International Journal of All Research Education and Scientific Methods (IJARESM), ISSN: 2455-6211
Volume 9, Issue 7 July -2021, Impact Factor: 7.429, Available online at: www.ijaresm.com

Efficient Pneumonia Detection in Chest Xray Images Using Convolution Neural Network

Zeenat Parveen[1], Dr. S. Adinarayana[2], Rapeti Aamani Sri Santoshi[3], Seerapu Tulasi[4]

[1]Department of CSE, Raghu Institute Of Technology, Visakhapatnam AP , India
[2]Professor, Department of CSE, Raghu Institute Of Technology, Visakhapatnam AP , India
[3]Department of CSE, Raghu Institute Of Technlogy, Visakhapatnam AP ,India
[4]Department of CSE, Raghu Institute Of Technology, Visakhapatnam AP, India

----------**********----------

ABSTRACT

This study proposes a CNN model trained to detect the pneumonia from a collection of chest X-ray images. Unlike other methods that rely solely on transfer learning approaches or traditional handcrafted techniques to achieve a classification performance, we constructed a convolutional neural network model to extract features from a given chest X-ray image and classify it to determine if a person is infected with pneumonia or not. This model could help lightening challenges often faced when dealing with medical imagery. Unlike other deep learning classification tasks with sufficient images, it is difficult to obtain a large amount of pneumonia dataset for this classification task therefore; we deployed several data augmentation algorithms to improve the validation and classification accuracy of the CNN model and achieved good accuracy.

Keywords: Convolution neural networks, Pneumonia, DenseNet, classification, deep transfer learning, Data augmentation

INTRODUCTION

Pneumonia is an acute respiratory infection that impacts the lungs. It is a deadly illness in which the air sacs get packed with pus and different liquid. There are particularly two types of pneumonia: bacterial and viral. Generally, it is located that bacterial pneumonia causes more acute signs. The maximum huge distinction between bacterial and viral pneumonia is the treatment. Remedy of bacterial pneumonia is achieved using the antibiotic remedy, whilst viral pneumonia will usually get better on its very own. It is a universal disease all across the globe. Its main purpose includes an excessive level of pollutants. Pneumonia is ranked 8 within the list of the top 10 reasons for loss of life within America[1]. Due to pneumonia, every year, 3.7 lakh youngsters die in India, which constitutes a complete fifty percent of the pneumonia deaths that arise in India [2]. The disorder regularly is going not noted and untreated till it has reached a fatal factor, especially in the case of vintage sufferers. Its miles the single biggest cause of death in youngsters worldwide. Children can be covered from pneumonia. It can be prevented with simple interventions and dealt with low-value, low-tech medicine and care. Consequently, there's an urgent need to do studies and development on laptop-aided prognosis so that the pneumonia-related mortality, in particular in youngsters, can be reduced. One of the following exams can be done for pneumonia analysis: chest x-rays, ct of the lungs, ultrasound of the chest, needle biopsy of the lung, and MRI of the chest. Currently, chest x-rays are one of the quality methods for the detection of pneumonia. X-ray imaging is preferred over ct imaging due to the fact ct imaging typically takes appreciably extra time than x-ray imaging, and enough great ct scanners won't be to be had in lots of underdeveloped areas. In evaluation, x-rays are the most not unusual and broadly available diagnostic imaging technique, playing a vital function in medical care and epidemiological research. There are numerous areas across the globe in which there is a scarce availability of practiced healthcare employees and radiologists whose prediction on such diseases is counted significantly. Computer-aided diagnosis using artificial intelligence primarily based answers is turning into an increasing number of popular in recent times. This facility may be made to be had to a huge population at a minimal price. Another issue with this ailment is that on occasion, the functions that describe the very existence of the sickness regularly get mixed with other sicknesses, and for this reason, radiologists locate it hard to diagnose this ailment. Deep studying strategies clear up all these problems, and their accuracy in the prediction of the ailment is equal and every so often even extra than a median radiologist. Some of the deep studying strategies, convolutional neural networks (CNN's) have shown the first-rate promise in picture category and segmentation and therefore are extensively followed by using the research network. Biomedical photo prognosis that makes use of the techniques of deep studying and computer imaginative and prescient has proven to be very useful to offer a quick and correct prognosis of the ailment that matches the accuracy of a reliable radiologist. Presently, deep mastering primarily based strategies cannot update trained clinicians in medical diagnosis, and the goal to complement clinical selection making. In this paper, a version is offered based totally on the programs of deep getting to know and convolutional neural networks which are capable of classifying robotically that the patient has pneumonia or now not. The proposed method uses a deep transfer learning set of rules that extracts the functions

