International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Diagnosis of Lungs X-ray Using Image Processing

Ganesh B. Barate[1], Varada P. Deshpande[1], Payal S. Golande[1], Shashank D. Biradar[2]

[1]B.E. Electronics & Telecommunication Engineering/Student, & Vidya Pratishthan's Kamalnayan Bajaj Institute of Engineering and Technology, Baramati, India
[2] M.Tech Electronics & Telecommunication Engineering/Assistant Professor, & Vidya Pratishthan's Kamalnayan Bajaj Institute of Engineering and Technology, Baramati, India

Email Address: *ganesh.barate.entc.2020@vpkbiet.org* ***(Ganesh B. Barate)*** *shashank.biradar@vpkbiet.org* ***(Shashank D. Biradar)***

Abstract - The abstract of the document discusses the use of convolutional neural networks (CNN) and support vector machines (SVM) to detect Covid-19 patients based on X-ray chest images. The study focuses on using the ResNet-50 model to extract features from the images and classify them using SVM. The results show high sensitivity and overall performance values for Covid-19 detection. The study suggests that this method can be beneficial for radiology specialists and help reduce false detection rates. These methods offer potential solutions for the early and accurate diagnosis of COVID-19 patients using X-ray imaging.

Key Words: covid-19, convolutional neural network, SVM, prediction, feature extraction, deep learning

1.INTRODUCTION

The most prevalent and serious medical conditions in the world are chest disorders. Every day, a large number of people pass away from chest illnesses, primarily from COVID-19, pneumonia, lung cancer, and tuberculosis (TB). If chest disorders are not identified in their early stages, they can be fatal. The World Health Organization (WHO) states that chest disorders have a very high fatality rate and can be fatal in a number of circumstances. The World Health Organization estimates that 3 million people die from COPD (chronic obstructive lung disease) each year, affecting 65 million people globally. The death rate from pneumonia is concerning; in 2017, 808,694 children under the age of five died from it. Approximately 10 million individuals (3.2 million women, 5.6 million men, and 1.2 million children) contracted TB, resulting in 1.4 million fatalities. Similarly, lung cancer claims the lives of almost 1.6 million people each year.

Discusses the importance of detecting and isolating Covid-19 patients at an early stage to control the spread of the disease. It mentions that reverse transcription polymerase chain reaction (RT-PCR) tests are commonly used for detection but have limitations in terms of sensitivity and time consumption. The study aims to develop alternative methods using chest X-ray images and convolutional neural networks (CNN) with support vector machines (SVM) for Covid-19 detection.

The dataset used in the study consists of X-ray images of Covid-19, Normal, and Viral Pneumonia cases. The study focuses on using the ResNet-50 model for feature extraction and SVM for classification. The results show high sensitivity and overall performance values for Covid-19 detection. The study suggests that this method can be beneficial for radiology specialists and help reduce false detection rates.

2. LITERATURE SURVEY

The literature survey in the given context focuses on the use of machine learning for computer-aided COVID-19 identification from CT and X-ray images. The study evaluates the accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the suggested method in comparison to other previous studies. The study makes use of a number of classification techniques, including Bag of Tree, k-NN, SVM, and K-ELM. According to the findings, the suggested strategy has a high success rate and requires little time to apply, making it a viable tool for COVID-19 early detection and treatment. The study also emphasizes the value of early identification and the ability of traditional learning techniques to yield effective outcomes on par with those of deep learning techniques.[1]

The field of lung cancer detection has already produced works such as automatic back propagation-based image segmentation, gray coefficient mass estimation approach, and lung cancer detection and classification by learning and multi nominal detection. But the publication doesn't offer a thorough review of the literature or a synopsis of these earlier studies conclusions. [6]

The effectiveness and interpretability of transfer learning for COVID-19 detection in chest X-ray (CXR) images using pre-trained deep convolutional neural networks (CNNs). The use of well-known CNN architectures, including VGG16, DenseNet201, ResNet50, and EfficientNetB3, for the classification of viral pneumonia, COVID-19, and healthy CXR pictures is included in the survey. The study uses criteria like accuracy, sensitivity, and specificity to assess how well these models perform. Furthermore, in order to comprehend the features utilized for predictions, the study investigates the interpretability of the models utilizing Local Interpretable Model-Agnostic Explanations (LIME). The findings demonstrate that whereas VGG16 had trouble learning lung properties, DenseNet201 fared well in terms of accuracy and sensitivity. The research highlights the significance of comprehension in medical applications and proposes that LIME explanations can enhance the models' reliability and applicability.[13]

