Journal of Computer and Electrical Sciences (JCES)- Volume-1 Issue-4, April 2026
ISSN: 3049-2602

LUNG CANCER DETECTION

Hemadri Satya Krishna Venkata Narayana.Namburu[1],

Dr. K. Sireesha[2]

[1]Student, Department of Computer Science and Engineering

Andhra Loyola Institute of Engineering and Technology, Vijayawada, Andhra Pradesh, India
[2]Associate Professor, Department of Computer Science and Engineering
Andhra Loyola Institute of Engineering and Technology, Vijayawada, Andhra Pradesh, India
Email id: hemadrisatyanamburu014@gmail.com

Abstract: *Lung Cancer Detection is a web-based clinical decision-support prototype developed to facilitate the analysis of lung computed tomography (CT) scans. The system employs a Flask-based backend to handle input validation, patient metadata management, and secure storage of uploaded medical images in PNG or JPG formats (≤16 MB), while a pretrained EfficientNet-B0 deep learning model performs automated classification across four diagnostic categories: adenocarcinoma, large-cell carcinoma, squamous-cell carcinoma, and normal tissue, generating confidence-scored predictions. To enhance interpretability for non-expert users, the system augments predictions with heuristic indicators related to disease stage, risk level, and estimated survival, and supports visual explainability through heatmap overlays that highlight regions of interest within CT images. Results are presented via a clinician-oriented user interface designed for clarity and usability, with an additional feature enabling the generation of structured PDF reports containing patient information, diagnostic summaries, wellness recommendations, and side-by-side comparisons of original and heatmap images. Overall, the system provides a complete end-to-end workflow—from image upload to report generation—while maintaining a modular architecture that separates inference, visualization, and reporting components, making it suitable for academic research, demonstrations, and investigational clinical workflows.*

Keywords: Lung Cancer Detection, Computed Tomography (CT), Deep Learning, EfficientNet-B0, Medical Image Classification, Clinical Decision Support System, Flask Web Application, Image Processing, Explainable AI (XAI), Heatmap Visualization, Diagnostic Prediction, Healthcare Informatics, Computer-Aided Diagnosis (CAD), Medical Imaging, PDF Reporting System

1. INTRODUCTION

Lung cancer is one of the most severe and life-threatening diseases globally, characterized by the uncontrolled growth of abnormal cells in the lungs that form tumors. A major challenge in reducing mortality is that the disease is often diagnosed at an advanced stage, significantly lowering the chances of successful treatment and survival. Early detection plays a crucial role in improving patient outcomes; however, conventional diagnostic methods such as analyzing Computed Tomography (CT) scan images are time-consuming and require high precision. In many cases, subtle abnormalities in medical images may be overlooked due to human limitations, especially when large volumes of data must be examined.

Recent advancements in Artificial Intelligence (AI) and Deep Learning have introduced powerful solutions to address these challenges in medical imaging. By leveraging large datasets of annotated CT scan images,

deep learning models can be trained to recognize complex patterns associated with lung cancer. These models are capable of automatically analyzing new medical images with high accuracy and speed, thereby assisting healthcare professionals in making more informed decisions. The integration of AI into diagnostic processes not only enhances efficiency but also reduces the likelihood of human error, ultimately contributing to improved reliability in disease detection.

This project proposes an AI-Based Lung Cancer Detection System designed to support early diagnosis using CT scan images. The system is implemented through a user-friendly web application that enables users to upload lung scan images for analysis. A trained deep learning model processes the input image and predicts whether the lung is normal or cancerous. Additionally, the system generates a heatmap to highlight critical regions of interest and provides supplementary outputs such as confidence scores, estimated stage, and risk level. The primary objective of this project is to assist medical professionals by offering a fast, accurate, and efficient tool for early detection, thereby improving clinical outcomes and supporting better patient care.

