IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.114108

ANALYSIS AND CLASSIFICATION OF COPD USING DEEP LEARNING

Anitha G[1], Abhishek S[2], Amulya A T[3], Arpitha Gowda G D[4], Meghana M[5]

Associate Professor, ISE dept. Bapuji Institute of Engineering and Technology, Davangere-04 , India[1]

ISE dept. Bapuji Institute of Engineering and Technology, Davangere-04, India[2]

ISE dept. Bapuji Institute of Engineering and Technology, Davangere-04, India[3]

ISE dept. Bapuji Institute of Engineering and Technology, Davangere-04, India[4]

ISE dept. Bapuji Institute of Engineering and Technology, Davangere-04, India[5]

Abstract: The Chronic Obstructive Pulmonary Disease Prediction System aims to revolutionize early detection and prognosis through the integration of deep learning and health data analysis using dataset that includes X-Ray obtained from a diverse range of patients. Deep learning algorithms are used together with the integration of data gathered from several hospitals. The prediction model identifies patterns in the data that has been gathered and determines early signs of COPD. The COPD aims to mitigate the impact of this chronic respiratory condition. This project carries significant implications for advancing early identification of COPD using Convolutional Neural Networks (CNNs) and aspires to enhance health care efficiency.

Keywords: COPD classification, X-Ray images, CNN, Deep Learning.

I. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is advancing lung disease characterized by obstructed airflow, leading to breathing difficulties. It is primarily caused by continuous exposure to irritants such as air pollution, dust from work environments, chemicals, and cigarette smoke and involves diseases including emphysema and chronic bronchitis. COPD is a major global health condition that affects millions of people globally and raises significant healthcare expenditures as well as morbidity and mortality. Early detection and diagnosis are essential for effective management and prevention of COPD because the disease is frequently misidentified and left untreated in its early stages. The conventional approach to diagnose COPD is spirometry, which evaluates lung function and clinically analyses symptoms and risk factors. Not all healthcare environments may have easy access to these techniques, especially in positions with minimal resources or during public examinations. With recent advancements in deep learning and machine learning techniques, there has been growing interest in leveraging artificial intelligence (AI) for medical image analysis and disease diagnosis. Another form of deep learning model that has exhibited remarkable performance in a variety of image recognition applications, including medical imaging, is Convolutional Neural Networks (CNNs). The project aims to evolve a deep learning-based system for analysis and classification of COPD from chest X-ray images. By harnessing the power of CNNs and transfer learning, aiming to develop a robust and accurate model capable of automatically identifying signs of COPD in medical images. The ultimate goal is to provide healthcare practitioners with a valuable tool for early COPD screening and diagnosis, potentially improving patient outcomes and reducing the burden on healthcare systems.

II. LITRATURE REVIEW

1. The paper titled **"A 3D-CNN model with CT-based parametric response mapping for classifying COPD subjects", Thao Thi Hol et.al,** presents a detailed and thorough methodology for identifying Chronic Obstructive Pulmonary Disease (COPD) from CT imaging data by leveraging a sophisticated deep 3D convolutional neural network (CNN) model. This approach encompasses various crucial steps, including dataset collection, image registration, the application of parametric response mapping (PRM), the detailed architecture of the 3D CNN model, rigorous training procedures, and meticulous methods for evaluating performance. In an effort to diagnose COPD from CT imaging data obtained from both current and former smokers, as well as individuals without the disease, the study meticulously crafted a deep 3D-CNN model tailored specifically for this purpose.

2. The paper titled **"COPD Classification in CT Images Using a 3D Convolutional Neural Network",** Jalil **Ahmed et.al** presents a condition affecting the lungs that is generally irreversible. Early detection and diagnosis of COPD

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.114108

are crucial factors that can enhance patients' chances of survival and the management of their condition. Spirometry stands as the primary diagnostic tool for identifying COPD, yet computed tomography (CT) scans play a significant role in categorizing COPD subtypes and detecting symptoms like emphysema.Despite the benefits of utilizing multiple imaging modalities for comprehensive evaluation, interpreting the results remains a challenge for healthcare professionals due to inconsistencies among observers. To streamline this process, there is a noteworthy interest in leveraging technology to automatically differentiate between COPD patients and healthy individuals.

