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IDENTIFICATION OF COVID-19 USING AI TOOL

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Abstract:

COVID disease still spreads all over the world through changing its structure and developing a new variant. This new variant of the virus developed through modification of its structure causes worse symptoms in patients than the previous variant. Many scientists worldwide are tracking the structural modification in viruses and looking forward to achieving faster and more automated prediction techniques to deduce the spread of infection. However, the existing prediction techniques face difficulties in attaining early and accurate predictions of infected persons. So, in this current research automated COVID prediction model is proposed to achieve effective prediction. The chest X-ray images collected from medical IoT devices are initially taken as input. The input image is pre-processed using anisotropic diffusion filtering and adaptive gamma correction for achieving noise removal and enhancing contrast. Then, the required region for prediction is segmented from the image using the watershed segmentation technique. At last, COVID infected persons are predicted using a hybrid CNN-LSTM model. The simulation analysis of the proposed automated prediction is done by estimating certain metrics such as accuracy, sensitivity, error precision and specificity. The accuracy, precision, specificity and error value reached for the proposed model is 97%, 96%, 94% and 3%. This analysis reveals that automated early and accurate prediction of COVID disease is achieved by means of the proposed CNN-LSTM model.

Keyword: COVID disease; Medical IoT devices; chest x-ray images Automated prediction, deep learning techniques. hybrid CNN-LSTM model

Introduction:

- Throughout history, different disease outbreaks have afflicted humanity. The World Health Organization (WHO) and various national governments worldwide have been fighting these pandemics. The coronavirus COVID-19 pandemic, which was first discovered in Wuhan, China, in December 2019, is still a major threat in our current society (Toğaçar, Ergen and Cömert, 2020, p.103805). The COVID-19 virus can spread through a variety of routes, including air, infected money and direct contact such as infected people sneezing or coughing (He, Deng and Li, 2020,

pp.719-725). It is an effective action to restrict COVID-19 transmission. Many scientists worldwide are tracking the structural modification in viruses and looking forward to achieving faster and more automated prediction techniques to deduce the spread of infection. Artificial intelligence (AI) is becoming more used in healthcare systems to diagnose diseases and perform medical assessments with recent computer and software technology (Cheng ZJ and Shan J, 2020). One of the most important characteristics of AI is the capacity to quickly extract relevant data from a variety of sources, including health records, social media, news and media. AI tools have become even more important in healthcare systems as a result of simple access to various data sources. The advancement of machine learning and deep learning has benefited healthcare professionals enormously. COVID-19 has recently received a lot of attention from the Several investigations using an X-ray imaging technique to detect and diagnose COVID-19 disorders have been studied in the literature. COVID-19 detection is a classification challenge with three classes: normal cases, COVID-19 afflicted cases and pneumonia based on X-ray images. Data collection related to COVID diseased patients is attained by means of IoT technology for diagnosing using intelligent system.

Literature Review:

COVID-19 epidemic is a serious illness that ruins the lives of millions of people all over the world. Deep learning approaches have been developed to diagnose COVID-19 using X-rays, CT scans and clinical images of the chest. This review discusses newly improved COVID-19 detection systems implemented using deep learning techniques.

Rahimzadeh and Attar.et.al developed a classification of COVID-19 cases using chest X-rays with concatenated CNN based on Xception and ResNet50V2 model. The experimental outcome of accuracy and recall for COVID-19 cases is better.

Alqudah *et al.* developed a system that detects COVID-19 from chest X-rays using AI techniques. Different machine learning approaches such as CNN, Support Vector Machine (SVM) and Random Forest (RF) are employed to classify the photos. The accuracy, specificity, and sensitivity obtained from the system perform better outcomes.

Loey, Smarandache and Khalifa.et.al executed a diagnosis of COVID-19 from chest X-rays by the generative adversarial network (GAN) with deep learning. Google Net, RestNet18 and Alex Net were the three pre-trained models employed in the approach

Objective

- ;Automated and effective prediction of COVID diseased individuals is achieved with the assistance of a hybrid CNN-LSTM model.
- Improving classification performance through introducing anisotropic diffusion filtering for noise removal and adaptive gamma correction for contrast enhancement.
- The Watershed segmentation technique is included for marking the region of interest and solving the over-segmentation problem.
- The proposed prediction technique achieves improved accuracy with a lesser error rate.

Gap in Literature

COVID is considered as a pandemic situation and it is now ruling the whole world. The researchers all over the globe are focusing on developing effective data collection and automated prediction technique for achieving robust and accurate detection of COVID infected persons. The most mostly commonly utilized automated prediction approach is machine learning technique. Several machine learning techniques such as ANN, SVM and NB had been utilized by various researchers for performing automatic disease prediction. However, this machine learning technique possess limited training capability and there is high possibility for occurrence of error. To overcome these drawbacks deep learning technique which is an extension of machine learning technique is introduced. Deep learning technique is recently applied in various fields for attaining automated and accurate prediction. So, the present research is motivated on designed IoT based deep learning approach for automated prediction of COVID infected individuals.

