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Deep Learning for Identification of Pneumonia and COVID-19

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----------ABSTRACT----------

The novel corona virus (COVID-2019) was encountered in Wuhan; it then spread at an alarming rate around the world and led to an ongoing pandemic. The public health, daily lives & global economy have been affected severely. Pneumonia is a life-threatening respiratory infection which affects lungs in humans and its main cause is Streptococcus pneumonia bacteria. Based on World Health Organization (WHO) statistics, pneumonia is the main cause of one out of every three deaths in India. It is very crucial to identify the positive cases in the initial stages to avoid the spread of this epidemic to a further extent and to treat the affected patients at a faster rate. Due to the non-availability of accurate automated toolkits, the requirements for auxiliary diagnostic tools have increased. The latest findings procured using techniques based on radiology imaging propose that this data contains information which is critical pertaining COVID-19. To accurately detect this disease, artificial intelligence (AI) technique is integrated along with technology based on radiological imaging. This is also beneficial in identifying pneumonia and COVID-19 in the absence of experts in the medical field. This research presents an accurately designed model for COVID-19 detection with the help of X-ray's. The model designed, classifies the diagnosis accurately into COVID-19, No-Findings and Pneumonia.

Keywords - **deep learning, convolution neural network, machine learning, pneumonia, covid-19, vgg-16.**

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1. INTRODUCTION

Pneumonia is a life-threatening respiratory infection which affects one or both lungs in humans by inflaming the alveoli present in lungs. The alveoli will be filled with pus (purulent material) or fluid, which manifests into fever, difficulty in breathing, coughs with phlegm or pus and chill. Pneumonia is caused by various organisms like viruses, bacteria & fungi. The evaluations of Chest X-Rays by expert radiotherapists are required to diagnose pneumonia.

COVID-19 was first encountered in Wuhan city in China on December 31, 2019, which spread at an alarming rate across the world to become an ongoing pandemic [1~3]. The virus is given the name SARS-CoV-2 and the disease name is given as COVID-19. This virus spread all over China from Wuhan in 30 days [4]. A few cases were identified as COVID-19 on 20th of January 2020 in USA [5], it reached to about 300,000 cases by the 5th of April 2020.

By virtue of their zoonotic nature the coronaviruses which usually affect animals can also be transmitted to the individuals. Severe Acute Respiratory Syndrome-Coronavirus (SARS-CoV) and the Middle East Respiratory Syndrome-Coronavirus(MERS-CoV) are the primary reasons behind severe respiratory infections and have caused human deaths [6].

The clinical symptoms which are typical to COVID-19 virus are shortness of breath, headache, cough, fatigue, muscle pain, sore throat [7]. The convenient test that is mostly used to diagnose COVID-19 is Reverse Transcription-Polymerase Chain Reaction (RT-PCR). In the initial diagnosis & in the treatment of this disease, chest X-rays and human chest radiological imaging like CT scan (computed tomography) play a very vital role [8].

Even if a RT-PCR returns a negative result, a patients radiological imaging tests can exhibit the symptoms of COVID-19 owing to the poor accuracy of RT-PCR which is about 60%-70% [9,10, 23]. A CT scan is a more accurate technique to diagnose COVID-19 and pneumonia. It should be used as a supplement to RT-PRC [11]. The results of computed tomography [CT] scans are more accurate if there is a long interval after the exposure to the virus and onset of symptoms. The patients CT scan does not exhibit any COVID-19 symptoms in the first 0-2 days [12].

2. RELATED WORK

2.1. Deep Learning

Deep Learning (DL) is basically the method of designing & developing a pattern based on the knowledge gained on a particular subject [13]. It improves its implementation based on the execution & performance of various applications of AI & ML [14, 24]. The Deep learning approach utilizes the advancement in the computing power based on the acceleration of GPU and the concept of nonlinearity which allows deeper networks which in turn improves the operation [15].

The recent research in the field of DL algorithms has rapidly increased and this has been implemented in treating pneumonia in the field of medicine as a well-known discipline. Accurate research based on this is done by the integration of techniques based on image processing. The extraction of image from the lung region is done by the algorithms and then develops a cropped image. The results show an accuracy of 97% by identifying VGG-16 model as one of the best to detect pneumonia and COVID-19 [16].