3. The paper titled **"An artificial intelligence approach to early predict symptom-based exacerbations of COPD", Miguel Angel Fernandez-Granero et.al** gives an innovative and promising method explored by Fernandez-Granero et al. involves the use of artificial intelligence to predict symptom-based exacerbations in patients suffering from chronic obstructive pulmonary disease (COPD). It is widely recognized that acute exacerbations can significantly impact the overall quality of life for COPD patients and often lead to hospitalization. By accurately predicting exacerbations in advance, this approach seeks to alleviate the negative outcomes associated with exacerbations and reduce the substantial financial burdens that COPD patients face.

4. The paper titled **"Machine Learning Algorithms and Forced Oscillation Measurements for Automated Chronic Obstructive Pulmonary Disease Identification", Jorge L.M. Amaral et.al** conducts an extensive analysis of the integration of forced oscillation measurements with machine learning techniques to automate the diagnosis of COPD. The authors meticulously design experiments and scrutinize the effectiveness of various classifiers, including but not limited to K Nearest Neighbours, Support Vector Machine, Artificial Neural Network, Least Bayesian Network Classifier, and Decision Tree. Their evaluation aims to identify respiratory alterations indicative of COPD in patients. Significantly, the findings underscore the significance of this approach in potentially overcoming the limitations of existing diagnostic methods. The research posits that machine learning algorithms, especially KNN, exhibit promising levels of accuracy, which could enhance the integration of Forced Oscillation Technique into clinical diagnostics.

III. EXISTING SYSTEM

The process of identifying Chronic Obstructive Pulmonary Disease (COPD) includes a wide range of assessment that includes diagnostic tests, medical history, and clinical assessment. While the existing system has been a mainstay in COPD diagnosis, it faces several challenges that warrant consideration:

1. **Subjectivity and Interobserver Variability:** These are introduced during the manual processing of medical images. A comparable collection of photos may be interpreted differently by different medical specialists, which could result in inconsistent diagnoses.
2. **Time-Consuming Process:** Manually analysing medical photos takes a lot of time. Patient care and treatment planning may be impacted by delays in picture interpretation in a healthcare setting where accurate diagnosis is essential.
3. **Limited Sensitivity to Early Changes:** The ability of traditional approaches to recognize the early indicators of COPD may be limited. Manual analysis may miss small variations in medical pictures that could point to early-stage COPD.
4. **Resource Intensive:** For analysing images, the current system needs a large amount of staffing, including qualified doctors or medical personnel. In environments with limited resources, this dependence on human skill could provide difficulties. Considering these challenges, there is an increasing need to investigate and use innovative technology, in particular deep learning, to enhance the effectiveness and precision of COPD diagnosis.

IV. PROPOSED SYSTEM

The proposed method uses deep learning, specifically convolutional neural networks (CNNs), to transform the analysis and classification of Chronic Obstructive Pulmonary Disease (COPD). To guarantee accurate results, the study makes use of X-Ray images from both affected and unaffected patients. The carefully developed architecture is systematically trained to identify complex patterns linked to COPD severity levels, making use of learned features from previously trained models to improve efficiency and avoid over fitting. When compared to human methods, the model's ability to enable automatic image evaluation greatly reduces diagnosis time once it is trained. Therefore, the approach that has been proposed utilizes deep learning to transform COPD diagnosis. Utilizing CNNs that have been trained on a variety of datasets and integrating expert remarks, the model shows impressive effectiveness in identifying patterns associated with COPD and accelerating diagnosis.

