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EMERGING TRENDS IN SCIENCE AND TECHNOLOGY (ETIST-2021)

27th October 2021

Jointly Organized by

Department of Biological Science, Physical Science and Computational Science

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ABOUT THE INSTITUTION

A nations's growth is in proportion to education and intelligence spread among the masses. Having this idealistic vision, two great philanthropists late. S.P. Nallamuthu Gounder and Late. Arutchelver Padmabhushan Dr.N.Mahalingam formed an organization called Pollachi Kalvi Kazhagam, which started NGM College in 1957, to impart holistic education with an objective to cater to the higher educational needs of those who wish to aspire for excellence in knowledge and values. The College has achieved greater academic distinctions with the introduction of autonomous system from the academic year 1987-88. The college has been Re-Accredited by NAAC and it is ISO 9001 : 2015 Certified Institution. The total student strength is around 6000. Having celebrated its Diamond Jubilee in 2017, the college has blossomed into a premier Post-Graduate and Research Institution, offering 26 UG, 12 PG, 13 M.Phil and 10 Ph.D Programmes, apart from Diploma and Certificate Courses. The college has been ranked within Top 100 (72nd Rank) in India by NIRF 2021.

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The International conference on “Emerging Trends in Science and Technology (ETIST-2021)” is being jointly organized by Departments of Biological Science, Physical Science and Computational Science - Nallamuthu Gounder Mahalingam College, Pollachi along with ISTE, CSI, IETE, IEE & RIYASA LABS on 27th OCT 2021. The Conference will provide common platform for faculties, research scholars, industrialists to exchange and discus the innovative ideas and will promote to work in interdisciplinary mode.

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A Low Cost Initial Screening Model For Corona Virus Infection From X-Ray Images Using Artificial Neural Networks

S. Dhandapani[1]- Dr K.Haridas[2]

ABSTRACT: Every keyboard in the universe would have typed the word "corona" by now. COVID-19 is a pandemic and many people struggle by it and medical researches try to stop the spreading of the virus. Using artificial intelligence, this paper tries to screen the early possibility of infection by the virus. In this paper, Chest X-rays are used to scan the amount of lung opacity. It is a low cost and independent method developed for the normal public and this paper is to solve the time taken for the corona test results to reach patients. One who is suspecting of infection first has to measure the body temperature and if it is high with symptoms, he can go to an X-ray centers and take a chest X-ray and feed the chest X- ray image to the Neural Network model and if the model outputs a possibility percentage above 59, he is likely to go to a COVID screening center for further test. It is a first-line screening test and this model reduces the queue in the COVID centers and help the badly needed infected patients get screened first and start the treatment at the earliest. This research also fed the input to a Neuro-Fuzzy classifier and when comparing the experimental results, it is claimed that Neural Network performs better than Neuro-Fuzzy for the corona virus infection initial screening.

Keywords: COVID-19, Artificial Intelligence Model, Neural Networks, Neuro-Fuzzy.

1. Introduction

Corona Virus Disease of 2019 (COVID-19) is a disease caused by a novel virus called corona. People infected with this virus may have mild symptoms like cough and respiratory issues. This paper focuses on the x-ray image classification. Results can be increased with further lung segmentation and extracting the opacity regions very accurately. Corona is a disease caused by a novel virus called corona. It affects people of all ages and mostly who have less immunity. Chest X- ray is the initial imaging method to diagnose corona infection. Virus infected persons lungs showed increased lung opacity [15]. Forecasting the spread of the corona virus is a certain thing [18] in which the same pattern rarely repeats itself. Authors in [7] predicted the possibility of the spread and so the government can concentrate on the area predicted by the model.

Further [19] recommends that an Artificial Intelligence Model developer need not wait for the complete large

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dataset to be available. So with the existing dataset of X-rays, this model is developed and can further tuned with the new dataset. The company Alibaba has claimed 96% accuracy in the detection of pneumonia virus [10].

Out of the four stages of the COVID-19 [9] Prediction, Detection, Response and Recovery, this paper helps to detect the possibility of the infection of the corona virus. Figure 1 depicts the entire work flow of the proposed research. If the temperature is shooting up, one has to take an X-ray and feed to the model to get tested for corona infection.