from the x-ray photo that describes the presence of sickness mechanically and reviews whether or not it's miles a case of pneumonia.

LITERATURE SURVEY

Since Deep learning-based methods are already being used in various fields [3][4][5][6][7] Different authors have already proposed many works that have already been done for the detection of numerous diseases by using deep learning techniques, as stated by Dinggang Shen [8] and Andre [9] developed a deep learning model for dermatologist-level classification of skin cancer. and the author F.Milletari [10] also proposed a methodology for the depiction of prostrate in MRI volumes using CNN. and one among them is proposed several biomedical image detection techniques discussed the challenges and the future of medical image processing by M.I.Razaak [11]. Grewal [12] used the technique of deep learning for brain hemorrhage detection in CT scans, and Varun [13] proposed a method for detecting diabetic retinopathy in retinal fundus photographs. Many works have already been done for the detection of many diseases by using deep learning-based techniques. Methods regarding the examination of the detection of disease by chest X-ray have also been worked on earlier by performing various examination techniques. Chest X-ray images are evaluated through the process of scan line optimization such it eliminates the other body parts to avoid any error in diagnosis. There was algorithm described by S. Hermann [14] used two deep 3D customized mixed link network architectures for lung nodule detection and classification.Yao Letal. [15] combined DenseNet and long-short term memory networks to exploit the dependencies between abnormalities. Several authors also have worked on pneumonia classification. An author Khatri et al.[16] proposed the use of EMD (earth mover's distance) to identify infected pneumonia lungs from normal non-infected lungs. and Stephen 0. [17] used a CNN model for pneumonia classification. A localization approach based on pre-trained DenseNet-121, along with feature extraction, was used to identify 14 thoracic diseases in [18]. Some researchers have shown assuring results tried to explain the performance of customized CNNs to detect pneumonia and further differentiated between bacterial and viral types in pediatric CXRs[19]. Rajpurkar et al. [20] used CheXNeXt, a very deep CNN with 121 layers, to detect 14 different pathologies, including pneumonia, in frontal-view chest X-rays. Saraiva et al. [21], Ayan et al. [22], and Rahman et al. [23] used deep learning based methods for pneumonia classification. Few used a region-based convolutional neural network for segmenting the pulmonary images along with image augmentation for pneumonia identification. All of these techniques have some serious disadvantages such as decreasing accuracy levels, lack of efficiency, sometimes classifying the normal Xrays as Pneumonia and vise versa. These disadvantages are overcome in this Pneumonia detection system using the DenseNet121 technique.

Proposed methodology

The key objective of this project is to detect pneumonia from the chest Xrays with high accuracy, less medical cost, and reduce the time for detection and eventually the death rate. For the past many years, the medical field has been doing the detection manually with radiologist experts. But as now during the covid crisis, the demand for experts is increasing, the machine learning is bringing a significant improvement to the determining binary classification of lung disease. An efficient solution for the detection of pneumonia from chest X-rays is proposed in this paper. Data augmentation was used to address the problem of the limited dataset, and then, state-of-the-art deep learning models were fine-tuned for pneumonia classification. Then, predictions from these models were combined to compute the final prediction. The complete block diagram of the proposed methodology can be seen below in Figure1.