It states that COVID-19 is a worldwide health emergency and that early clinical intervention and efficient screening are essential to containing the virus. The gold standard for COVID-19 detection is the Reverse Transcription Polymerase Chain Response (RT-PCR) assay, which is laborious, manual, and complex. Chest X-ray (CXR) pictures are one type of radiographic imaging that can be utilized to screen suspected instances early. Convolutional Neural Networks (CNN), one type of deep learning technique, demonstrate promise in image analysis and classification applications. Utilizing pre-trained models such as Inception V3, transfer learning can enhance CNN performance on smaller datasets. The use of data augmentation methods to expand the training dataset is also mentioned in the document. According to the study, this computer-aided diagnostic tool can greatly increase the efficiency and precision of diagnosing COVID-19 patients, which is essential during a pandemic. [12]

A lung cancer detection system based on neural networks and image processing methods. Through the analysis of chest X-ray pictures, the method seeks to identify lung cancer early on. The methodology which includes image acquisition, preprocessing, enhancement, feature extraction, lung region extraction, and neural network analysis is described in the study.[4]

Image processing methods for the detection of lung cancer in CT scans. It draws attention to how deadly lung cancer is and how crucial early detection is to raising survival rates. The report states that when it comes to identifying and diagnosing lung cancer, CT scans are superior to standard chest x-rays. Additionally, it goes over the various phases of lung cancer and how important precise segmentation and feature extraction are in determining each stage. Using MATLAB, the study focuses on feature extraction, segmentation, and image enhancement. There is mention of a number of methods, including watershed segmentation, auto-enhancement, thresholding, and Gabor filter. The paper highlights the need for more precise findings as well as the promise of image processing methods for the identification of lung cancer.[7]

Early-stage lung cancer candidate tumors are detected by the method. Patient-provided helical X-ray CT lung pictures serve as the system's input data. The technology analyzes blood artery anatomy and diagnoses lung cancer using image processing techniques and medical knowledge. Using data from 20 patients, the algorithm's efficacy is assessed; in 8 cases of abnormal individuals, the tumor was successfully detected.[9]

The division of chest radiography The article highlights the several image processing and analysis techniques that have been put forth for chest radiographs, with an emphasis on lung field and rib cage segmentation. While clustering techniques have been employed in certain ways, region-based characteristics computed as wavelets have been used in others. Additionally highlights the value of computer-aided diagnostic (CAD) systems and

the affordability, ease of use, and minimal radiation exposure of chest radiographs.[18]

Table 1. Modified TRIPOD assessment of X-ray

Lead Author	Year	Country	Study Type	Aim	Dataset	Comparator	Validation
[1]	2020	Turkey	Case Control	Detection of Covid-19 Patients From X-ray	COVID-19 and Pneumonia	Not Mentioned	K-fold Validation (5-fold)
[2]	2013	India	Case Control	Detection of Lungs Scan Covid-19 Patients From X-ray	Lungs Scan MRI- 682 COVID SemiSeg 100 CT scan	NO	Not Mentioned
[17]	2020	UnitedState of America	Retrosp-ective	Detection of Covid-19 Patients From X-ray	COVID = 455 (Cohen 2020) Normal = 532 Bacterial pneumonia = 492Viral non-COVID Pneumonia = 552 Split 75 training 25 validation	NO	Epoch K-fold cross validation
[12]	2020	China	Case Control	Classification of COVID-19 from Chest X-ray image	"COVID-19-864" "Normal-1341" "Viral-1345" "Italian Society of Medical and Interventional Radiology COVID-19 (SIRM)"	NO	Cross-Validation

Table 2. Summary of results from AI Studies for chest

Ref	Dataset	Deep Learning Model	2D/3D	All Data	COVID Data	Training Data	Validation	Testing Data	Sensitivity	Specificity
[1]	COVID-19/ non-COVID Pneumonia/ normal	VGG19 And DenseNet201	2d	4353	1726	Not Mentioned	Not Mentioned	Not Mentioned	86.53%	91.94%
[2]	COVID-19/Healthy Viral Pneumonia	VGG16, DenseNet201 ResNet50 EfficientNet-B3	Not Mentioned	15123	3616	Not Mentioned	Not Mentioned	Not Mentioned	96.1%	Not Mentioned
[18]	COVID-19/ Infection / Normal	AIDCOV using VGG16	2d	5801	269	4698	523	580	99.3%	99.98%
[11]		Deep Neural Network Model	Not Mentioned	6691	Not used	5309	1338	1338	93.56%	81.96%

