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Lung Cancer Prediction Using CNN and Transfer Learning

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Abstract: *One of the leading causes of cancer-associated death globally is lung cancer Effective therapy for different subtypes of lung cancer depends on early and precise diagnosis. A convolutional neural network (CNN)-based method for classifying several forms of lung cancer, such as adenocarcinoma, big cell carcinoma, squamous cell carcinoma, and normal lung tissues, is presented in this research. The model makes use of the Inception architecture, which was pretrained on ImageNet before a custom classification layer was added. There are 323 validation photos and 613 training images spread over four classes in the dataset. To increase model generality, image data augmentation methods including rescaling and horizontal flipping were used. During training, the final model's validation accuracy was over 70%. In order to minimize learning rate and avoid overfitting, early halting was employed to maximize training efficiency. The suggested approach shows promise for accurately and automatically classifying different forms of lung cancer, laying the groundwork for next clinical decision support systems.*

Keywords: Lung Cancer, Medical Imaging, Transfer learning, deep learning, CNN, Neural Network.

I. INTRODUCTION

Lung cancer continues to be one of the most common and deadliest types of cancer in the world, contributing significantly to the annual death toll from cancer. Because cancer that is detected early may frequently be treated more successfully, early detection is essential to increasing survival rates. But classifying lung cancers into subtypes including adenocarcinoma, squamous cell carcinoma, and big cell carcinoma necessitates a thorough examination of medical imaging, which takes time and varies among radiologists.Convolutional neural networks (CNNs), one of the most recent developments in deep learning, have demonstrated significant promise for automating image categorization tasks in the medical domain. CNNs can accurately discriminate between various tissue types and disorders by learning hierarchical characteristics from medical images. By using this capacity to detect lung cancer, radiologists will be able to diagnose patients more consistently and accurately, which could result in earlier diagnosis and better patient outcomes. In this work, we suggest a CNN-based method for leveraging medical pictures to classify lung cancer into several subgroups. The suggested approach makes use of the Xception architecture, a deep learning model that has been customized for the particular job of classifying lung cancer subtypes and pre-trained on the ImageNet dataset. With transfer learning, even with sparse medical picture data, we can take advantage of the pre-trained model's rich feature extraction capabilities to greatly improve classification job performance.

In order to decrease overfitting and increase the diversity of the training data, our method also includes data augmentation approaches. The results show the potential of deep learning for precise and automated categorization of lung cancer subtypes. The model is tested on a dataset of tagged photos of the disease. The goal of this project is to aid in the creation of clinical decision support systems that will aid in the early diagnosis and management of lung cancer.

II. PROBLEM STATEMENT

Lung cancer remains one of the leading causes of cancer-related deaths worldwide, with early detection being critical to improving survival rates. Current diagnostic methods rely heavily on radiological imaging, which is time-intensive and subject to variability in interpretation among radiologists. There is a growing need for automated, accurate, and

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efficient tools to assist in the early and precise classification of lung cancer subtypes, including adenocarcinoma, squamous cell carcinoma, large cell carcinoma, and normal lung tissue.

III. LITERATURE SURVEY

Abhishek Kumar Murgunde, "Lung Cancer Detection using **CNN",**This study develops a Convolutional Neural Network (CNN)-based model to detect lung cancer from CT scan images. The authors aim to improve the accuracy and speed of lung cancer diagnosis by automating the detection process. The research demonstrates the effectiveness of CNNs in image recognition tasks and highlights the model's ability to classify various lung cancer types. The study achieves significant accuracy and suggests that AI-based solutions could streamline the diagnostic process by reducing human error and manual labor [1].

P Rajesh, M Harinath Reddy , P Chandana, “Lung Cancer Detection Using Transfer Learning”,This paper explores the use of transfer learning to detect lung cancer from CT scans. By utilizing pre-trained models, the authors manage to reduce the training time and computational resources required for lung cancer classification. Their transfer learning-based approach enables the model to adapt to new datasets while retaining high accuracy. The research emphasizes the practicality of using transfer learning in medical applications, especially where data availability and computational power are constrained [2].

Tehnan I. A. Mohamed et al."Automatic detection and classification of lung cancer CT scans based on deep learning",This study focuses on automating lung cancer detection using deep learning. The researchers developed a deep learning model capable of detecting and classifying lung cancer types from CT images. The paper emphasizes the model's ability to differentiate between malignant and benign tumors efficiently. The results demonstrate improved diagnostic accuracy and faster analysis time, showcasing the potential of deep learning in medical diagnostics and its ability to assist radiologists by minimizing errors [3].

M. Mohamed Musthafa et al. "Optimizing double-layered CNNs for efficient lung cancer classification",This research introduces a double-layered CNN model optimized for lung cancer detection through hyperparameter tuning and advanced image preprocessing techniques. The authors focus on improving classification performance by enhancing model architecture and optimizing training processes. The study achieves a notable increase in accuracy compared to conventional methods. By emphasizing hyperparameter optimization, this research contributes to the development of highly efficient deep learning models for clinical use [4].