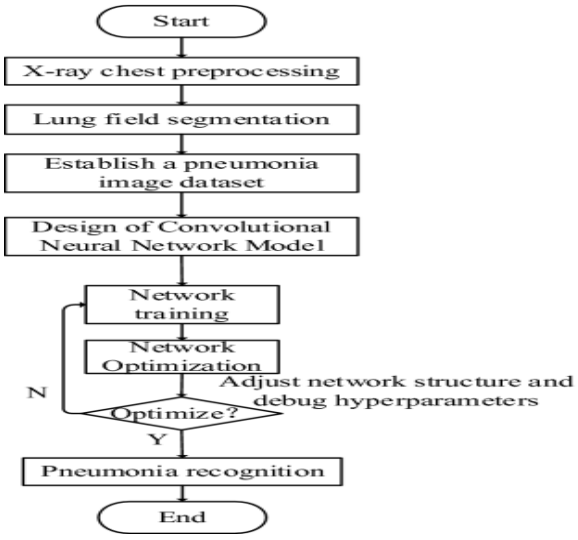

Figure 1: Procedure followed for implementation

Implementation

The architectural design implementation is divided into three stages: Data preparation and preprocessing, Fine-Tuning the Architectures, and Classification. In this study, the authors utilized the Radiological Society of North America (RSNA) dataset through the Kaggle Pneumonia Detection Challenge [24] which contains 26,684 image data. The data format obtained is in JPEG and it was grouped into two classes, pneumonia infected and normal with the dimensions of 1024 x 1024 pixels at maximum. The image data consume 75%, 25%, for training, and testing, of data respectively. The training data provides the primary input for feature extraction and having extensive training data can produce strong features for a great result. Training data can produce strong features for a great result. The testing data can draw results to validate the effectiveness of the model to work in actual circumstances. In the study, all images were labeled properly and precisely by medical experts to confirm correct labels for classification. Raw chest X-ray images, after being pre-processed and normalized, were used to train the network. Then, data augmentation techniques were used to process the dataset more efficiently. All the layers of the networks used were trainable, and these layers extracted the features from the images. Every single block in CNN Process is used in architecture followed by wholly inter-connected layers and softmax activation. Feature extraction is composed of an input image, convolution, max-pooling while classification involves fully interconnected layers and output. After creating the model on detection of pneumonia gives accurate results.

Experimental design

To further test the robustness of the proposed model, we have used the open source tool Python to implement the proposed model and evaluated the performance on image data using accuracy, recall, TP Rate, TN Rate, FP Rate and FN Rate measures. The formulas of all the measures are given in the following equations.

In figure 4, the accuracy, recall, precision score, F1 score, and AUC score for the model and the proposed weighted classifier were calculated. To calculate the mentioned scores, confusion matrices for all the architectures were obtained with the help of the confusion matrix, the number of true positives, true negatives, false positives, and false negatives could be calculated, which further helped in checking the efficiency of the model. Recall or sensitivity is defined as the fraction of relevant images that were retrieved. The accuracy is the fraction of predictions our model got right. Formally, accuracy is defined as the number of correct image predictions divided by the total number of predicted images.