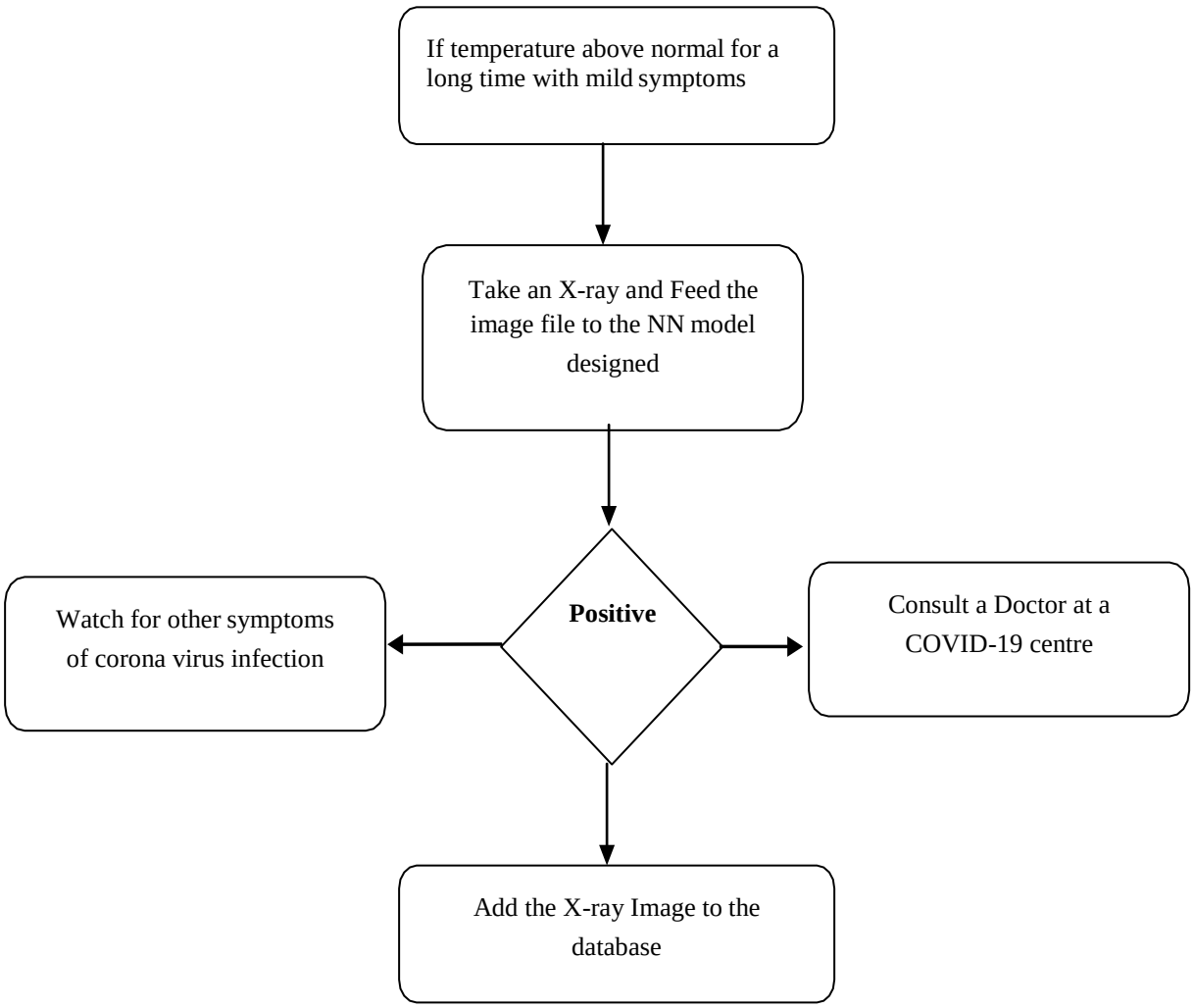


Figure 1 Workflow diagram of the Model

2. Literature Review

Santhosh [19] has discussed some AI tools to help the pandemic. The author focuses on active learning in which various data type can be used. Halgurd S. Maghdid et al [8] used sensors and captured the data through the smart phones and their framework operated in 4 layers. CT scan images are used and the assistance of a radiologist is needed for the review. Few research projects that the error between the official data and the official data model