II. METHODOLOGY

A. *Aim*

The study's objective was to create a technique for correctly identifying people with Covid-19 using chest X-ray pictures. Convolutional neural networks (CNN) were used in the study for feature extraction and classification. Cubic and quadratic functions were utilized to classify the images after features from the images were extracted using the ResNet-50 CNN model. Images of Covid-19, Normal, and Viral Pneumonia were taken from the Kaggle website and used in the study. For every data sample, 1000 features were retrieved after the photos were scaled and pre-processed.

B. *Dataset*

Three-class datasets, which are publicly available on the Kaggle website, are used in this study. The data collection includes 162 "Normal," 219 "Covid-19," and 162 "Viral Pneumonia" X-ray chest pictures Fig.1 serving as an example. The data set contains 1024 × 1024 images.[5]

An technique based on deep transfer learning and utilizing the Inception V3 model is suggested in the majority of the study's primary findings. Over 98% of COVID-19 cases were correctly identified by the classification model.

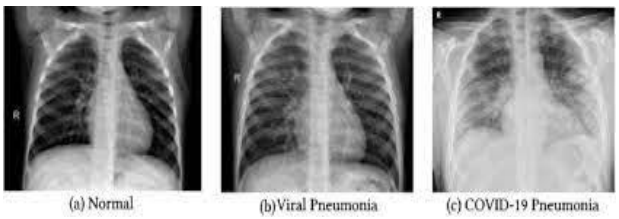

Fig.1 (a)Normal (b) Viral Pneumonia (c) COVID-19 Pneumonia

C. Reference Standard and Comparator

The reference standard utilized in the trials varied; in 11/17, the label was based on an annotation by a radiologist, in 2/17, the label was assigned based on the findings of an RT-PCR test, and in a mix of both RT-PCR and radiologist evaluation.

Four of the 17 papers evaluated AI's performance against a comparable comparator a radiologist with a range of years of experience.

Table3. Summary of different DL architectures used for pneumonia detection.

Ref.	Dataset	Model	Result
[5]	Viral Dataset (“COVID-19= 219,“Normal-1341”, “Viral Pneumonia-1345”)	ResNet50 with 50 Layers	For Linear SVM ACC=98.90,94.77,99.35 SPE=99.70,95.52,96.86 SEN=94.52,96.87,94.72
[12	“COVID-19= 864”,”Viral Pneumonia-1352”,Normal Chest X-ray Images-1341	Inception V3 model TensorFlow Library	ACC= 98%

D. *Validation and Testing*

Methods of validation are employed to evaluate a given model's resilience. While external validation evaluates the model's performance using a dataset from a fresh, independent source, internal validation makes use of data from the initial training source. Each investigation included internal validation, dividing the dataset between training and testing sets. Most of the research used a train-and-test methodology, splitting the dataset in half. Additionally, some research used k-fold cross validation. Seven of the sixteen research used an independent dataset for external validation.

Table 4. Deep learning methods (CNN) used across all studies.

Network Name	Study Used
Neural Network	[6]
Artificial Neural Network	[4]
BackPropagation Neural Network	[16]
Convolutional Neural Network(CNN), ResNet50, Support Vector Machine(SVM)	[5]

3. CONCLUSIONS

An overview of the literature on AI systems for COVID-19 detection on CT and chest X-rays is provided in this review. In terms of automated COVID-19 diagnosis by both modalities utilizing deep-learning techniques, the research that are being presented show favorable findings. AI has a lot of potential as a diagnostic tool, but its applicability in clinical practice is limited because to a significant risk of bias resulting from small datasets, a lack of external validation, and an appropriate clinical comparator. So, to improve the chances of new AI systems being implemented in areas where patients stand to gain the most, future research should incorporate appropriate clinical comparison and external validation

REFERENCES

[1] Saygılı A. A new approach for computer-aided detection of coronavirus (COVID-19) from CT and X-ray images using machine learning methods. Applied Soft Computing. 2021 Jul 1;105:107323.

