Chest X-ray Classification using Deep learning

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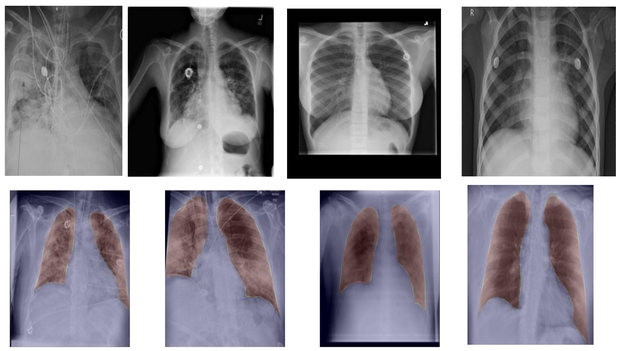
Abstract

The classification of chest X-ray images for COVID-19, pneumonia, lung cancer, and normal cases is the focus of this study. This research is motivated by the urgent need for accurate diagnostic tools, particularly considering in the worldwide pandemic situation. Our comprehensive approach integrates preprocessing, feature extraction, and advanced deep learning techniques such as convolutional neural networks (CNNs) and transfer learning by utilizing the Covid-19 repository dataset of 299x299 high-resolution images and metadata. Thorough evaluation and hyperparameter optimization plays an essential role in the effective classification of these kinds of scenarios. The study offers encouraging results and enhances healthcare solutions by emphasizing the potential emerging deep learning techniques and their integration to medical image analysis.

Introduction

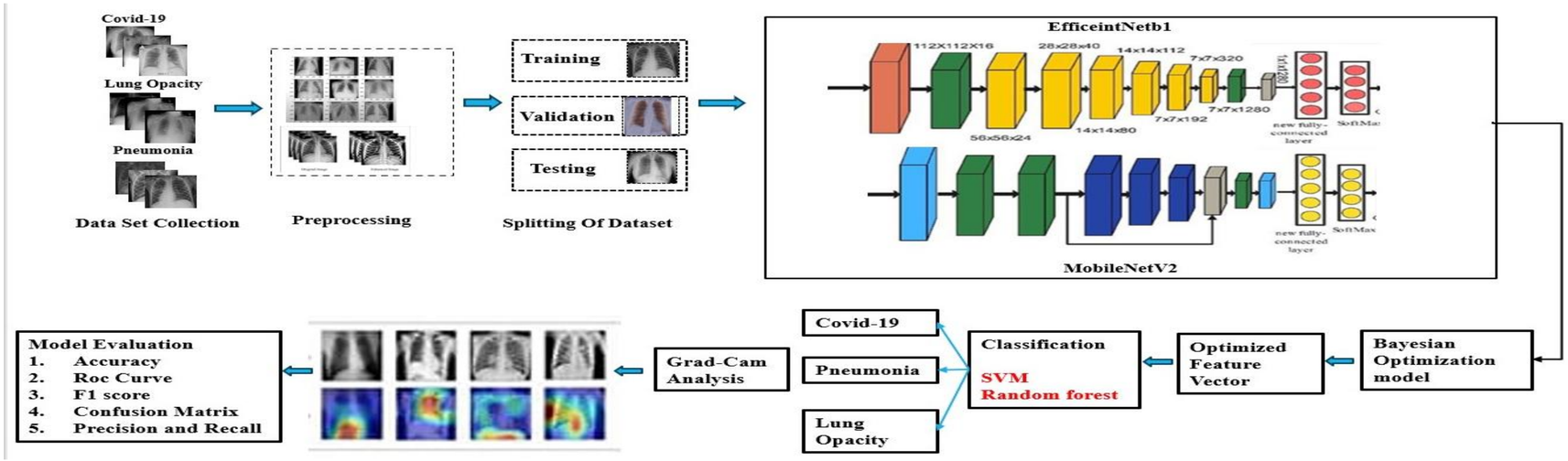
A global health challenge has been created by the widespread growth of diseases like pneumonia, lung cancer, COVID-19, and heart abnormalities. The rapid and accurate identification of these diseases becomes crucial to stopping their spread and guaranteeing early treatments. Chest X-rays provide a quicker and more affordable understanding of the condition of the chest than complex and time-consuming imaging techniques like MRI. However, there are fundamental challenges in the traditional manual analysis of chest X-ray images by medical professionals requires expertise, which is also highly prone to human error and may result in delays in patient care. The main goal of an automated chest X-ray classification system aims to dramatically increase diagnostic efficiency and accuracy in clinical settings. It builds upon previous techniques in medical image analysis, utilizing machine learning methods to extract complex patterns from X-ray images. Data preparation involves preprocessing techniques like image standardization and noise removal, while feature extraction techniques such as texture analysis and edge detection decode intricate patterns. Disease categorization utilizes various approaches, from conventional methods like Support Vector Machines to deep learning models like Convolutional Neural Networks (CNNs). These methods exhibit promise in identifying and classifying chest-related disorders, underscoring their potential for enhancing diagnostic outcomes.

