



Efficient Disease Classification from Chest X-Rays Using CNN with DenseNet-201

Meesala Ramana; Doddapaneni V Subba Rao

Department of Computer Science and Engineering, SRK Institute of Technology, Vijayawada, Andhra Pradesh, INDIA

Associate Professor, Department of Computer Science and Engineering, SRK Institute of Technology, Vijayawada, Andhra Pradesh, INDIA

ABSTRACT

Chest X-ray (CXR) pictures are essential for the diagnosing various respiratory diseases, but accurate and efficient disease classification remains challenging. This project proposes a novel approach for disease classification from CXR pictures by employing CNN's or Convolutional Neural Networks with sophisticated algorithms including Efficient Net, Resnet, Dense Net, CNN, and VGG. By utilizing these algorithms, our system seeks to enhance the efficiency and accuracy of disease classification, enabling timely diagnosis and treatment planning. Through comprehensive testing and evaluation, we prove that our method is efficient in accurately classifying chest diseases, paving the way for enhanced healthcare diagnostics and patient care.

Indexed Words

Disease Classification, Convolutional Neural Networks, Efficient Net, Resnet, Dense Net, VGG, Mobile Net and Chest X-rays.

1.Introduction

Chest X-rays (CXRs) are essential for the diagnosis of respiratory diseases, offering valuable insights into various pulmonary conditions. However, accurate disease classification from CXR images residual of difficult task due to the complication and subtlety of pathological features. In latest years, Convolutional Neural Networks, or CNN'S have shown to be a useful tool for image classification tasks, revolutionizing medical imaging analysis. In this project, we leverage cutting-edge CNN architectures, including Efficient Net, Resnet, Dense Net, CNN, and VGG, to develop a robust system for disease classification from CXR images. By harnessing the capabilities of these advanced algorithms, we aim to address the pressing need for accurate and efficient disease identification in clinical practice.

Advancements in dl techniques have surfaced the way for important improvements in medical image evaluating, particularly in the field of radiology. CNNs, with their capability to spontaneously learn and extract intricate aspects from images, offer promising solutions for disease classification tasks. Efficient Net, Resnet, Dense Net, CNN, and VGG are among the most widely used CNN architectures, each with unique strengths and capabilities. By incorporating these algorithms into our system, we aim to capitalize on their respective advantages and achieve superior performance in disease classification from CXR images.

The proposed system has enormous potential to completely change how respiratory diseases are diagnosed and treated in clinical settings. By automating the process of disease classification from CXR images, healthcare professionals can streamline diagnostic workflows and expedite treatment planning for patients. Moreover, the utilization of advanced CNN architectures such as Efficient Net and Dense Net ensures that the system is equipped to handle the complexities of CXR images and accurately identify subtle pathological features.

In addition to its clinical applications, the proposed system adds to advancing the area of medical imaging research. By exploring the capabilities of advanced CNN architectures, we aim to deepen our understanding of disease patterns and characteristics present in CXR images. This knowledge can inform future developments in image analysis techniques and pave the way for further innovations in healthcare diagnostics.

Overall, this project represents a significant step forward in disease classification from CXR images using advanced CNN architectures. By harnessing the power of Efficient Net, ResNet, Dense Net, CNN, and VGG, we strive to develop a robust and reliable system that offers accurate and efficient disease identification, ultimately enhancing patient results and improving the quality of healthcare delivery.

2.Literature Survey

S.No	Title	Authors	Method used
1.	Utilization of Deep Convolutional Neural Networks for Accurate Chest X-Ray Diagnosis and Disease Detection.	Mukesh Mann et al.,	Deep Convolutional Neural Networks (CNNs), including DenseNet121, ResNet50, and EfficientNetB1, are utilized to automate accurate chest X-ray diagnosis and disease detection
2.	CXray-EffDet: Chest Disease Detection and Classification from X-ray Images Using the EfficientDet Model.	Marriam Nawaz et al.,	utilizing the EfficientDet model for detecting and classifying chest diseases from X-ray images in the project CXray-EffDet.
3.	Chest Diseases Classification Using CXR and Deep Ensemble Learning.	Adnane Ait Nasser et al.,	Involves employing deep ensemble learning for classifying chest diseases using chest X-ray (CXR) images.
4	Deep Learning-Based Classification of Chest Diseases Using X-rays, CT scans, and Cough Sound Images	Hassaan Malik et al.,	Utilizing deep learning to classify chest diseases by integrating X-ray images, CT scans, and cough sound images.