curve is small [12] and has predicted the epidemic situation and helped to control the spread. Chen, Jun & Wu et al [4] have used CT scan images which is expensive than an X-ray and has build a model using deep learning and has attained higher accuracy. Ashok Kumar and Dhandapani [1] has proposed a neural network model to classify signature images and has claimed that backprogation neural networks suits image classification as the results are fine tuned until it reaches a minimum error rate. The parameters used for preparing holey polymer fibre is efficiently decided by Neuro-Fuzzy system [17]. Adaptive Neuro-Fuzzy inference systems is used to forecast the confirmed cases for the next 10 days. Mohammed A. et al [16] used the flower pollination algorithm and has compared with other algorithms. Their proposed model has minimum error and takes less computing time. Neuro-Fuzzy algorithm is used by LuisVirgen- Navarro et al [13] in finding the colour of the coffee bean during roasting. They trained the model with Backpropagation algorithm and the input digital image is in RGB jpg format. Bareq Salah etal [3] has proposed artificial intelligence models to detect skin cancer from digital images using neural network and Neuro-Fuzzy systems. Experimental results show a little difference between both the models they have proposed to detect different types of skin cancer. They claimed good sensitivity and specificity. Dongmei Liu and Zhaoxia Wang [5] has proposed an image recognition from X-ray scanner of passengers luggage. The model detects illegal objects inside the bags using Neural Network and Fuzzy logic systems. They have found that the computing efficiency of their model decreases with scalability. Fatemeh Ghofrani et al [6] proposed a method to classify medical x-ray images using fuzzy system. They claimed that the classification results are higher than the multilayer perceptron and SVM classifier. Khalatbari and Jenab [11] proposed a gamma-level fuzzy Bayesian model for monitoring the quality of an x-ray image. They worked to improve the quality and accuracy of the image given for diagnosis and has improved the reliability in health care system. Tran Manh Tuan et al [20] proposed a model using Fuzzy C-Means for classification of X-ray images. They have compared their model with other algorithms and claimed that the model proposed by them is better in diagnosing dentistry diseases.

3. Neuro-Fuzzy Model

Neuro-Fuzzy systems has the tendency to get trained fast with powerful learning algorithm [17]. Neuro-Fuzzy is a hybrid approach of neural network and fuzzy systems. The hybrid model maps the input and output using the IF-THEN rules. The input is mapped according to the degree of the membership function. Neural networks has the ability to recognize patterns and fuzzy logic has the decision making ability. In the proposed research, the area encroached by the mucus is to be identified and measured by its proportion. So the hybrid approach was used and compared with the neural network model. The same data is fed to both neural network and neuro-fuzzy and then compared for their performance.

4. Neural Network

Neural Network is widely used classification tool. Since corona virus is a new one in the virus community, medicos are learning from their experience and they did not know completely about the virus. Researches are going on to find the medicine and vaccine for the deadly virus. So Neural Network is also trained in parallel like the medicos. If any new invention about how to treat the infected patient, the information is fed to the neural network and it also learns and takes decisions based on the past inputs. Neural Networks learn, adapt and make decisions with the help of neurons. Neurons can communicate with each other and in different layers. Weights and Bias are

used to fine tune the neural network to work like a human brain. The network has an input layer, one or more hidden layer and an output layer.