2.2. Convolution Neural Network

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The Convolutional Neural Network (CNN) is primarily modeled using human brain. It is a convolution neural network that has the potential of the feature extraction and the classification process. The convolution neural network has four essential layers: Sub sampling layer & fully connected layer, activation layer, rectified linear unit (ReLU) and the convolutional layer [17]. Convolution neural network process model is as shown in Figure 1. The input is an image for a typical convolutional neural network layer and then creates a feature map by utilizing the kernel [18]. By sharing of weights, basically the outcome of the lessen number of parameters is obtained and every CNN layer that is connected further with the ReLU activation layer, provides the convolution neural network with. The extra are the additional acceleration to obtain more complex functions [19]. Pooling layer is put-in as the sub-sampling operation that masters the over fitting & reduces the number of parameters to combat the problem of over fitting that occurs at times in the Convolution neural network [18][25]. The connected layers are accompanied to summarize the trained features to determine the results.

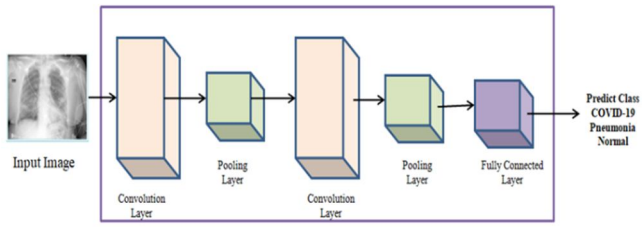

Figure 1. Architecture of CNN Model

3. METHODOLOGY

The usage of a large dataset ensures better performance for deep convolution neural network when compared to a smaller one. Despite the presence of loads of positive COVID-19 patients around the world, the publicly available online chest X-ray images are small and are scattered. The sample images of the dataset are shown in Figure 2.

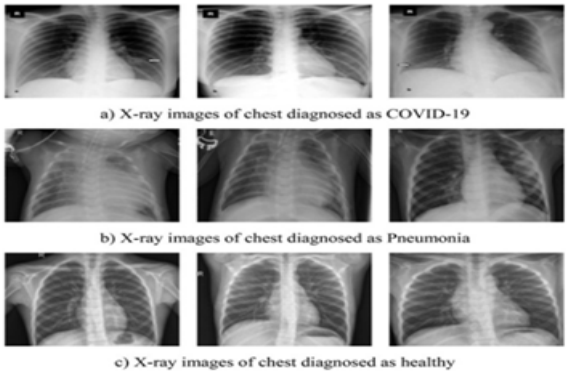

Figure 2. Chest X-Ray Images Dataset

4. DATASET COLLECTION

The survey of the Chest X-Rays is a demanding assurance to contemplate in the health sector. Chest X-Ray are currently available online in the form of huge number of datasets and these are only limited.

Kaggle COVID-19 radiography dataset is one of the most popular and demanding datasets holding 15,161 chest X-rays's classified into normal, pneumonia & COVID-19 varying from 299 pixels to 299-pixel resolution [20]. The table 1 shows the number of samples of images under different category. It has 15,161 images, 1,346 images belong to viral-pneumonia classification and 3,617 images are of COVID and 10,192 images are of normal chest X-rays.

Table 1. Dataset samples

Sl. No	*Label*	*Number of Samples*
0	*Normal*	*10192*
1	*Viral Pneumonia*	*1346*
2	*COVID-19*	*3617*

5. PROPOSED CNN ARCHITECTURE

Several compact units called nodes or neurons are organized in the form of a layered architecture is used to construct a CNN. The weights that comprise the nodes are updated at the time of training of developed model using optimizing methodologies like back propagation. All the CNN models have the convolutional or the feature extraction portion & classification portion. The VGG16 architecture is Convolution Neural Network (CNN) architecture. It is widely known to be excellent visual model architecture. The main feature of VGG16 is that it contains convolution layers which are of 3x3 filters from stride 1 and uses the padding as well as maxpool layer of 2x2 filters from stride 2 always in place of many hyper-parameters. The above-mentioned positioning of convolution layers and maxpool layers which is constant all through the whole architecture. At the extreme end, two fully connected layers (FC) and a SoftMax for the output is present. The 16 denotes the 16 layers present in VGG16. It is shown in Figure 3, that have weights.