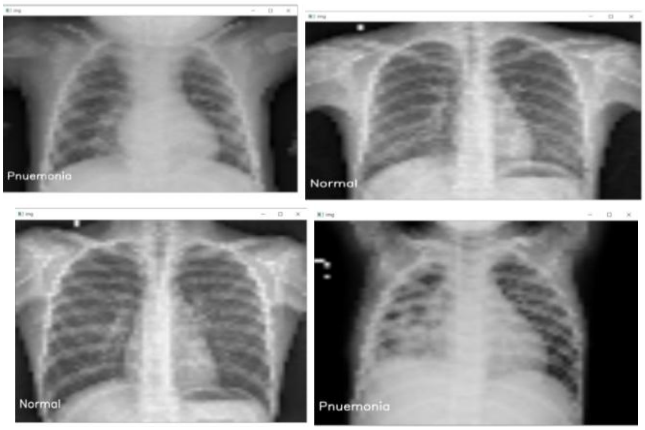

Figure 2: Output Images

Performance Analysis

This research surveys the deep learning function in detecting pneumonia through computer view using three convolutional neural network models. Pneumonia constitutes a great cause of morbidity and mortality. Even there is a possibility of imaging equipment; there is a shortage of the specialist who can verify X-rays. In this paper, the spontaneous detection of pneumonia in chest X-ray images using deep learning techniques was implemented. Our study makes it easy to identify the best model to detect pneumonia. Though many methods have developed to work on dataset this proposed methodology i.e DenseNet121 attained better results as we can see the fig5 and fig6 with the comparison of other models like ResNet18 and ResNet50.

Table 1: Result analysis

	Accuracy	Recall
DenseNet121	0.88942	0.97179
ResNet-18	0.85515	0.98947
ResNet-50	0.87486	0.98531

The comparative analysis of our proposed work is done with ResNet-18 and ResNet-50 algorithms on the image dataset. The results of the proposed approach are presented in the Table 1. Studies have shown that the connections between layers will help in increasing the performance and requires fewer parameters for DenseNet121.DenseNet121 model was able to attain an accuracy of 0.899038 and 0.984615 recall value.DenseNet121 has advantages such that the number of parameters is considerably reduced, features are reworked, and the vanishing gradient is alleviated.

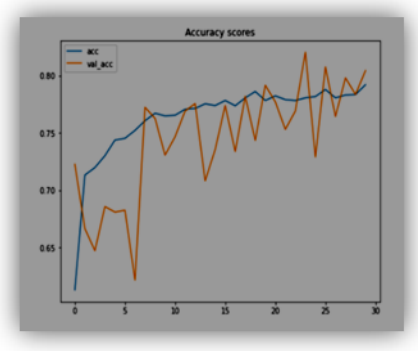

Figure 3.Model Accuracy

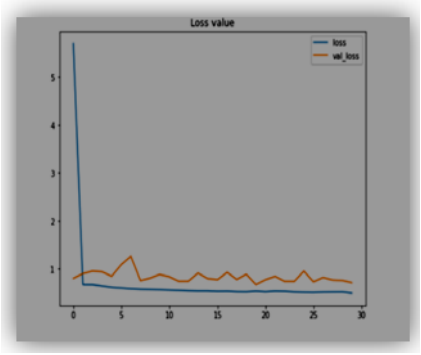

Figure 4.Model Loss

Based on the confusion matrix values accuracy and recall values are calculated for the models and are presented in the figures5 and 6..

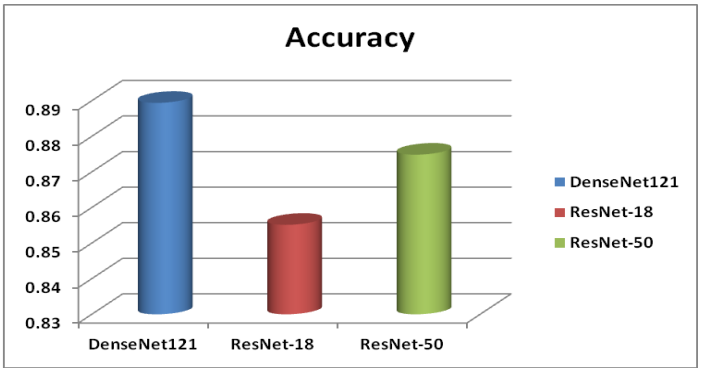

Figure 5.Performance analysis w.r.t. Accuracy

Figure

The results show that there is a good improvement in recall, accuracy and precision. The recall values of the performance analysis are shown in Figure6.