2. LITERATURE SURVEY

Lung cancer is one of the most common and deadly diseases worldwide. Early detection plays an important role in improving the survival rate of patients. Medical imaging techniques such as Computed Tomography (CT) scans are widely used to detect lung abnormalities and tumors. However, manual examination of CT scan images by radiologists can be time-consuming and difficult because lung nodules vary in shape, size, and location. This has led researchers to develop computer-aided diagnosis (CAD) systems that help doctors detect lung cancer more efficiently.

Many research studies have focused on using deep learning techniques for lung cancer detection. Convolutional Neural Networks (CNNs) are widely used because they can automatically extract important features from medical images. Several models such as VGG16, VGG19, and Inception networks have been applied to CT scan images to classify lung tumors. These models have achieved high accuracy rates in detecting cancerous and non-cancerous lung images, demonstrating the effectiveness of deep learning in medical image analysis.

Researchers have also proposed advanced deep learning frameworks to improve detection accuracy. For example, a hybrid system combining deep learning and support vector machines (SVM) has been used to analyze lung CT images. In one study, the model was trained using annotated CT scan datasets and achieved around 94% accuracy in detecting pulmonary nodules, which are early signs of lung cancer. This shows that combining deep learning with traditional machine learning techniques can improve diagnostic performance.

Another important research area focuses on improving lung cancer screening using large datasets of CT scans. A deep learning approach called DeepScreener was developed to analyze CT images and predict the presence of lung cancer. The system was trained using thousands of CT scan images and demonstrated promising performance in identifying cancer cases while reducing false positive results. Such systems show the potential of AI in assisting doctors during large-scale cancer screening programs

Recent studies have also introduced explainable AI methods to improve the transparency of lung cancer detection models. Techniques such as Grad-CAM heatmaps are used to highlight the regions of CT scans that influence the model's predictions. This helps doctors understand how the AI system makes decisions and increases trust in automated diagnosis systems. Research shows that combining deep learning models with visualization techniques can improve both accuracy and interpretability in lung cancer detection systems.

Overall, previous research demonstrates that AI-based methods, especially deep learning models, have significantly improved the accuracy and efficiency of lung cancer detection from CT scan images. However, challenges such as dataset quality, model interpretability, and real-world clinical validation still

remain. Therefore, developing reliable AI-based systems for lung cancer detection continues to be an important research area in medical imaging.

3. PROPOSED SYSTEM

The proposed system is an AI Based Lung Cancer Detection System designed to detect lung cancer from CT scan images quickly and accurately. The system allows users to upload lung CT scan images through a simple web interface. Once the image is uploaded, it is processed and analyzed using a trained deep learning model, which predicts whether the lung is normal or affected by cancer.

The system uses advanced deep learning techniques to automatically extract important features from the CT scan images, reducing the need for manual analysis. It can classify different types of lung cancer and provide a confidence score for the prediction. This helps users understand how reliable the result is and supports better decision-making.

In addition to prediction, the system generates a heatmap visualization that highlights the important regions in the CT scan which influenced the AI model's decision. This makes the system more transparent and helps users understand the analysis clearly.

Finally, the system provides a downloadable PDF report containing the CT scan image, heatmap, and prediction results. The proposed system is designed to be user-friendly, efficient, and reliable, helping in the early detection of lung cancer and supporting medical professionals in their diagnosis..