Krishnamoorthy Natarajan et al."A novel method for the detection and classification of multiple diseases using transfer learning-based deep learning techniques",This paper extends the application of transfer learning to the detection and classification of multiple diseases, including lung cancer. The research highlights the effectiveness of deep learning combined with transfer learning in improving diagnostic accuracy across diverse medical conditions. The authors argue that leveraging pre-trained models can significantly enhance performance without requiring large datasets, making the method applicable in various clinical settings with minimal computational effort [5].

IV. PROPOSED SYSTEM

The Figure 1 illustrates the workflow of a lung cancer detection system using deep learning techniques. A lung CT scan picture is uploaded by the user to start the procedure, and this image is used as the system's input.The image first undergoes data preprocessing, including resizing, normalization, and noise reduction, to ensure it is suitable for analysis. The preprocessed image is then fed into a deep learning framework that incorporates Convolutional Neural Networks (CNNs) and the InceptionV3 architecture. These models work together to extract critical features from the image and identify patterns associated with lung cancer.The system first determines whether the uploaded image indicates the presence of lung cancer. If no cancer is detected, the process ends here. However, if cancer is identified, the system proceeds to classify it into one of three specific subtypes: adenocarcinoma, large cell carcinoma, or squamous cell carcinoma. This automated approach provides accurate and efficient detection, assisting radiologists and healthcare professionals in diagnosing lung cancer and its subtypes, ultimately contributing to improved patient outcomes through early and precise detection.

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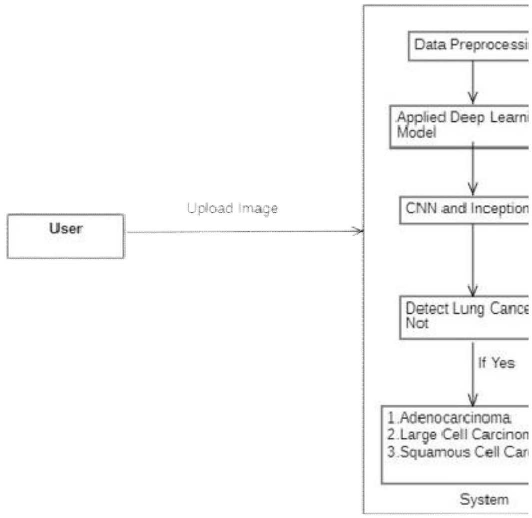

Figure 1: System Architecture

V. ALGORITHM

5.1 CNN (Convolution Neural Network)

Convolutional Neural Networks (CNNs) are advanced deep learning architectures widely recognized for their effectiveness in image recognition tasks, particularly in medical imaging applications such as lung cancer detection. This research utilizes CNNs to classify lung cancer subtypes, including adenocarcinoma, squamous cell carcinoma, large cell carcinoma, and normal lung tissue, from CT scan images. CNNs operate by learning hierarchical features directly from input images through convolutional layers, which extract critical patterns like edges, textures, and shapes. Pooling layers reduce spatial dimensions while retaining essential features, enhancing computational efficiency. Fully connected layers at the network's end map these learned features to output classes, employing activation functions such as softmax for multi-class classification.

To address the limitations of small and imbalanced medical datasets, this study integrates transfer learning using the InceptionV3 architecture pre-trained on ImageNet. This approach leverages the robust feature extraction capabilities of InceptionV3 while fine-tuning the model for lung cancer classification. Data augmentation techniques, including rescaling and horizontal flipping, are applied to enhance model generalizability and mitigate overfitting. The proposed methodology incorporates global average pooling, custom dense layers, and techniques like early stopping, learning rate reduction, and dropout regularization to optimize performance. The model achieved high accuracy during training and evaluation, demonstrating its potential to support radiologists by providing consistent, automated, and accurate lung cancer subtype classification. This work lays the foundation for developing advanced clinical decision support systems, aiming to improve early detection and patient outcomes.

5.2 Transfer Learning

A machine learning method called transfer learning uses information from one task to enhance performance on a related activity. It is particularly useful in deep learning, where training large models from scratch can be resource-intensive and time-consuming. Instead of starting from zero, transfer learning allows practitioners to build upon pre-trained models, which have already learned valuable features from vast amounts of data.In the field of medical image processing, transfer learning models are important. Histopathology slides, CT scans, MRIs, X-rays, and other medical imaging technologies provide enormous volumes of visual data that need to be accurately and quickly analyzed. To address medical image processing challenges, transfer learning makes it possible to use pre-trained models that have been trained on sizable datasets from a variety of domains, including natural pictures.

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VI. CONCLUSION

This study demonstrates the effectiveness of Convolutional Neural Networks (CNNs) in detecting lung cancer from medical images. The model successfully learned patterns from the data, showing a decreasing trend in training loss. However, the fluctuations in validation loss indicate overfitting, Which suggests that the model's ability to generalize to new, unseen data is limited. Despite this, the model's performance on the training data validates the potential of deep learning techniques in medical image analysis, particularly for lung cancer detection. With further improvements, CNNs can serve as a valuable tool for aiding healthcare professionals in early diagnosis, ultimately improving patient outcomes.

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