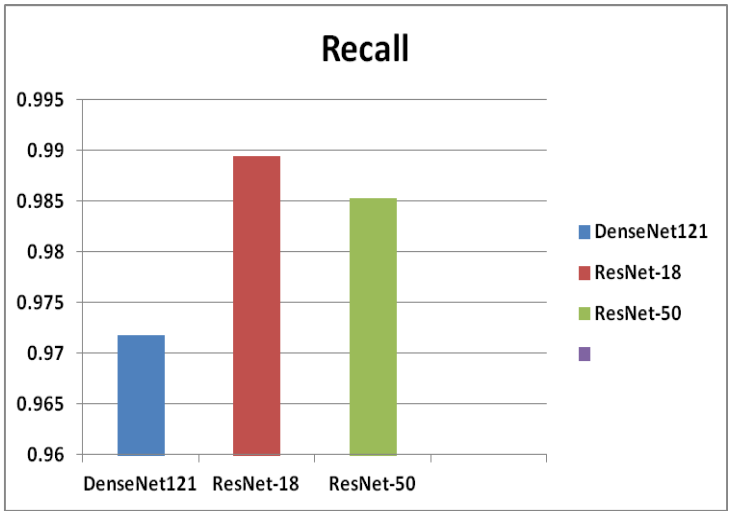

Figure 6.5: Performance analysis w.r.t. Recall

CONCLUSION AND FUTURE ENHANCEMENT

In this paper presented the connections between layers will help in increasing the performance and requires fewer parameters for DenseNet121.DenseNet121 model was able to attain better accuracy and recall value.DenseNet121 has advantages such that the number of parameters is considerably reduced, features are reworked, and the vanishing gradient is alleviated. In the future, this study will help the medical service force in analyzing for a real-time application for the use of the accurate model in detecting pneumonia and explore the potential of diagnosing pneumonia using deep learning models. To combine different architectures proficiently, a weighted classifier was implemented. The analysis was performed, and the distinct scores obtained, such as the accuracy, recall, precision, and AUC score, proved the robustness of the model. DenseNet121 architecture for pneumonia detection be executed and the development of hyper-parameters should also be observed to enhance the accuracy of the model.DenseNet121 model was able to attain improved accuracy and recall values over the compared models. It would be fascinating to view the approaches in which the weights compare to various models can be estimated more sufficiently and a model that takes into consideration, the patient's history while making prophesy.