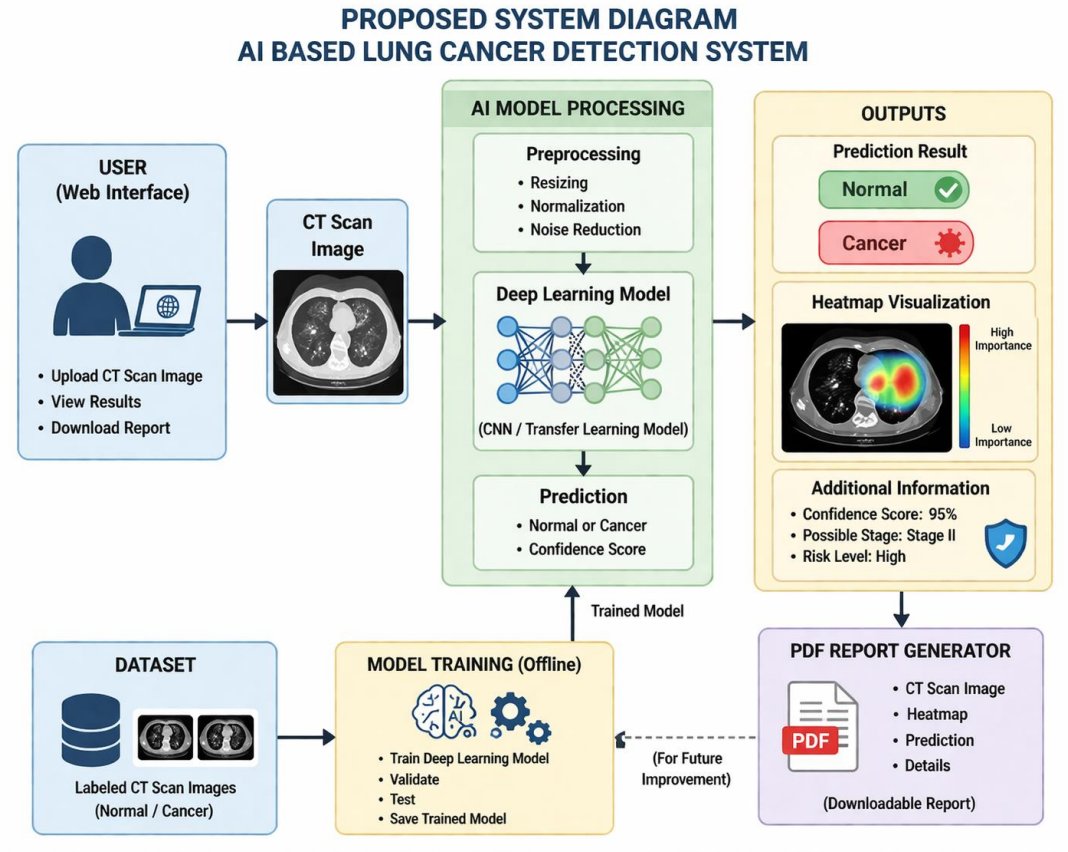

Fig 1: Proposed System

- The system starts with the user uploading a CT scan image through a web interface.
- The image is passed to the AI model, where preprocessing and deep learning analysis are performed.
- The system generates outputs like prediction (normal/cancer), confidence score, and heatmap visualization.

- Finally, a PDF report is created for download, and the model is trained using labeled datasets in the background.

4. METHODOLOGY

The methodology of the system is organized into the following steps:

- Data Collection
  Collect CT scan images of lungs (both normal and cancerous) from reliable datasets.

- Data Preprocessing
  Clean and prepare images by resizing, normalization, and noise removal to improve quality.

- Model Training
  Train a deep learning model (CNN/Transfer Learning) using the prepared dataset.

- Model Evaluation
  Test the model using validation data and check performance using accuracy, precision, and recall.

- Model Deployment
  Integrate the trained model into a web application for real-time usage.

- Image Upload
  User uploads CT scan image through the web interface.

- Prediction
  System analyzes the image and predicts whether it is normal or cancerous.

- Heatmap Generation
  Highlight important areas in the image that influenced the prediction.

- Result Display
  Show prediction result along with confidence score and risk level.

- Report Generation
  Generate and allow download of a PDF report with all results.

