Lung Cancer Detection Using Convolutional Neural Network (CNN)

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***Abstract*— Lung cancer is a major cause of death globally, often due to delayed or inaccurate diagnosis. Traditional methods rely on manual image analysis, which is time-consuming and prone to human error. This project proposes an automated lung cancer detection system using Convolutional Neural Networks (CNNs) and transfer learning to improve diagnostic accuracy and speed. The system classifies CT and X-ray images into four categories: Normal, Adenocarcinoma, Large Cell Carcinoma, and Squamous Cell Carcinoma. A Raspberry Pi–based web platform enables users to upload medical images and receive real-time predictions. This approach reduces human effort, supports healthcare professionals, and ensures faster, more reliable diagnoses. It offers a scalable and efficient solution to enhance early detection and improve patient outcomes.**

***Index Terms*— lung cancer detection, convolutional neural network (CNN), medical imaging, transfer learning, deep learning, classification, automated diagnosis, CT scan, X-ray analysis, healthcare AI.**

I. INTRODUCTION

Traditional lung cancer diagnosis lacked automation, resulting in delays, human error, and inconsistent outcomes. As the demand for early and accurate detection grew, especially with the rise in cancer-related deaths, the need for advanced diagnostic systems became evident. Conventional methods, heavily reliant on manual analysis of CT and X-ray images, posed challenges in scalability and precision. This gap highlighted the importance of integrating intelligent systems capable of automating the diagnosis process and assisting overburdened healthcare infrastructures.

To address these challenges, we propose an AI-powered Lung Cancer Detection System using Convolutional Neural Networks (CNNs) and transfer learning. The system analyzes medical images to classify lung conditions into categories such as Normal, Adenocarcinoma, Large Cell Carcinoma, and Squamous Cell Carcinoma. By incorporating pre-trained CNN models and advanced image preprocessing, the solution enhances accuracy while reducing the time and effort required for diagnosis. The model is deployed through a web platform that allows users to upload medical scans and receive real-time predictions.

This solution is developed to automate the early detection of lung cancer, reducing the burden on radiologists and enabling timely medical intervention. The system supports hospitals, telemedicine, and research institutions with a user-friendly interface and robust backend processing. By combining deep learning with healthcare, it offers a reliable, scalable, and efficient diagnostic tool that promotes better patient outcomes and contributes to reducing global lung cancer mortality rates.

II. LITERATURE REVIEW

Research has explored the application of deep learning models like Convolutional Neural Networks (CNNs) and vision transformers to enhance diagnostic accuracy in lung cancer detection. Studies utilizing datasets such as LIDC and LUNA16 demonstrate improved sensitivity and specificity compared to traditional methods. However, while these approaches show promise in automating medical image analysis, they face limitations related to dataset quality, generalization across populations, and lack of integration with clinical metadata. This underscores the need for explainable AI and broader validation to ensure clinical adoption.

Another approach combines gene expression data with Weighted CNNs, integrating optimization techniques like Z-score normalization and Levy flight cuckoo search. This method achieves high accuracy in detecting lung cancer but introduces challenges such as high computational complexity and limited testing across diverse datasets. The study showcases the potential of genomic data in improving diagnostic outcomes while also emphasizing scalability concerns..

Further research focuses on preprocessing techniques and feature extraction to improve CT image clarity and nodule identification. Techniques such as noise reduction and contrast enhancement, combined with CNN-based classifiers, demonstrate effective lung cancer detection. Yet, the absence of standardized imaging protocols and annotated datasets continues to hinder real-world deployment. The findings advocate for the integration of multimodal imaging and robust AI models to overcome these limitations.

III. METHODOLOGY

This project integrates deep learning and medical imaging to enable automated lung cancer detection. CT scan images of lungs are collected and undergo preprocessing to enhance image quality and standardize input formats. These processed images are then used to train and test a Convolutional Neural Network (CNN) model. The CNN performs feature extraction, identifying patterns and abnormalities associated with lung cancer. Based on the extracted features, the system classifies the lungs as either cancerous ("Yes") or non-cancerous ("No"). This streamlined pipeline ensures accurate, efficient, and early diagnosis, supporting faster clinical decision-making and reducing human error in traditional analysis.