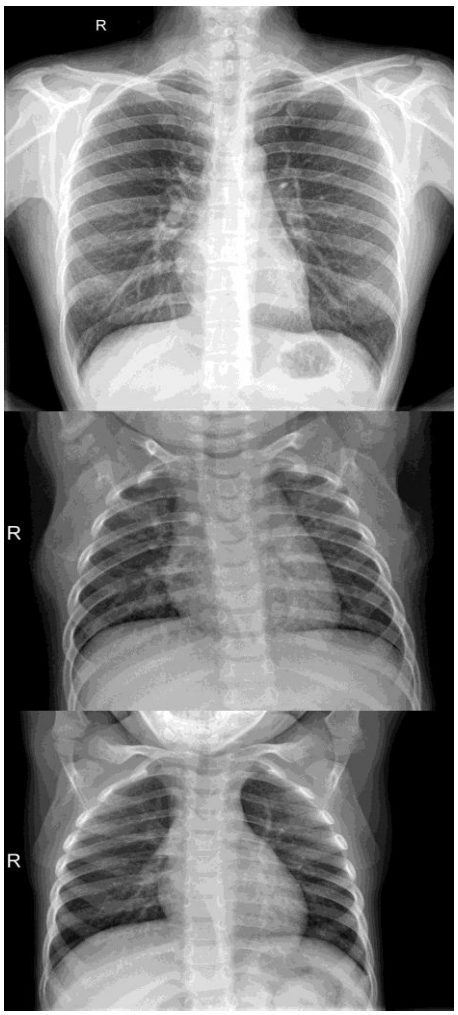


Figure 2.a

Figure 2.a shows the X-ray radiology image of a normal person

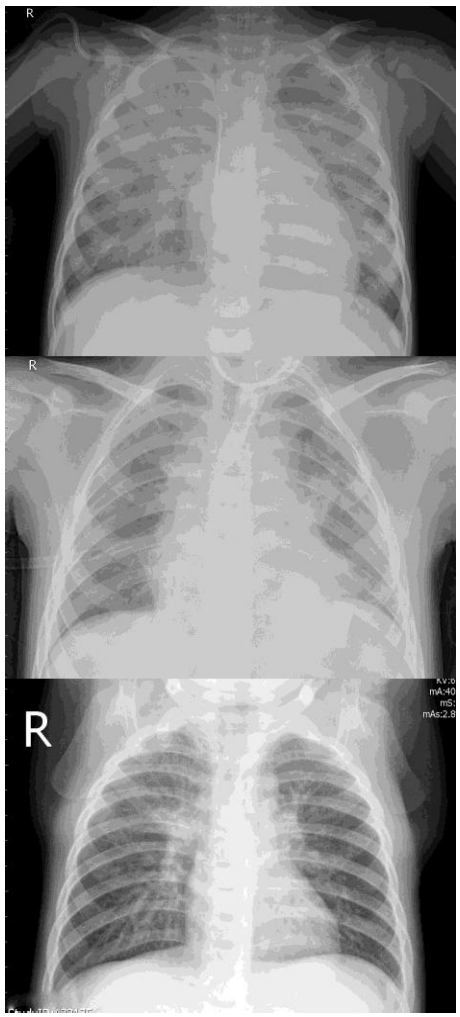


Figure 2.b

Figure 2.b shows the X-ray radiology image of an infected person.

Input layer is fed with the X-ray image to be tested and processing done at the middle layer and the result either positive or negative is sent to the output layer. Activation function controls the process and tries to increase the performance of the model. In this paper, the input to the model is the amount of opacity found inside the lungs. When the opacity is above a threshold percentage, the result will be positive and if it is low, the output will be negative and the person can be hopeful of not having infected at present. Some patients may develop more opacity even after 15 days of infection. Ashok Kumar and Dhandapani [2] have proposed an image classifier with three input signature images for verification. Presently this paper uses only one feature of the X-ray and in further research, many features from the X-ray regarding to the corona infection is to be found so that the performance of

the model is increased and so the detection accuracy .

The Neural Network used in the proposed research is the FeedForward Backpropagation Type. The result is backpropagated until the model is trained better with known samples.
During training, if the expected and target outputs have huge differences, the weights and bias are adjusted and backpropagated to improve the efficiency of the model.

1. Experimental Results and Discussion

The dataset for the X-ray images are fetched from Kaggle dataset bundle of X-ray. Table 1 shows the number of gas and opaque pixels inside the lungs. The opaque portion is the thick sticky mucus which fills the lungs and makes less space for the fresh air to flow. If the opacity is high, it appears as white portions in the X-ray and black portions shows the gas in the lungs. Gas is the normal air flowing region. The proportion of the mucus in the lungs is shown in the last column of the table.