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S.NO	Author name	Technique	Advantage	Limitation
1.	Gergo Pinter *et al.,*[21]	hybrid machine learning methods of adaptive network-based fuzzy inference system (ANFIS) and multi-layered perceptron-imperialist competitive algorithm (MLP-ICA	Projection of individual infection rate and mortality rate	data uncertainty and lack of essential data
2.	L. J. Muhammad *et al.,*[22]	Supervised Machine Learning Models	Obtained better prediction result	However, there is increased probability of error rate
3.	Najmul Hasan *et al.* [23],	hybrid model merging ensemble empirical mode decomposition (EEMD) and artificial neural network (ANN)	Improved prediction was done due to large training.	Prediction of time series data is quite complex.
4.	R. G. Babukarthik *et al.,*[24]	Genetic Deep Learning Convolutional Neural Network (GDCNN)	Early prediction with better accuracy was reached.	Creation of higher impact due to improper prediction result
5.	Sertan Serte *et al.,*[25]	ResNet-18 model	Accurate prediction of COVID 19 was	Diagnosis using CT scan can

			attained using the designed model.	create delay in hospitals.

Proposed Automated Covid Prediction Model:

COVID is a dreadful disease that causes serious health issues in a large population. So, early prediction and timely treatment are essential to reduce the risk of COVID affected patients. Conventionally, medical equipment like PCR was used for the prediction of disease. But this equipment was not that effective and did not produce accurate results. Nowadays, computer vision and various machine learning techniques such as ANN, SVM, K-NN and NB are focused on by many medical researchers for achieving automated detection of COVID diseases. But these machine learning algorithm faces difficulty in training large dataset. For that purpose, a deep learning technique emerged for COVID disease prediction. The architecture of the proposed automated deep learning-based COVID prediction is illustrated in figure 1.

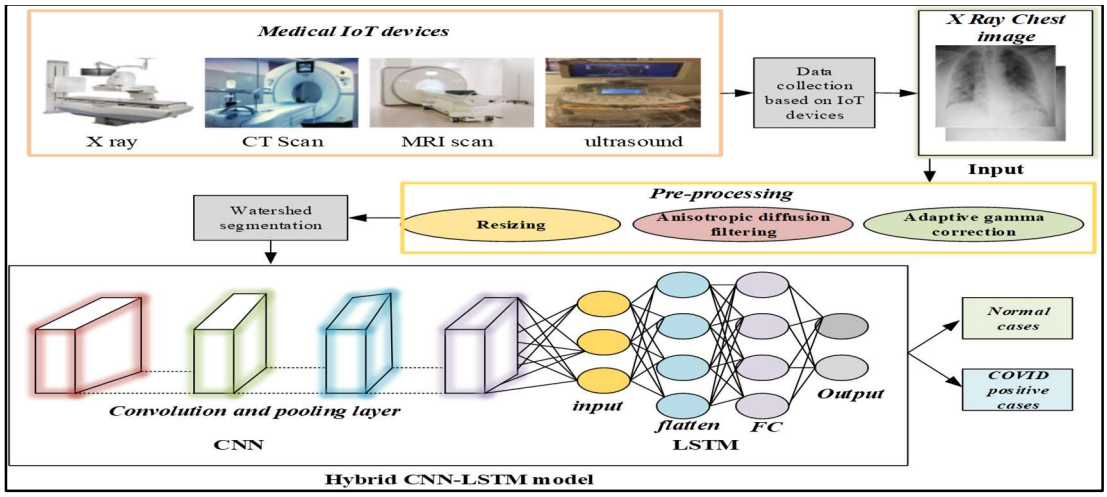

Figure 1. The architecture of the Proposed Deep Learning Prediction Model

Figure 1 illustrates the proposed hybrid deep learning technique designed for the prediction of COVID infected persons. Initially, the data collection for COVID disease prediction is performed based on IoT technology. Medical IoT devices that are involved in the process of data collection are X-rays, CT scans, MRI scans and ultrasounds. The image data collected based on these IoT medical devices are considered as input. Following that, the input image is pre-processed using three pre-processing techniques: resizing, noise removal and contrast enhancement. An anisotropic diffusion filtering technique removes the image's noise, and the image's contrast is improved through the adaptive gamma correction technique. Then, the image obtained as a result of pre-processing is sent as input for watershed segmentation. The segmented image is fetched as an input into a hybrid CNN-LSTM model for prediction. Finally, the COVID positive cases are classified from normal cases using the proposed hybrid model.