[2] Hassantabar S, Ahmadi M, Sharifi A. Diagnosis and detection of infected tissue of COVID-19 patients based on lung X-ray image using convolutional neural network approaches. Chaos, Solitons & Fractals. 2020 Nov 1;140:110170.

[3] Shyni HM, Chitra E. A comparative study of X-ray and CT images in COVID-19 detection using image processing and deep learning techniques. Computer Methods and Programs in Biomedicine Update. 2022 Jan 1;2:100054.

[4] Kumar, V. and Saini, A., 2013. Detection system for lung cancer based on neural network: X-Ray validation performance. *International Journal of Enhanced Research in Management & Computer Applications*, *2*(9), pp.40-47.

[5] Narin A. Detection of Covid-19 patients with convolutional neural network based features on multi-class X-ray chest images. In2020 Medical Technologies Congress (TIPTEKNO) 2020 Nov 19 (pp. 1-4). IEEE.

[6] Miah MB, Yousuf MA. Detection of lung cancer from CT image using image processing and neural network. In2015 International conference on electrical engineering and information communication technology (ICEEICT) 2015 May 21 (pp. 1-6). ieee.

[7] Anitha Chaudary, Sonit, and S. Singh. "Lung cancer Detection on CT images by using image processing"." In *IEEE, International Conference on Computer Sciences*. 2012.

[8] Portela RD, Pereira JR, Costa MG, Costa Filho CF. Lung region segmentation in chest x-ray images using deep convolutional neural networks. In2020 42nd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC) 2020 Jul 20 (pp. 1246-1249). IEEE.

[9] Kanazawa, K., N. Niki, H. Satoh, H. Ohmatsu, and N. Moriyama. "Computer assisted diagnosis of lung cancer using helical X-ray CT." In *Proceedings of IEEE Workshop on Biomedical Image Analysis*, pp. 261-267. IEEE, 1994.

[10] Arsomngern P, Numcharoenpinij N, Piriyataravet J, Teerapan W, Hinthong W, Phunchongharn P. Computer-aided diagnosis for lung lesion in companion animals from x-ray images using deep learning techniques. In2019 IEEE 10th

International Conference on Awareness Science and Technology (iCAST) 2019 Oct 23 (pp. 1-6). IEEE.

[11] Ullah MI, Kuri SK. Lung nodule Detection and Classification using Deep Neural Network. In2020 IEEE Region 10 Symposium (TENSYMP) 2020 Jun 5 (pp. 1062-1065). IEEE.

[12] Asif S, Wenhui Y, Jin H, Jinhai S. Classification of COVID-19 from chest X-ray images using deep convolutional neural network. In2020 IEEE 6th international conference on computer and communications (ICCC) 2020 Dec 11 (pp. 426-433). IEEE.

[13] Cervantes EG, Chan WY. Lime-enabled investigation of convolutional neural network performances in covid-19 chest x-ray detection. In2021 IEEE Canadian Conference on Electrical and Computer Engineering (CCECE) 2021 Sep 12 (pp. 1-6). IEEE.

[14] Li X, Chen F, Hao H, Li M. A pneumonia detection method based on improved convolutional neural network. In2020 IEEE 4th Information Technology, Networking, Electronic and Automation Control Conference (ITNEC) 2020 Jun 12 (Vol. 1, pp. 488-493). IEEE.

[15] Darapaneni N, Ranjane S, Satya US, Reddy MH, Paduri AR, Adhi AK, Madabhushanam V. COVID 19 severity of pneumonia analysis using chest X rays. In2020 IEEE 15th International Conference on Industrial and Information Systems (ICIIS) 2020 Nov 26 (pp. 381-386). IEEE.

[16] Kumar V, Garg DK. Neural Network Based Approach for Detection of Abnormal Regions of Lung Cancer in X-Ray Image. International Journal of Engineering Research & Technology, ISSN. 2012 Jul:2278-0181

[17] Zokaeinikoo, M.; Kazemian, P.; Mitra, P.; Kumara, S. AIDCOV: An Interpretable Artificial Intelligence Model for Detection of COVID-19 from Chest Radiography Images. ACM Trans. Manag. Inf. Syst. **2021**, 12, 1–20

[18] Dai Duong H, Tinh DT. A texture-based approach to chest radiography segmentation. In2012 International Conference on Control, Automation and Information Sciences (ICCAIS) 2012 Nov 26 (pp. 187-190). IEEE.