The main objectives are:

1. To extract a diverse image dataset from electronic health records, ensuring it encompasses various COPD manifestations.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.114108

2. To standardize and normalize the image datasets.

3. To choose Convolutional Neural Networks (CNNs) for image analysis, train the model on standardized data, and evaluate its performance using dedicated test sets and relevant metrics.

V. METHODOLOGY

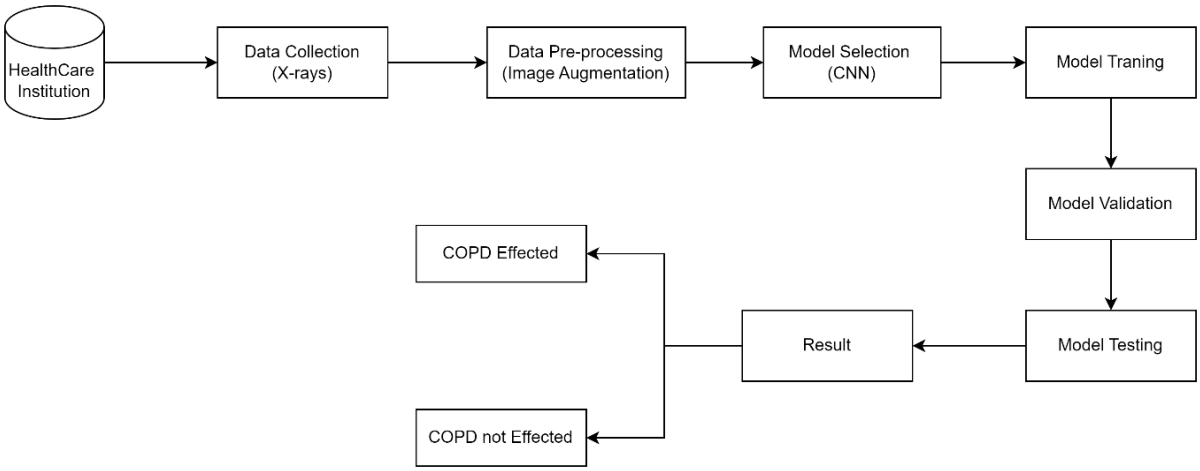

Fig. 1 Methodology of COPD

The implementation of the COPD detection system involves importing essential libraries like TensorFlow and NumPy and defining constants for image processing. Data augmentation techniques are applied to enhance the training dataset, followed by the creation of a CNN model using Conv2D, MaxPooling2D, and Dense layers with Relu activation, along with a dropout layer for regularization. The model is compiled using the Adam optimizer and binary cross-entropy loss function. Training is conducted using the fit() function, and the finalized model is saved for future use. This meticulous process ensures the development of an accurate and reliable system capable of analyzing chest X-ray images for early COPD diagnosis and management.

The Fig.1 serves as a detailed roadmap outlining the key stages involved in a comprehensive machine learning project focused on the classification of patients based on Chronic Obstructive Pulmonary Disease (COPD) using the advanced technology of Convolutional Neural Networks (CNN).

1. **Image Dataset**: The dataset consists of X-Ray images, which are the raw data input for the project. These images are from patients with and without COPD.
2. **Data Pre-processing:** Before feeding the images into the CNN, they undergo pre-processing. This step is crucial for improving the model's performance, as it involves cleaning the data and preparing it in a format suitable for model. This includes resizing images, standardizing pixel values, and augmenting the dataset to increase diversity and avoid over fitting.
3. **Model training and validation**: The pre-processed X-Ray images are used to train the CNN model to recognize patterns associated with COPD. During training, the parameters of the model are adjusted to reduce the difference between the predicted outputs and the true labels. Validation is performed simultaneously using a separate set of images to tune the hyper parameters and ensure the model generalizes well to unseen data.
4. **Model Selection (CNN):** This step involves selecting the most suitable CNN architecture suitable for the task. Different architectures or configurations might be experimented with, and the best-performing one on the validation set is chosen for further testing.
5. **Model testing:** The model is evaluated on a new set of images after it has been trained and verified. This phase is essential for evaluating the model's performance in the real world on data that it hasn't encountered before.
6. **Classification**: The final step is the actual classification where the model chooses a binary decision: whether a patient's image indicates they are affected by COPD or not.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.114108