5.	Deep Learning Methods for Chest Disease Detection Using Radiography Images.	Adnane Ait Nasser et al.,	Utilizing deep learning to classify chest diseases by integrating X-ray images, CT scans, and cough sound images.
6.	Anatomy-XNet: An Anatomy Aware Convolutional Neural Network for Thoracic Disease Classification in Chest X-Rays	Uday Kama et al.,	Anatomy-XNet utilizes anatomical knowledge to guide spatial feature prioritization in thoracic disease classification from chest X-rays.
7.	Complexity and Robustness Trade-Off for Traditional and Deep Models	Aijaz Ahmad Reshi et al.,	Examines the trade-off between complexity and robustness in both traditional and deep models

3.Existing System:

In the existing system for disease classification from chest X-rays, traditional machine learning algorithms or simpler deep learning architectures may be employed. These methods often lack the capacity to effectively capture complex patterns and features present in chest X-ray images, leading to suboptimal performance in disease classification tasks. Additionally, the existing system may rely heavily on manual feature engineering, which can be time-consuming and may not fully exploit the rich information available in the images.

Drawback of Existing System:

To overcome this, we have proposed a system that introduces a more advanced approach for disease classification using state-of-the-art deep learning architectures such as Efficient Net, Dense Net, VGG, ResNet, and custom CNN architectures. By leveraging these powerful algorithms, the proposed system aims to significantly improve the accuracy and efficiency of disease classification from chest X-ray images. Efficient Net and Dense Net algorithms, known for their ability to efficiently handle complex data and capture intricate features, will be at the core of the proposed system. Moreover, the inclusion of VGG and ResNet architectures along with custom CNN models enhances the versatility and robustness of the system.

4.Proposed System:

The proposed system will also leverage transfer learning techniques to fine-tune pre-trained models on chest X-ray datasets, thereby accelerating the training process and improving model performance. By harnessing the capabilities of deep learning algorithms, the proposed system automates feature extraction and classification, eliminating the need for manual feature engineering and enabling more accurate and reliable disease classification.

Overall, the proposed system represents a significant advancement over the existing methods by employing state-of-the-art deep learning algorithms and techniques to achieve superior performance in disease classification from chest X-ray images.

4.1 ALGORITHMS

Here in this project, we are focusing on accuracy and Efficiency for this we are using Convolutional Neural Network (CNN), Efficient Net, ResNet, Dense Net-201, Visual Geometry Group (VGG) and Mobile Net.

a) Convolutional Neural Network (CNN):

A Convolutional Neural Network (CNN) is a type of dl model specifically designed for processing structured grid data, such as images or videos. It utilizes convolutional layers to extract hierarchical features from input data, and pooling layers to reduce dimensionality and increase computational efficiency. CNNs are widely used in computer vision tasks, such as image classification, object detection, and image segmentation. They can automatically learn and adapt to complex patterns and variations within the data, making them powerful tools for image analysis and recognition tasks.

b) Efficient Net:

Efficient Net is a deep learning model that has achieved state-of-the-art performance on various image recognition tasks while being computationally efficient. It achieves this by scaling the model depth, width, and resolution with a compound scaling coefficient. This allows Efficient Net to achieve higher accuracy with lower computational costs compared to other models.

c) ResNet:

ResNet (short for Residual Network) is a deep learning neural network architecture that revolutionized image classification tasks with residual blocks. By introducing skip connections that allow the network to bypass certain layers, ResNet was able to address the problem of vanishing gradients and enable training of much deeper neural networks. The design of ResNet has been widely adopted in various applications and has led to significant advances in the field of computer vision.

d) Dense Net-201:

Dense-201 is a pre-trained deep learning model developed by Google as part of the TensorFlow library. It is designed for image classification tasks and consists of 201 layers of densely connected neural network units. This model has been trained on a large dataset of images to achieve high accuracy in identifying various objects and patterns within images.

e) VGG:

VGG (Visual Geometry Group) model is a convolutional neural network architecture that is widely used for image classification tasks. It consists of multiple convolutional and pooling layers, followed by fully connected layers for feature extraction and classification. VGG models are known for their simplicity and effectiveness in learning intricate patterns in images.

