering and Support Vector Machine are helpful techniques for classifying the lesions from lung image with high level of accuracy and precision. DNN also required a large amount of data models in order to effectively perform the technique. It is extremely expensive to train the model with complex data GPU. Knowledge of topology, training method and other parameters are required so there is no standard theory to guide you in choosing the right in-depth learning tools. Understanding output on the basis of learning alone is not so easy and requires classifiers to do so.

IV.CONCLUSION & FUTURE SCOPE

As per the COVID-19 diagnosis, there is throat saliva testing methodology available but there are lots of deficiencies in this model. There should be an alternative diagnostic system that can effectively work for advance stages. This paper reviewed various implemented systems that extract COVID-19 lung lesion using DNN, Topsis, NN, Marine Predators Algorithm, AI Technique and many more. Most of the system uses DNN and a training model for creating templates that later match for nearest classification. But there is no appropriate model for lung lesion feature extraction due to COVID-19, instead of that it can be achieved through various pre-processing models. The system can be enhanced in future by implementing it with different techniques and filters, which may acquire good accuracy and minimal false alarm rate. Because as per the ideal system, accuracy is an important parameter, that is why accuracy of system can be enhanced in future with different techniques or filters.

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