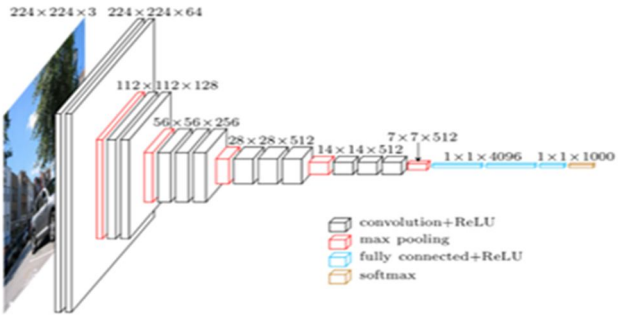

Figure 3. Architecture diagram of VGG-16 model

5.1. Convolution Layer

The Convolution Layer is a primary component for CNN. A filter of fixed size is used to pull out several features in this layer. By shifting the filters per strides, the inspection of images is done; in the above-mentioned theory, there are basically six convolution layers, each with a size- 32, 64, 64, 128, 128, 128, 224 filters in the Convolution Neural Network

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model. Each layer operates using 2-Dimensional convolution filters, each with a size of 3x3 and also with a stride of one.

5.2. Pooling Layer

A process of down-sampling the gathered feature-map from a convolution layer is known as pooling. Every convolution layer uses a max-pooling filter size of 2*2 and average-pooling.

5.3. Flatten

Flattening is the process where the data is converted to 1-D array for providing the input to the next layer. The output of the CNN layers is flattened to develop a single long feature vector. The final classification model is connected to the long feature vector, which is called a fully connected layer.

5.4. Dropout

Dropout is a method where the over-fitting of the model is eliminated. The nodes present in the layer that make use of the dropout process are set aimlessly to be idle on certain occasions. It ensures that the designed model doesn't get used to with the data.

5.5. Dense Layers

Convolution layer's output is flattened further and then submitted as the input to the dense layer. The dense layer is used for image classification based on the features extracted by the convolution layer. The convolution neural network architecture has 2 dense layers with a total of 512 nodes each & 2 nodes for last layer. The Figure 4 shows the layer wise parameters and the components of the proposed model VGG16.

Layer (type)	Output Shape	Param #
conv2d_1 (Conv2D)	(None, 224, 224, 64)	1792
conv2d_2 (Conv2D)	(None, 224, 224, 64)	36928
max_pooling2d_1 (MaxPooling2	(None, 112, 112, 64)	0
conv2d_3 (Conv2D)	(None, 112, 112, 128)	73856
conv2d_4 (Conv2D)	(None, 112, 112, 128)	147584
max_pooling2d_2 (MaxPooling2	(None, 56, 56, 128)	0
conv2d_5 (Conv2D)	(None, 56, 56, 256)	295168
conv2d_6 (Conv2D)	(None, 56, 56, 256)	590080
conv2d_7 (Conv2D)	(None, 56, 56, 256)	590080
max_pooling2d_3 (MaxPooling2	(None, 28, 28, 256)	0
conv2d_8 (Conv2D)	(None, 28, 28, 512)	1180160
conv2d_9 (Conv2D)	(None, 28, 28, 512)	2359808
conv2d_10 (Conv2D)	(None, 28, 28, 512)	2359808
max_pooling2d_4 (MaxPooling2	(None, 14, 14, 512)	0
conv2d_11 (Conv2D)	(None, 14, 14, 512)	2359808
conv2d_12 (Conv2D)	(None, 14, 14, 512)	2359808
conv2d_13 (Conv2D)	(None, 14, 14, 512)	2359808
max_pooling2d_5 (MaxPooling2	(None, 7, 7, 512)	0
flatten_1 (Flatten)	(None, 25088)	0
dense_1 (Dense)	(None, 4096)	102764544
dropout_1 (Dropout)	(None, 4096)	0
dense_2 (Dense)	(None, 4096)	16781312
dropout_2 (Dropout)	(None, 4096)	0
dense_3 (Dense)	(None, 2)	8194

Total params: 134,268,738
Trainable params: 134,268,738
Non-trainable params: 0

Figure 4. The layer parameters and the layers of the proposed model.