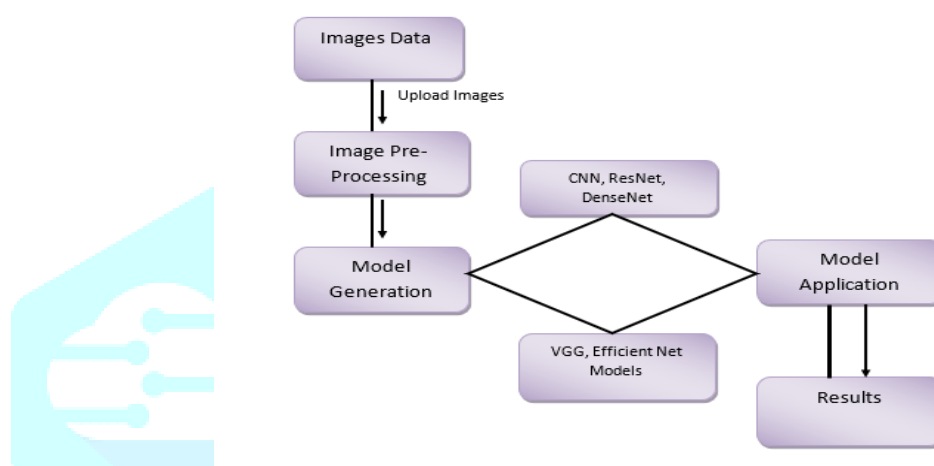
f) Mobile Net V2:

MobileNet V2 is a neural network architecture that is designed for mobile and edge devices with limited computational resources. It is an improved version of the original MobileNet architecture, with better performance and efficiency. MobileNet V2 utilizes depth wise separable convolutions and linear bottlenecks to reduce the number of parameters while maintaining high accuracy.

5. Methodology:

The research involves analyzing a dataset comprising 1640 Chest X-Ray images, with 613 reserved for testing, 72 for validation, and 315 for training. These images are classified into 4 distinct groups of chest diseases. Various models such as CNN, Resnet, Dense net, efficient net, and VGG were employed to train and assess their performance in accurately diagnosing the conditions. Image data is first inputted into the system and then preprocessed before being uploaded into the application. The deep learning algorithms including CNN, Dense net, Resnet, VGG, and Mobile net models are then utilized to analyze the images for training and testing to ensure accurate results.

6. Flow Chart:



7. OUTPUT OF EFFICIENT DISEASE CLASSIFICATION:

In this screenshot we have shown the efficient classification phase shows an example of disease that is classification as disease in the result.

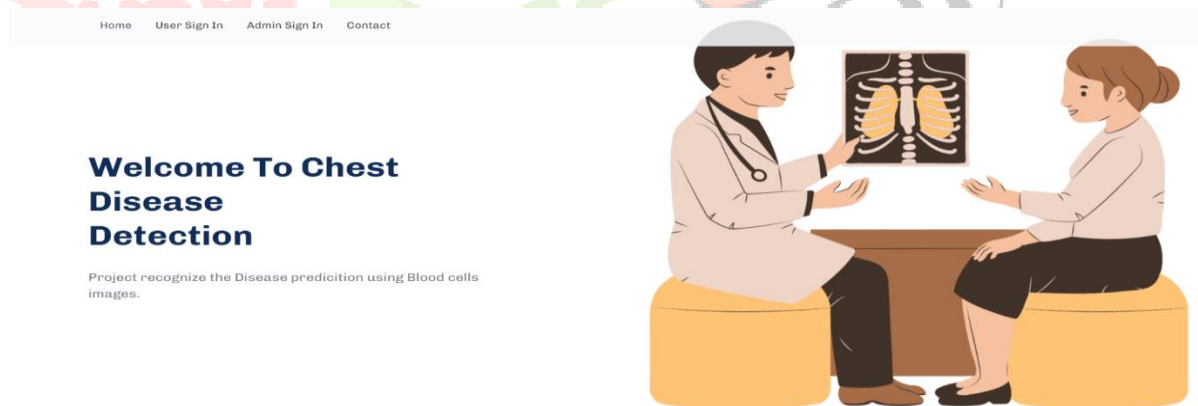


Figure 7.1: Home Page of the Project

New User

Enter Username:

abc

Enter Password1:

Enter Password2:

Enter Email:

abc@gmail.com

Enter PhoneNo:

1234567890

submit

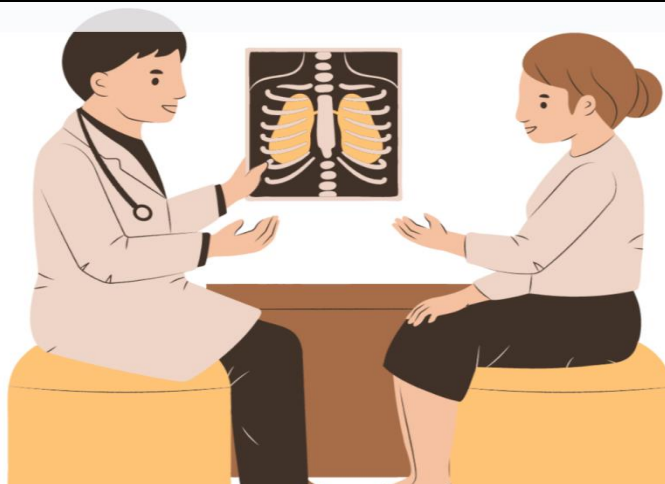
[Sign In](#)