Table: 1 Pixel distribution ratio of 20 normal persons X-ray

S.No	Gas	Opaque	Total	Proportion
1	1282886	1541026	2823912	54.57060985
2	854563	1316237	2170800	60.6337295
3	1281625	1618407	2900032	55.80652213
4	695143	820709	1515852	54.14176318
5	1087942	1090766	2178708	50.06480905
6	1294945	1625247	2920192	55.6554843
7	725594	1620086	2345680	69.06679513
8	1997481	2101295	4098776	51.26640246
9	950362	921170	1871532	49.22010417
10	1885357	1713079	3598436	47.60621003
11	1222831	1565105	2787936	56.13848381
12	2383824	2706576	5090400	53.17020273
13	1303814	1231600	2535414	48.57589333
14	2350705	1997327	4348032	45.93634545
15	806753	1088107	1894860	57.42413688
16	929845	1073555	2003400	53.58665269
17	1321439	1323177	2644616	50.03285921

18	1332372	1752764	3085136	56.81318425
19	552795	971155	1523950	63.72617212
20	1405162	946952	2352114	40.25961327

Table 2 shows the pixel distribution ratio of the infected person and usually the mucus will be in large clusters inside the infected persons lungs. So the opaque portion will be larger than the gas portion.

Table: 2 Pixel distribution ratio of 20 infected persons X-ray

S.No.	Gas	Opaque	Total	Proportion
1	68253	714595	782848	91.28144927
2	236684	581906	818590	71.08638024
3	260580	216732	477312	45.40677796
4	559349	1048075	1607424	65.20214953
5	814141	2566275	3380416	75.91595236
6	142337	680959	823296	82.71132132
7	973	837683	838656	99.88398104
8	459232	1222688	1681920	72.69596651
9	625315	1361885	1987200	68.53286031
10	404379	1477221	1881600	78.50876913
11	79247	193297	272544	70.92322708
12	231579	1103717	1335296	82.65710374
13	684601	611399	1296000	47.17584877
14	684601	611399	1296000	47.17584877
15	54013	571139	625152	91.36002124
16	486018	694462	1180480	58.82878151
17	128544	554016	682560	81.1673699
18	369965	729043	1099008	66.33645979
19	669889	758591	1428480	53.10476871
20	55008	1272864	1327872	95.85743204

Table 3 shows the predictions by Neuro-Fuzzy Model for the corona virus infection.The same data like the gas occupied portion, mucus occupied portion of the lungs and their total lung area are fed to the hybrid model and the results are tabulated.

Table 3: Neuro-Fuzzy Predictions

S.No	Gas	Opaque	Total	NF Output	Result
1	977712	1591248	2568960	-0.54598	Negative
2	1392847	2139929	3532776	0.429849	Negative
3	2115424	2976208	5091632	0.040543	Negative
4	1819390	1188356	3007746	1.313498	Positive
5	332607	888977	1221584	0.770557	Positive
6	1636665	1388053	3024718	0.937811	Positive
7	1148572	1372688	2521260	-0.36013	Negative
8	949533	848667	1798200	0.531174	Negative
9	604414	536002	1140416	0.974298	Positive
10	1141608	1067644	2209252	0.089299	Negative
11	704417	1602783	2307200	0.144016	Negative
12	98723	680797	779520	1.296903	Positive
13	114757	924667	1039424	1.185332	Positive
14	430423	806249	1236672	0.743021	Positive
15	322500	817980	1140480	0.925582	Positive
16	310789	850427	1161216	0.893253	Positive
17	232393	733751	966144	1.159025	Positive
18	139774	880578	1020352	1.184412	Positive
19	383372	962996	1346368	0.501126	Negative
20	344426	1207702	1552128	0.372432	Negative

Table 4 displays the predictions done by the neural network model. The test sample X- rays are fed to the model. First the pixels are counted inside the lungs and the values are fed to the model and it predicts the results as either positive or negative. The ratio can be varied according to the climate and geographical location. In this model, if the ratio is greater than or equal to 60 %, it is considered positive. The person has to go to a COVID-19 test center for

further diagnosis.

Table: 4 Neural Network Predictions

S.No.	Gas	Opaque	Total	NN Output	Result
1	977712	1591248	2568960	-0.03631	Negative
2	1392847	2139929	3532776	-0.10859	Negative
3	2115424	2976208	5091632	0.056875	Negative
4	1819390	1188356	3007746	0.765835	Positive
5	332607	888977	1221584	0.859347	Positive
6	1636665	1388053	3024718	0.584259	Negative
7	1148572	1372688	2521260	0.132393	Negative
8	949533	848667	1798200	0.493672	Negative
9	604414	536002	1140416	0.794078	Positive
10	1141608	1067644	2209252	0.387016	Negative
11	704417	1602783	2307200	0.666335	Positive
12	98723	680797	779520	1.198995	Positive
13	114757	924667	1039424	1.07689	Positive
14	430423	806249	1236672	0.795707	Positive
15	322500	817980	1140480	0.913683	Positive
16	310789	850427	1161216	0.908443	Positive
17	232393	733751	966144	1.057458	Positive
18	139774	880578	1020352	1.077176	Positive
19	383372	962996	1346368	0.751043	Positive
20	344426	1207702	1552128	0.644734	Positive