The primary goal of this project is to develop an automatic system for detecting Covid-19 and pneumonia which will help people to treat the disease very accurately. Additionally, we seek to:

- To accurately classify the X-rays to determine the infected and healthy lungs.
- Manual process errors are reduced by providing automated and a reliable system that uses Convolution Neural Networks.
- CNN is an efficient and a method that is successful up to a point. For good accuracy, CNNs require a very large training set.
- The main aim is to develop an efficient and accurate model to recognize normal and abnormal (Covid-19 & pneumonia) chest X-rays.

6. EXPERIMENTAL RESULTS

The application was executed on a 64-bit Windows 10 OS using Python 3.6 to develop and design the software. The application uses Keras as the interface for the TensorFlow framework to advance and upskill the model. The machine used the Intel® Core™ i5 CPU @2.80GHz with 12M Cache processor and 8GB RAM for implementing the model.

In Table II, a batch-size of 20 and epoch of 50 is considered for the assessment. It presents a matrix outcome of VGG-16 Convolution Neural Network model.

The graphs in Figure 4 depict the Training & Validation accuracy with loss. Altogether, the performance of designed model which is executed in repetitive steps to pull out the essential features from X-ray images at the time of model training is displayed in the plot. The result of 97.33% accuracy was obtained as illustrated in Table II. The Figure 5 describes the comparison of precision, recall, f1-score of three classes pneumonia, COVID-19 and Normal.

Table II. Assessment of VGG-16 Architecture of batch size of 20 and epochs 50.

	Precision	***Recall***	***F1-Score***
COVID-19	*97*	*96*	*96*
Normal	*96*	*97*	*96*
Pneumonia	*96*	*98*	*97*
Macro Avg	*96*	*97*	*96*
Weighted Avg	*96*	*96*	*96*

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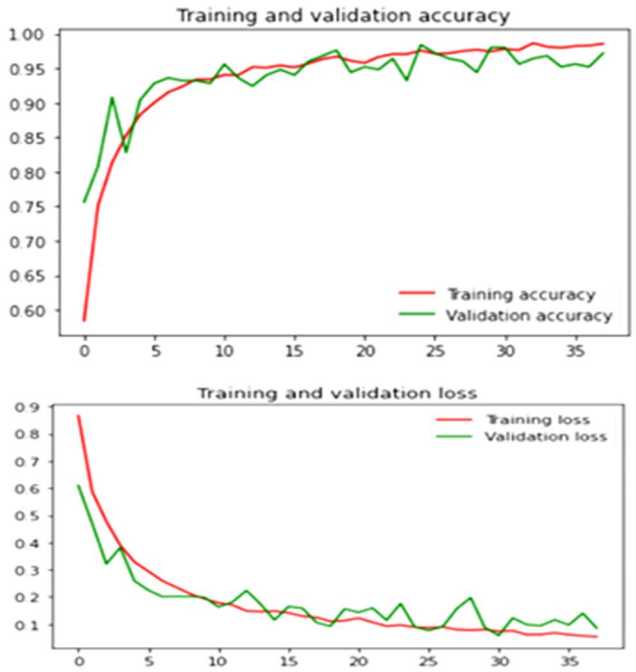

Figure 4. Graph showing Training and Validation accuracy and loss

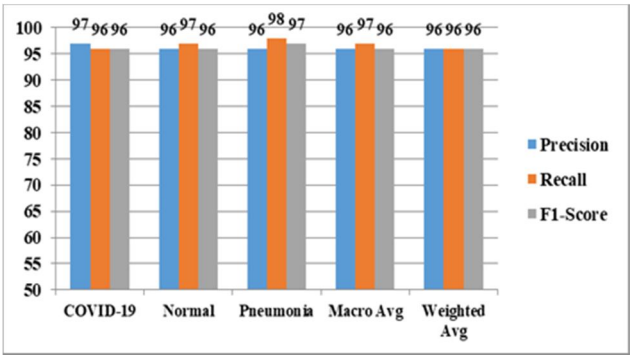

Figure 5. Graph showing comparison of precision, recall and f1-score for covid-19, normal and pneumonia.