VI. RESULTS

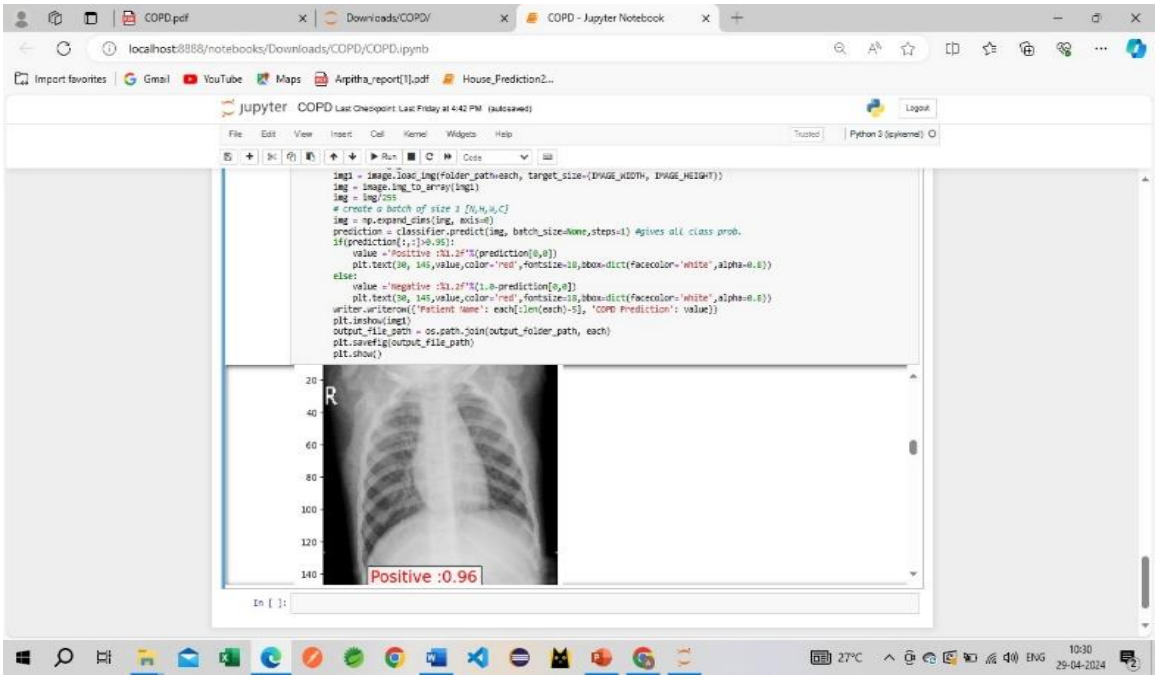

Fig 2 COPD Affected

The Fig.2 indicates that the model has predicted the given X-ray image as COPD positive, indicating that the individual is affected by the condition.