5. PROPOSED SYSTEM RESULTS

Test case 1:

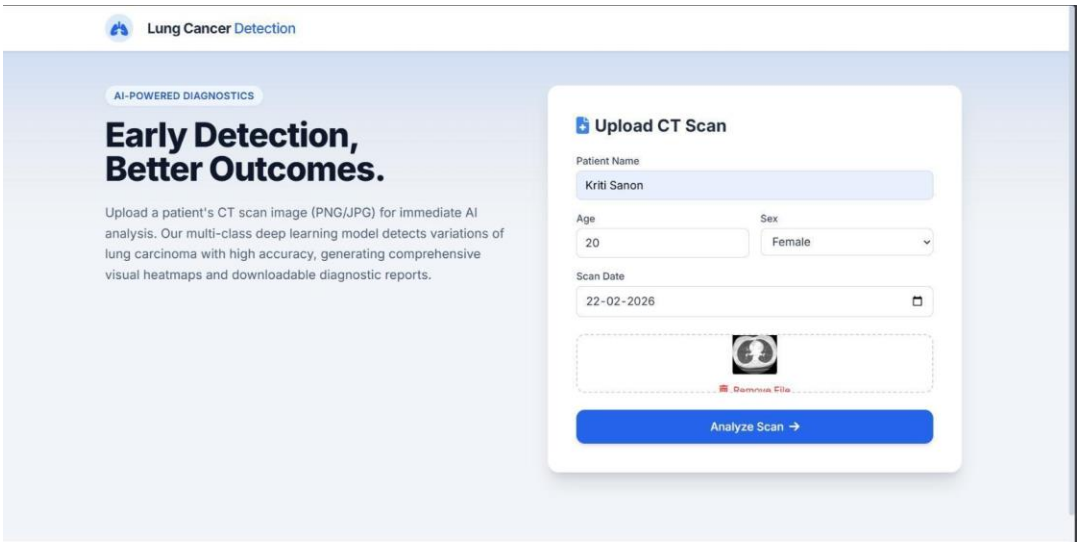

Fig 2.: Input CT scan image

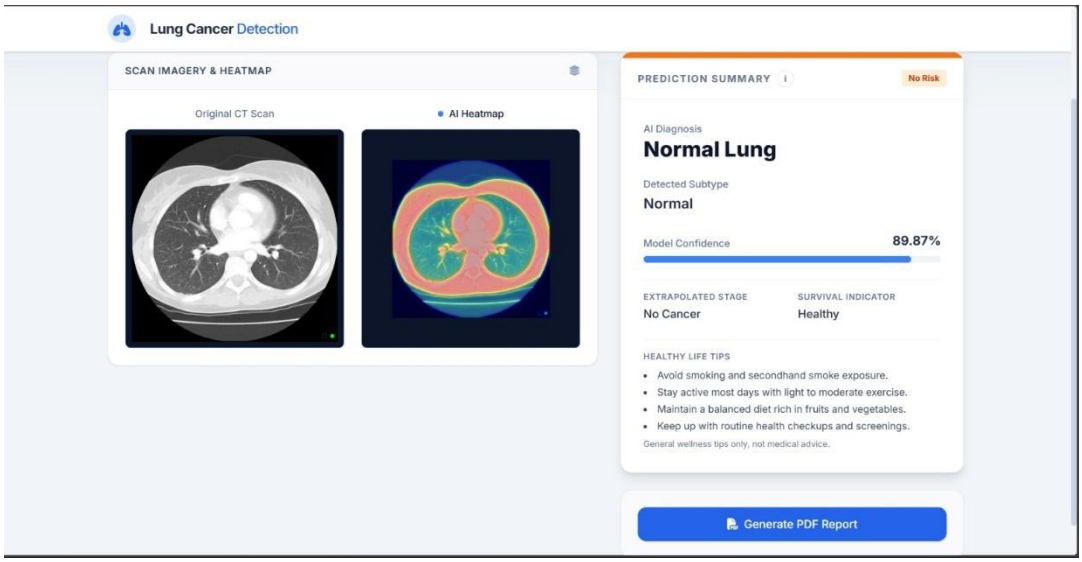

Fig2.1: Result1

The response time of the system was fast and accurate in producing results.