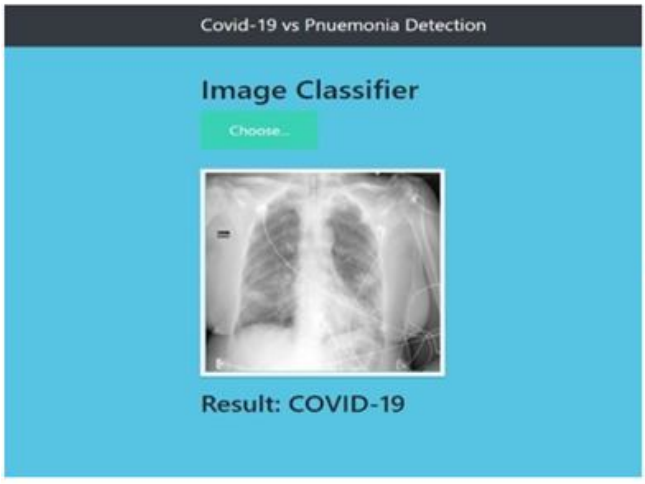

Figure 6. COVID-19 infected sample result.

The evaluation of the performance of classification model can be achieved using NxN confusion matrix; the number of target class is represented by N in confusion matrix. The real target values and the values that are evaluated by the ML model are compared in the matrix. Confusion Matrix for our model is shown in the Figure 7.

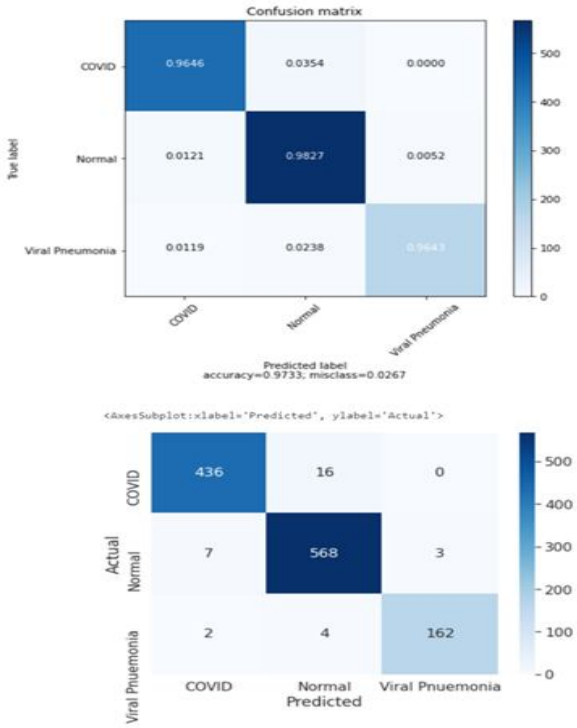

Figure 7. Confusion Matrix

7. CONCLUSION

This work, trained the VGG-16 model using CNN to obtain meaningful results in predicting the existence of COVID-19 & pneumonia on chest x-ray pictures. The convolution neural network model developed was successful in pulling out the key features from the human chest x-ray images and predicted appearance or non-appearance of COVID-19, normal, and pneumonia classifications. The methodologies that we've developed in this paper, predicts the COVID-19, normal, and pneumonia with a high accuracy and perfection. Our model obtained an accuracy of 97.33%. Future improvements can produce a better execution of CNN architecture by the fine-tuning of hyper-parameters with the combination of transfer learning. The places which are remote in the countries severely affected by COVID-19 can make use of this system to overcome the shortage of equipment and physicians with expertise in radiology. Improvements in the complex network-structure can produce better results which can be used to shape a good model for detecting pneumonia & COVID-19.

REFERENCES

[1] Wu, F., Zhao, S., Yu, B., et al. (2020). A new corona virus associated with human respiratory disease in China. Nature, 579(7798), 265-269.

[2] Huang, C., Wang, Y., et al. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The Lancet, 395(10223), 497-506.

[3] World Health Organization. (2020). Pneumonia of unknown cause–China. Emergencies preparedness, response, Disease outbreak news, World Health Organization (WHO).

[4] Wu, Z., McGoogan, J. M. (2020). Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. Jama.

[5] Holshue, M. L., DeBolt, C., et al. (2020). First case of 2019 novel coronavirus in the United States. New England Journal of Medicine.

[6] Kong, W., and Agarwal, P. P. (2020). Chest imaging appearance of COVID-19 infection. Radiology: Cardiothoracic Imaging, 2(1), e200028.

[7] Singhal, T. (2020). A Review of Coronavirus Disease-2019 (COVID-19). The Indian Journal of Pediatrics, 1-6.