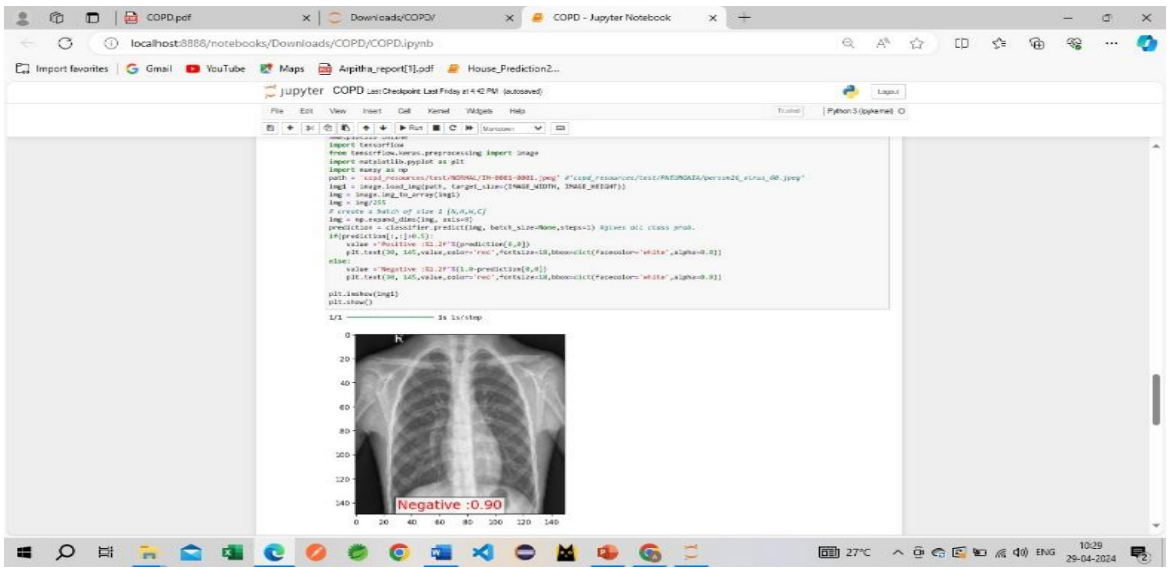

Fig 3 COPD Not Affected

The Fig.6.2 indicates that the model has identified the given X-ray image as negative for COPD, indicating that the individual is not affected by the condition.

VII. CONCLUSION

The project highlights how Convolutional Neural Networks (CNNs) hold promise for accurately diagnosing COPD from chest X-ray images, achieving impressive accuracy through optimized architectures and pre-processing methods. The reliability of approach is underscored by robust evaluation metrics, while interpretability techniques offer valuable insights for healthcare providers. This integration of deep learning and medical imaging offers a compelling pathway toward transforming COPD diagnosis and patient care.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 4, April 2024

DOI: 10.17148/IARJSET.2024.114108

REFERENCES

[1]. Thao Thi Hol et.al ,"A 3D-CNN model with CT-based parametric response mapping for classifying COPD subjects", https://doi.org/10.1038/s41598-020-79336-5, 2021

[2]. Jalil Ahmed et al., "COPD Classification in CT Images Using a 3D Convolutional Neural Network", DOI: 10.1007/978-3-658-29267-6_8, 2020

[3]. Miguel Angel Fernandez-Granero et al., "An artificial intelligence approach to early predict symptom-based exacerbations of COPD", https://doi.org/10.1080/13102818.2018.1437568, 2018

[4]. Jorge L.M. Amaral et al., "Machine Learning Algorithms and Forced Oscillation Measurements for Automated Chronic Obstructive Pulmonary Disease Identification", www.intl.elsevierhealth.com/journals/cmpb, 2011

[5]. Patel J, Burney PG, Newson RB, et al., "Global and regional trends in mortality from chronic obstructive pulmonary disease: their relation to poverty, smoking and population change", 2014; 44(Suppl 58):421.

[6]. Vestbo J, Hurd SS, Agustí AG, et al., "Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary",2013; 187(4):347–365.

[7]. Global Initiative for Chronic Obstructive Lung Disease (GOLD), "Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease", [updated 2015. cited 2016 May 10], http://goldcopd.org/.

[8]. Sanchez-Morillo D, Fernandez-Granero MA, Leon-Jimenez A., "Use of predictive algorithms in-home monitoring of chronic obstructive pulmonary disease and asthma: a systematic review", 2016; 13(3):264–283.

[9]. Effing TW, Kerstjens HA, Monninkhof EM, et al., "Definitions of exacerbations: does it really matter in clinical trials on COPD", 2009; 136:918–923.

[10]. Global Initiative for Chronic Obstructive Lung Disease (GOLD), "Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease", [updated 2015. cited 2016 May 10], http://goldcopd.org/.