Reverse Transcription-Polymerase Chain Reaction (RT-PCR) is the vital test to confirm corona virus infection and the test conducted in lab also suffers from high false-negative due to the way the samples are collected and transferred [14]. So various researches are conducted to take samples directly to the testing kit without infection. Table 5 shows the performance measures of the models. The proposed NN model has no false negatives and there are 3 false positives out of the 20 test samples. The accuracy of the developed model is 85% and it can be increased with training the model with new X-ray images and more features related to the virus infection. Neuro-Fuzzy model has a lesser accuracy of 65% and results reveal that Neural network model suits the dataset to find the infection in

the lungs.

Table: 5 Performance Measures

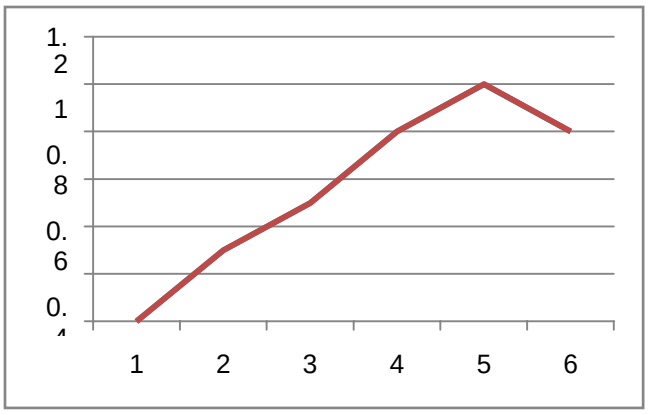
S.No.	Measure	Formula	NF Value	NN Value
1	TP	No. of Correctly identified Positives	6	7
2	TN	No. of Correctly identified negatives	7	10
3	FP	No. of Negatives incorrectly identified as positives	4	3
4	FN	No. of positivesincorrectly identified as negatives	3	0
5	Sensitivity	TP/ (TP +FN)	66.67 %	100 %
6	Specificity	TN / (TN +FP)	63.64 %	76 %
7	Accuracy	TP +TN / TP+ TN + FP + FN	65 %	85 %

Table 6 shows the confusion table for both the models and classification can be seen from the table. The performance of the classifier can be derived from the confusion table.

Table: 6 Confusion Table for classification

NF	Positive	Negative		NN	Positive	Negative
Positive	6	4	TP Rate	Positive	7	3
Negative	3	7		Negative	0	10

Figure 3 shows the ROC curve for the classifier. It shows the performance of the Neural Network classifier. It is a plot of TP against FP rates with different thresholds of the decision. For this model 5 threshold values were taken and the graph is plotted.



FP Rate

Figure 3 ROC curve

5. Conclusion

An artificial intelligence based model is built using the FeedForward Backpropagation Neural Network for the earlier detection of corona infection with 85% accuracy. When compared to other models cited, it is a low cost and easy method for the public to test themselves. This model helps the people to self diagnose themselves without waiting for weeks to get the corona test done. Even though rapid test kits have come, one has to book for a test and wait. This model is anyhow a precautionary one after the temperature check. It can help the medicos in giving priority for severe symptoms covid-19 cases. If a person suspects whether he has been infected first he has to check for his body temperature and then take an X-ray and check with the developed model. The proposed model helps the job of the radiologist in reducing his time from reviewing more number of x-ray images in a day. The advantage of the proposed model is it suggests whether the person needs a ventilator or not, which is less when compared to number of corona patients. The model has 100% sensitivity which is needed for such medical diagnosis and is an efficient system to pre-diagnose corona infection. Another advantage of this model is that the model has the facility to add new X-ray images on the go and retrain the model with new images so that the performance of the model increases further. The proposed model is also compared with Neuro-Fuzzy model and it is claimed that the proposed model has higher performance and efficiency.

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