[8] Zu, Z. Y., Jiang, M. D., Xu, P. P., Chen, W., Ni, Q. Q., Lu, G. M., & Zhang, L. J. (2020). Coronavirus disease 2019 (COVID-19): A perspective from China. Radiology, 200490.

[9] Kanne, J. P., Little, B. P., Chung, J. H., Elicker, B. M., &Ketai, L. H. (2020). Essentials for radiologists on COVID-19: an update—radiology scientific expert panel. Radiology, 200527.

[10] Xie, X., Zhong, Z., Zhao, W., Zheng, C., Wang, F., and Liu, J. (2020). Chest CT for typical 2019-nCoV pneumonia: relationship to negative RT-PCR testing. Radiology, 200343.

[11] Lee, E. Y., Ng, M. Y., and Khong, P. L. (2020). COVID-19 pneumonia: what has CT taught us?. The Lancet Infectious Diseases.

[12] Bernheim, A., Mei, X., et al. (2020). Chest CT findings in coronavirus disease-19 (COVID-19): relationship to duration of infection. Radiology, 200463.

[13] R. H. Abiyev and M. K. S. Ma'aitah, "Deep Convolutional Neural Networks for Chest Diseases Detection", Journal of HealthcareEngineering, 2018.

[14] S. Militante, N. Dionisio and B. Sibbaluca, "Pneumonia Detection through Adaptive Deep Learning Models of Convolutional Neural Networks".

[15] M. Cicero, A. Bilbily, E. Colak, T. Dowdell, B. Gra, K. Perapaladas, et al., "Training and Validating a Deep Convolutional Neutral Network for Computer-Aided Detection and Classification of Abnormalities on Frontal Chest Radiographs", Investigative Radiology, vol. 52, no. 5, pp. 281-287, 2017.

[16] S. V. Militante and B. G. Sibbaluca, "Pneumonia Detection Using Convolutional Neural Networks", International Journal of Scientific & Technology Research, vol. 9, no. 04, pp. 1332-1337, April 2020.

[17] Y. LeCun, Y. Bengio and G. Hinton, "Deep learning", Nature, vol. 521, pp. 436-444, May 2015.

[18] S. V. Militante, B. D. Gerardo and N. V. Dionisio, "Plant Leaf Detection and Disease Recognition using Deep Learning", 2019 IEEEEurasia Conference on IoT Communication and Engineering (ECICE), pp. 579-582, 2019.

[19] A. Krizhevsky, I. Sutskever and G.E. Hinton, "ImageNet Classification with Deep Convolutional Neural Networks", Neural Information Processing Systems, vol. 25, 2012.

[20] AlqudahAli Mohammad and QazanShoroq, "Augmented COVID-19 X-ray Images Dataset", Mendeley Data, 2020, [online] Available: http://dx.doi.org/10.17632/2fxz4px6d8.4.ae

[21] Malagi, S. S., Radhakrishnan, R., Monisha, R., Keerthana, S., and Ashoka, D. V. (2020). Content Modelling Intelligence System Based on Automatic Text Summarization. International Journal of Advanced Networking and Applications, 11(6), 4458-4467.

[22] Ankali, S. B., and Ashoka, D. V. (2011). Detection architecture of application layer DDoS attack for internet. International Journal of Advanced Networking and Applications, 3(1), 984.

[23] Kabir, Md Mohsin, M. F. Mridha, Ashifur Rahman, Md Abdul Hamid, and Muhammad Mostafa Monowar. "Detection of COVID-19, pneumonia, and tuberculosis from radiographs using AI-driven knowledge distillation." Heliyon 10, no. 5 (2024).

[24] Chetan, R., Ashoka, D. V., and Ajay Prakash, B. V. (2021). Smart agro-ecological zoning for crop suggestion and prediction using machine learning: an comprehensive review. *Advances in Artificial Intelligence and Data Engineering: Select Proceedings of AIDE 2019*, 1273-1280.

[25] Asin A, G.Raemsh, Deep Learning-Based Acoustic Analysis for Early Detection of Respiratory Diseases: A Hybrid CNN-LSTM Approach, Int. J. Advanced Networking and Applications Volume: 16 Issue: 06 Pages: 6659-6663 (2025) ISSN: 0975-0290

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