Figure 7.2: New User Login

Admin Login

admin

submit

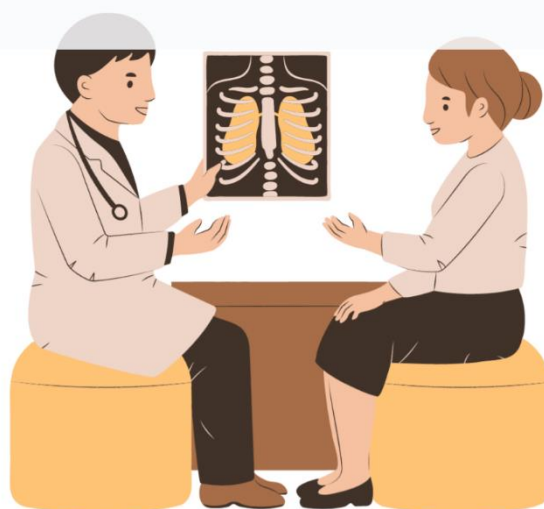


Figure 7.3: Admin Login

Welcome To Admin Page

To Activate New User, Follow below steps.

1. **Step 1:** Go to User Details Tab in Nav Bar
2. **Step 2:** Check Activate New User Table
3. **Step 3:** In Active Column - Check New User Row With Name
4. **Step 4:** In Active Column - Click Activate
5. **Step 5:** Check It Turns to Activated



Figure 7.4: Admin Home Page

To login to the admin page and click on the user details then activate your login credentials.

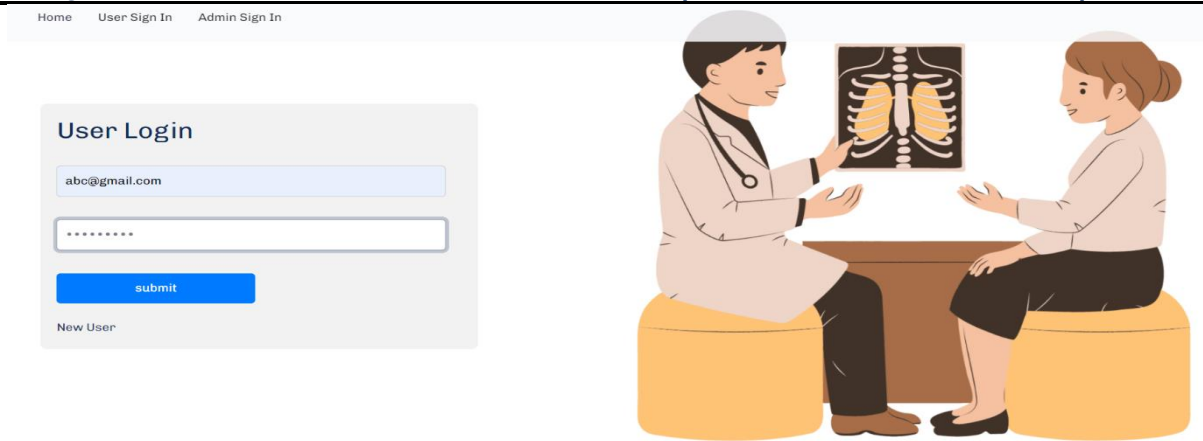


Figure 7.5: User Login

Then that user gets sign in using his mail and password to that log in page visible in the above figure.



Figure 7.6: User Home Page



Figure 7.7: Giving Input Data for Processing



Figure 7.8: Predicting Model

Table 1: Comparison of accuracy using various Algorithms

Algorithm Name	Training Accuracy	Testing Accuracy
Dense Net-201	85.3	94.4
Mobile Net(V2)	75	83.3
ResNet	73	84
Efficient Net	67	76

8.Conclusion:

The project represents the utilization of Convolutional Neural Networks (CNNs) with Efficient Net and Dense Net architectures for disease classification from chest X-rays has demonstrated significant promise in enhancing diagnostic accuracy and efficiency. The comparative analysis revealed varying degrees of performance across different CNN models, with DensetNet-201 achieving the highest accuracy at 94%, closely followed by VGG, ResNet, CNN, MobileNetV2, Efficient Net, and Dense Net. These results highlight the potential of dl algorithms to automate disease diagnosis from medical images, paving the way for more efficient and reliable healthcare practices

The effective use of CNNs for disease classification from chest X-rays ultimately marks a substantial advancement in the field of more precise and effective medical diagnosis. When deep learning is used effectively, healthcare providers can experience enhanced decision support tools that enhance patient care and contribute to better health outcomes. As advancements in technology continue to evolve, the potential for deep learning algorithms to revolutionize medical imaging and disease diagnosis remains promising, ushering in a new era of precision medicine and personalized healthcare.