Input and Pre-Processed Image for COVID and Normal Cases

Input image	Pre-processed image		
	Re-sizing	Noise removal	Contrast enhancement
			

Segmented Image Obtained Through Watershed Segmentation

Pre-processed (input)	Watershed segmentation	
	Marked image	Final segmented image
		

Result and Discussion:

The proposed automated COVID prediction model is implemented in Python 3.8 (spyder) with the system configuration as Intel ® Core ™ i5-10300H CPU @ 2.50 GHz, 16 GB installed RAM and 64-bit operation system. This implementation is carried out to evaluate the functioning of the proposed COVID prediction model. This proposed model is designed by merging two deep learning algorithms such as CNN-LSTM. In this hybrid CNN-LSTM model, CNN is used for extracting the features, and LSTM is used to predict classes. The dataset for analysing this proposed model is obtained from the Kaggle website (KAGGLE: https://www.kaggle.com/tawsifurrahman/covid19-radiography-database). It contains chest x-ray images of both normal and COVID cases. This database consists of chest X-ray images of normal, Pneumonia and COVID cases, and it is released in different stages. The final release of this dataset consists of 10912 images for normal cases and 3616 COVID cases. Using this dataset, the proposed prediction model is analysed.

Comparison analysis:

A comparison investigation between the proposed and existing prediction models is carried out to show the better operation of the proposed model in contrast with the existing one. Some statistical parameters used for comparison investigation are precision, specificity, accuracy, F1 Score, error, False Positive Rate (FPR), False Negative Rate (FNR) and sensitivity. These parameters are evaluated for both proposed and conventional prediction models. Some convention prediction models used for comparison are CNN, LSTM, ANN and SVM. The statistical value obtained for the proposed and conventional Prediction model is given in table 4.

Table 4. Comparison of Metrics Between Proposed and Exiting

Performance Metrics	CNN-LSTM	CNN	LSTM	ANN	SVM
Accuracy	0.97	0.91	0.87	0.82	0.72
Sensitivity	0.93	0.82	0.85	0.73	0.61
Specificity	0.94	0.87	0.88	0.72	0.65
Precision	0.96	0.90	0.87	0.82	0.72
FPR	0.08	0.13	0.14	0.21	0.32
Error	0.03	0.09	0.13	0.18	0.28
F1 Score	0.92	0.89	0.77	0.60	0.55
FNR	0.01	0.09	0.1	0.15	0.21

Statistical metrics estimated for the proposed prediction model are displayed in the prior table. The parameters generally used for error analysis, such as FPR, FNR and error, are lesser for the proposed model. At the same time, the rest of the metrics, such as specificity, sensitivity, precision, F1 Score and accuracy, are higher for the proposed.

Table 5. Performance Comparison with Literature Technique

Author(s)	Technique	Dataset	Accuracy (%)	Precision (%)	Recall (%)
Proposed	CNN-LSTM	X-ray image	97	96	93
Mohammad R and Abolfazl A, (2020)	ResNet50V2 Concatenated	X-ray image	91.40	72	80
Khan AI et al. (2020)	CoroNet	X-ray image	89.6	90	89.92
Hemdan EED et al. (2020)	COVIDX-Net	X-ray image	74.2	76.8	74.2

Then the proposed model segmentation performance is compared to other existing models presented in table 6. It shows the performance of the proposed model is well compared to FCM and FCM+LDA models.

Conclusion:

An automated COVID prediction model is designed in this current study by merging the CNN network with LSTM. Detection of COVID-infected patients at an earlier stage is considered significant in reducing the spread of infection and the mortality rate. Research Scientists are focusing on designing effective and automated prediction techniques that detect the new coronavirus variant. The main portion of the organ which is hugely affected due to this coronavirus is the lungs. The lung image of the individual is acquired from various medical such as MRI, CT, ultrasound and X-ray. The further prediction process is carried out with the help of these chest images. Various pre-processing techniques are performed on the input image to improve the prediction accuracy. Three pre-processing approaches, such as resizing, noise removal and contrast enhancement, are achieved using bi-cubic interpolation, anisotropic filtering and adaptive gamma correction. Following that essential region for prediction is marked and segmented from the image using the watershed segmentation technique. The segmented image is finally fetched into a hybrid CNN-LSTM model for prediction. Within this CNN-LSTM model, the features present in the image are extracted using CNN then the extracted features are given to the LSTM classifier for prediction. The designed automated COVID prediction model is tested, and performance is validated and compared with the existing. In future, the proposed automated prediction model can be compared with the radiologist prediction of COVID. Secondly, this proposed hybrid model can be used to predict other diseases.

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