REFERENCES

[1] https://data.unicef.org/topic/child-health/pneumonia/
[2] https://www.radiologyinfo.org/en/info/pneumonia
[3] Douarre C., Schielein R., Frindel C., Gerth S., Rousseau D. Transfer learning from synthetic data applied to soil–root segmentation in x-ray tomography images. *J. Imaging.* 2018;4:65. doi: 10.3390/jimaging4050065
[4] Wang Y., Wang C., Zhang H. Ship classification in high-resolution SAR images using deep learning of small datasets. *Sensors.* 2018;18:2929. doi: 10.3390/s18092929.
[5] Zhang Y., Wang G., Li M., Han S. "Automated classification analysis of geological structures based on images data and deep learning model". *Appl. Sci.* 2018;8:2493. doi: 10.3390/app8122493.
[6] Sun C., Yang Y., Wen C., Xie K., Wen F. "Voiceprint identification for limited dataset using the deep migration hybrid model based on transfer learning". *Sensors.* 2018;18:2399. doi: 10.3390/s18072399.
[7] Chen Z., Zhang Y., Ouyang C., Zhang F., Ma J. "Automated landslides detection for mountain cities using multi-temporal remote sensing imagery". *Sensors.* 2018;18:821. doi: 10.3390/s18030821.
[8] Shen D., Wu G., Suk H.I. "Deep learning in medical image analysis". *Annu. Rev. Biomed. Eng.* 2017;19:221–248. doi: 10.1146/annurev-bioeng-071516-044442.
[9] Esteva A., Kuprel B., Novoa R.A., Ko J., Swetter S.M., Blau H.M., Thrun S. "Dermatologist-level classification of skin cancer with deep neural networks". *Nature.* 2017;542:115–118. doi: 10.1038/nature21056.
[10] Milletari F., Navab N., Ahmadi S.A. V-net: "Fully convolutional neural networks for volumetric medical image segmentation",Proceedings of the International Conference on 3D Vision; Stanford, CA, USA. 25–28 October 2016; pp. 565–571.
[11] Razzak M.I., Naz S., Zaib A. "*Classification in BioApps".* Springer; Cham, Switzerland: 2018. Deep learning for medical image processing: Overview, challenges and the future; pp. 323–350.
[12] Grewal M., Srivastava M.M., Kumar P., Varadarajan S. "Radnet: Radiologist level accuracy using deep learning for hemorrhage detection in ct scans", Proceedings of the 2018 IEEE 15th International Symposium on Biomedical Imaging; Washington, DC, USA. 4–7 April 2018; pp. 281–284.
[13] Gulshan V., Peng L., Coram M., Stumpe M.C., Wu D., Narayanaswamy A., Venugopalan S., Widner K., Madams T., Cuadros J., et al. Development and validation of a deep learning algorithm for detection of diabetic retinopathy in retinal fundus photographs. *JAMA.* 2016;316:2402–2410. doi: 10.1001/jama.2016.17216.
[14] Hermann S. Evaluation of scan-line optimization for 3D medical image registration; Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition; Columbus, OH, USA. 23–28 June 2014; pp. 3073–3080.
[15] Yao L., Poblenz E., Dagunts D., Covington B., Bernard D., Lyman K. Learning to diagnose from scratch by exploiting dependencies among labels. *arXiv.* 20171710.10501
[16] Khatri A.A.R.J., Vashista H., Mittal N., Ranjan P., Janardhanan R. *Trends in Communication, Cloud, and Big Data.* Springer; Singapore: 2020. "Pneumonia Identification in Chest X-Ray Images Using EMD", pp. 87–98.
[17] Stephen O., Sain M., Maduh U.J., Jeong D.U. "An efficient deep learning approach to pneumonia classification in healthcare". *J. Healthc. Eng.* 2019;2019:4180949. doi: 10.1155/2019/4180949.
[18] Ho T.K.K., Gwak J. "Multiple feature integration for classification of thoracic disease in chest radiography". *Appl. Sci.* 2019;9:4130. doi: 10.3390/app9194130.
[19] Rajaraman S., Candemir S., Kim I., Thoma G., Antani S. "Visualization and interpretation of convolutional neural network predictions in detecting pneumonia in pediatric chest radiographs". *Appl. Sci.* 2018;8:1715. doi: 10.3390/app8101715.
[20] Rajpurkar P., Irvin J., Ball R.L., Zhu K., Yang B., Mehta H., Duan T. "Deep learning for chest radiograph diagnosis: A retrospective comparison of the CheXNeXt algorithm to practicing radiologists". *PLoS Med.* 2018;15:e1002686. doi: 10.1371/journal.pmed.1002686.

[21] Saraiva A., Santos D., Costa N.J.C., Sousa J.V.M., Ferreira N.F., Valente A., Soares S. "Models of Learning to Classify X-ray Images for the Detection of Pneumonia using Neural Networks.";2019 doi: 10.5220/0007346600760083.
[22] Ayan E., Ünver H.M." Diagnosis of Pneumonia from Chest X-Ray Images Using Deep Learning", Proceedings of the 2019 Scientific Meeting on Electrical-Electronics & Biomedical Engineering and Computer Science (EBBT); Istanbul, Turkey. 2–26 April 2019; pp. 1–5.
[23] Rahman T., Chowdhury M.E., Khandakar A., Islam K.R., Islam K.F., Mahbub Z.B., Kadir M.A., Kashem S. "Transfer Learning with Deep Convolutional Neural Network (CNN) for Pneumonia Detection using Chest X-ray." *Appl. Sci.* 2020;10:3233. doi: 10.3390/app10093233.
[24] https://www.kaggle.com/paultimothymooney/chest-xray-pneumonia/notebooks