Future Scope

- **Algorithm Optimization:** Further fine-tuning of CNN architectures and hyperparameters could lead to improved classification performance. Exploring novel architectures or optimization techniques may improve the accuracy and efficiency of disease detection, potentially surpassing the current performance benchmarks.
- **Data Augmentation and Expansion:** Expanding the diversity and quantity of the training dataset through advanced data augmentation methods can help CNN models generalize better to unseen data and improve robustness.
- **Ensemble Learning:** Testing the ensemble learning mechanisms by integrating predictions from different CNN algorithms could leverage the strengths of different architectures and improve overall classification accuracy.
- **Integration of Multi-Modal Information:** Integrating additional modalities, such as clinical data, patient history, or genetic information, with chest X-ray images, can provide a more holistic view of a patient's health condition.
- **Clinical Validation and Deployment:** Conducting rigorous clinical validation studies to assess the real-world effectiveness and reliability of CNN models is crucial before deployment in clinical settings. **Interpretability and Explainability:** Gaining the confidence and approval of medical experts requires improving CNN models' interpretability and explainability. Developing methods to

provide meaningful explanations for model predictions, such as attention maps or saliency techniques, can help clinicians understand the underlying features driving the classification decision

REFERENCES

- [1] Mukesh Mann, Rakesh P. Badoni, Harsh Soni, Mohammed Al-Shehri, Aman Chandra Kaushik & Dong-Qing Wei. Utilization of Deep Convolutional Neural Networks for Accurate Chest X-Ray Diagnosis and Disease Detection. <https://doi.org/10.1007/s12539-023-00562-2>.
- [2] Marriam Nawaz, Tahira Nazir, Jamel Baili, Muhammad Attique Khan, Ye Jin Kim and Jae-Hyuk Cha. CXray-EffDet: Chest Disease Detection and Classification from X-ray Images Using the EfficientDet Model. 10.3390/diagnostics13020248.
- [3] Adnane Ait Nasser, Author Picture Moulay A. Akhloufi. Chest Diseases Classification Using CXR and Deep Ensemble Learning. <https://doi.org/10.1145/3549555.3549581>.
- [4] Hassaan Malik, Tayyaba Anees, Ahmad Sami Al-Shamayleh, Salman Z. Alharthi, Wajeeha Khalil and Adnan Akhunzada. Deep Learning-Based Classification of Chest Diseases Using X-rays, CT scans, and Cough Sound Images. 10.3390/diagnostics13172772.
- [5] Adnane Ait Nasser & Moulay A. Akhloufi. Deep Learning Methods for Chest Disease Detection Using Radiography Images. 10.1007/s42979-023-01818-w.
- [6] Min Jae Cha, Myung Jin Chung, Jeong Hyun Lee, and Kyung Soo Lee. 2019. Performance of Deep Learning Model in Detecting Operable Lung Cancer with Chest Radiographs. *Journal of thoracic imaging* 34, 2 (2019), 86–91.
- [7] Marc-André Blais and Moulay A Akhloufi. 2021. Deep Learning and Binary Relevance Classification of Multiple Diseases using Chest X-Ray images. In 43rd Annual International Conference of the IEEE Engineering in Medicine Biology Society (EMBC). 2794–2797.
- [8] Steven Horng, Ruizhi Liao, Xin Wang, Sandeep Dalal, Polina Golland, and Seth J Berkowitz. 2021. Deep learning to quantify pulmonary edema in chest radiographs. *Radiology: Artificial Intelligence* 3, 2 (2021), e190228.
- [9] Septy Aminatul Khoiriyah, Arif Basofi, and Arna Fariza. 2020. Convolutional Neural Network for Automatic Pneumonia Detection in Chest Radiography. In 2020 International Electronics Symposium (IES). 476–480.
- [10] Hongyu Wang and Yong Xia. 2018. Chestnet: A deep neural network for classification of thoracic diseases on chest radiography. arXiv preprint arXiv:1807.03058(2018).