Dataset Description

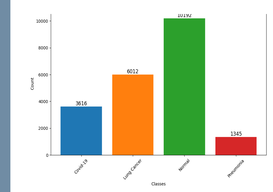


- **Dataset Name: Covid-19 Radiography Database**
- **Source of Dataset: Kaggle**
- **Total no. of Images: 21, 165**
- **Covid-19 Images: 3616**
- **Lung Cancer: 6012**
- **Normal : 10,192**
- **Pneumonia: 1345**
- **All the images are in Portable Network Graphics (PNG) file format**
- **The resolution are 299*299 pixels.**

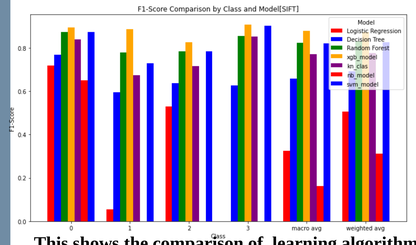
Methodology



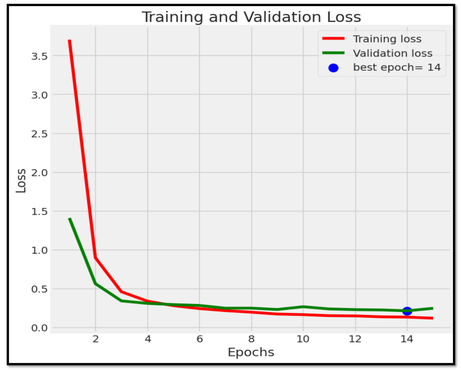
Results



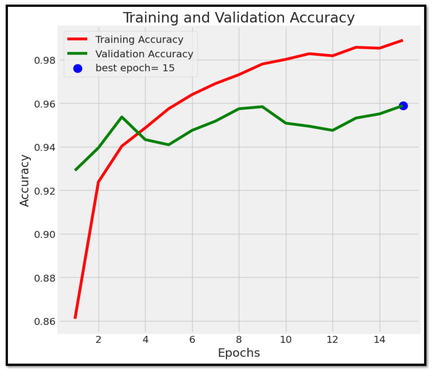
This shows the count of data for 4 different categories these are Covid-19, pneumonia, lung-cancer and normal.



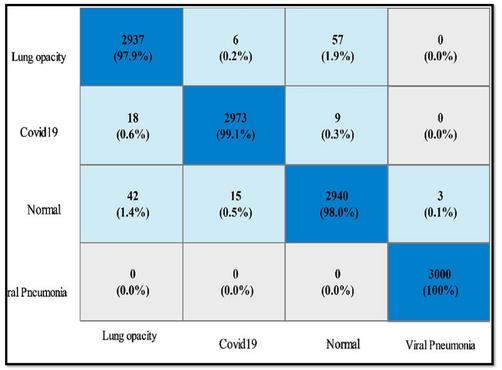
This shows the comparison of learning algorithm of different machine learning techniques.



This shows the loss function of testing and validation using EfficientNetB0 at epoch=14.



This shows the accuracy of training and testing using EfficientNetB0 at epoch=15.



The confusion matrix which based on SVM classification techniques of machine learning .

Comparative Analysis

Study	Method	Accuracy	Recall	Precision	F1-Score
[Ahmed et al., 2021]	CNN	90.64	80	92	89.8
[Choudhuri & Paul,2021]	VGG16	98.3	88	-	-
[Marques et al, 2020]	EfficientNet	96.70	96.69	97.59	97.11
[Ucar & Kokmaz,2020]	SqueezeNet	98.3	-	-	98.3
[Ozturk et al,. 2020]	DarkCovidNet	87.02	85.35	89.96	87.37
[Torman et al., 2020]	CapsNet	84.22	84.22	84.61	84.21

Conclusion and Future scope

We have achieved 97% and 97.3% accuracy in classifying chest X-ray images into three categories, including COVID-19, lung opacity and pneumonia, using advanced deep learning and classification techniques such as EfficientNetB0 and MobileNetV2 with SVM.

To further enhance accuracy of the system, we can explore

- **modern optimization techniques**
- **data augmentation**
- **ensemble learning etc.**

Reference

[1] M.E.H. Chowdhury, T. Rahman, A. Khandakar, R. Mazhar, M.A. Kadir, Z.B. Mahbub, K.R. Islam, M.S. Khan, A. Iqbal, N. Al-Emadi, M.B.I. Reaz, M. T. Islam, "Can AI help in screening Viral and COVID-19 pneumonia?" IEEE Access, Vol. 8, 2020, pp. 132665 - 132676.

[2] Rahman, T., Khandakar, A., Qiblawey, Y., Tahir, A., Kiranyaz, S., Kashem, S.B.A., Islam, M.T., Maadeed, S.A., Zughaier, S.M., Khan, M.S. and Chowdhury, M.E., 2020. Exploring the Effect of Image Enhancement Techniques on COVID-19 Detection using Chest X-ray Images.

[3] J. Read, "A pruned problem transformation method for multi-label classification," in Proc. New Zealand Comput. Sci. Res. Student Conf., 2008, pp. 143–150.

[4] ong W, Agarwal PP. Chest imaging appearance of COVID19 infection. Radiol: Cardiothorac Imaging. 2020 Feb 13;2(1):e200028.

[5] Li Y, Xia L. Coronavirus disease 2019 (COVID-19): role of chest CT in diagnosis and management. American J Roentgenol. 2020 214(6):1280–6.

[6] Abbas A, Abdelsamea MM, Gaber MM. Classifcation of COVID19 in chest X-ray images using DeTraC deep convolutional neural network. Appl Intell. 2021 Feb;51(2):854–64.

[7] Minaee S, Kafeh R, Sonka M, Yazdani S, Souf GJ. Deep-covid: Predicting covid-19 from chest x-ray images using deep transfer learning. Med image Anal. 2020;65:101794