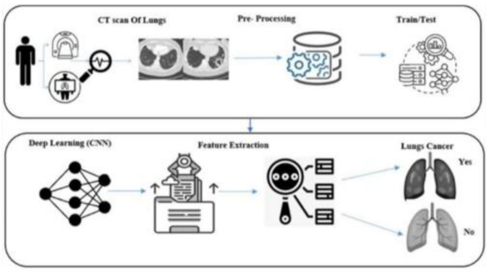

Fig 1: Block Diagram Representing Lung Cancer Detection System

IV. RESULT AND DISCUSSION

The outcomes of the Lung Cancer Detection System using deep learning and AI are elaborated in this section. By leveraging advanced image processing and CNN-based classification, the system successfully identifies lung cancer types and aids in early diagnosis. The integration of Flask ensures user-friendly interactions, while the trained model achieves accurate predictions. The results highlight the system's ability to support healthcare professionals in efficient and reliable lung cancer diagnosis.
The system's capabilities include:

DIAGNOSTIC ACCURACY RESULTS: Deep learning and transfer learning techniques significantly enhanced lung cancer detection accuracy. The model effectively classified CT and X-ray images into four categories: normal, adenocarcinoma, large cell carcinoma, and squamous cell carcinoma. It provided real-time predictions, offering timely diagnostic support to healthcare professionals. Dynamic preprocessing managed variations in image quality, ensuring reliable outcomes. This system improves both the speed and precision of lung cancer diagnosis.
Classification Logs: The system records detailed logs of image diagnoses, enabling users to track model performance and diagnostic trends over time..
Visualization Features:The platform offers graphical representations of prediction results and model metrics, highlighting the accuracy and reliability of the lung cancer detection system.

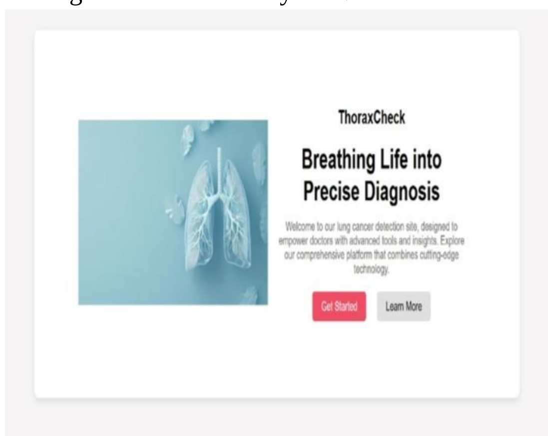

Figure 2: Depicts the output interface for the Start page when the system is launched.

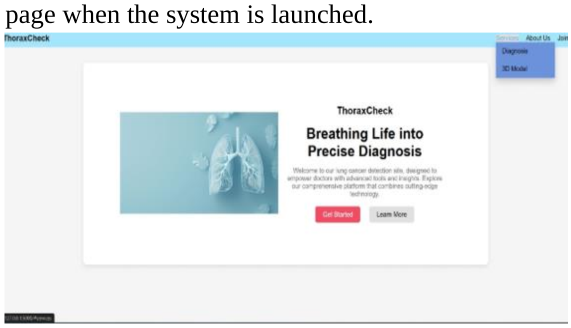

Figure 3: Depicts the output interface where user can check Diagnosis and 3D Model.

Figure 4: Depicts the output interface when user brows to upload image.

Figure 5: Depicts the output of the uploaded image (Classified the type of Cancer).

IV. CONCLUSION

The Lung Cancer Detection System offers an innovative solution by combining deep learning and medical imaging to enable early and accurate diagnosis. Unlike traditional manual analysis, which is time-consuming and prone to errors, this automated system efficiently classifies lung cancer types from CT and X-ray images, reducing diagnostic delays and improving precision. Its scalable design supports deployment in hospitals, telemedicine, and research centers, facilitating widespread access to reliable diagnostics. By enhancing early detection and supporting healthcare professionals, the system contributes to better patient outcomes, advancing cancer care and improving survival rates globally.

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