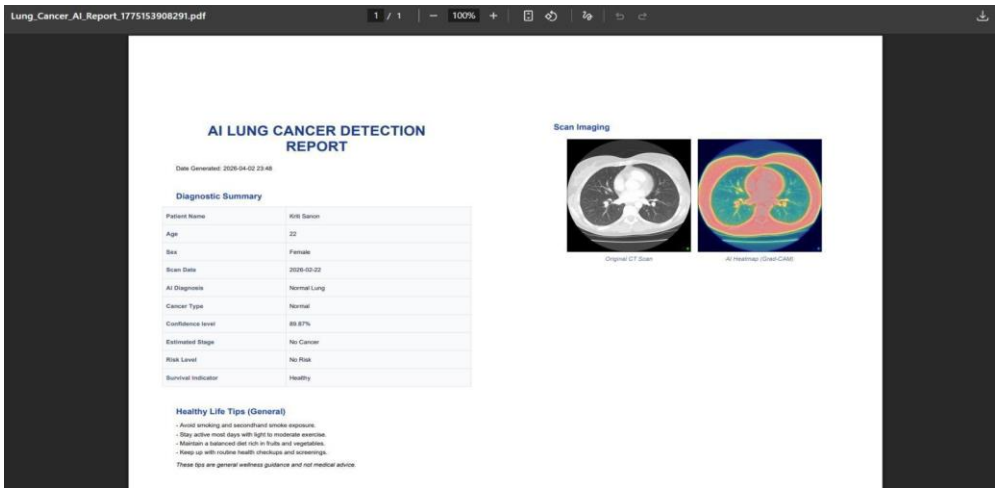

Fig2.2: Report Generation

Test case 2:

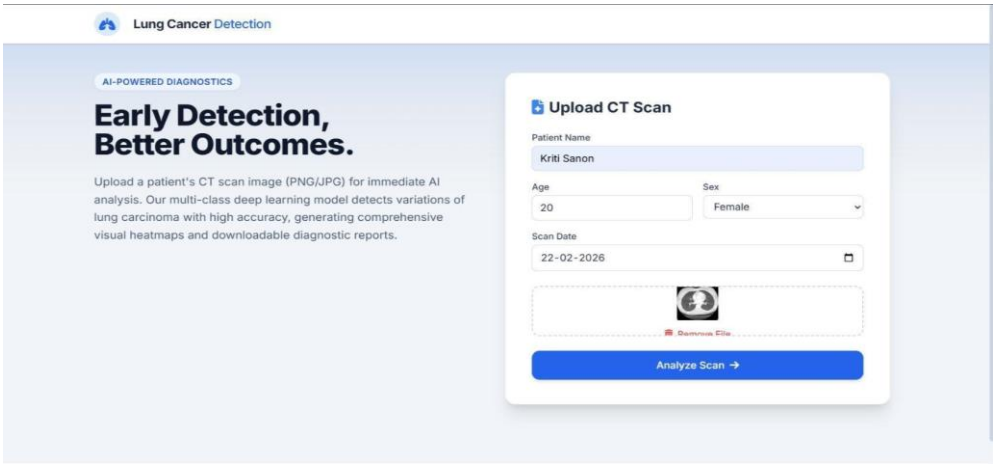

Fig 3.: Input CT scan image

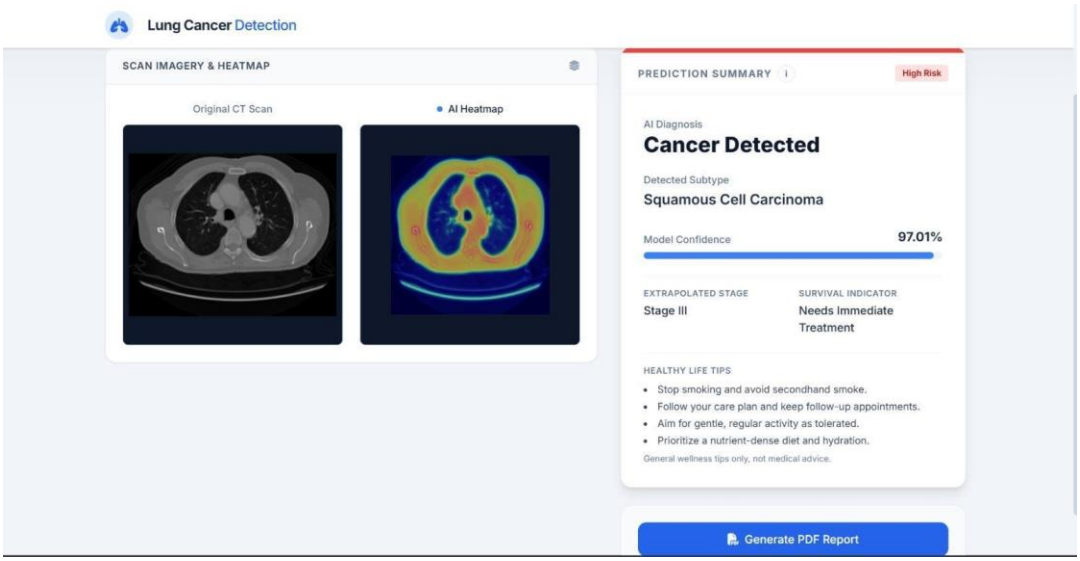

Fig 3.1: Result

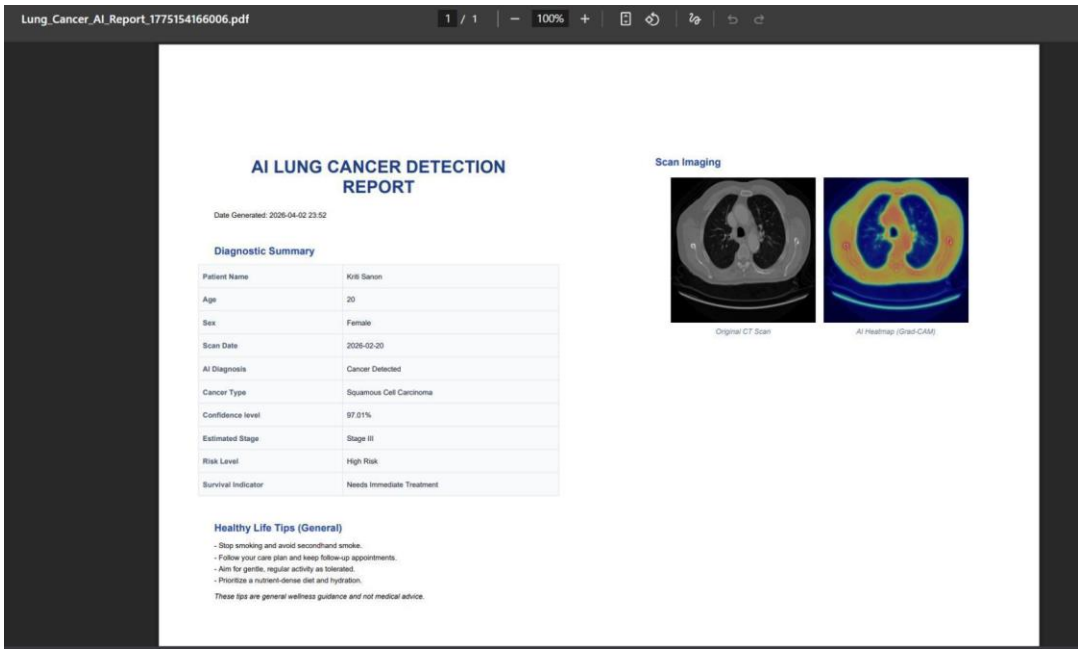

Fig 3.2: Report

6. CONCLUSION

The AI Based Lung Cancer Detection System presented in this project demonstrates the effective integration of advanced deep learning techniques with a user-friendly web-based interface to assist in the early detection of lung cancer. By leveraging CT scan image analysis through a trained EfficientNet model, the system is capable of providing reliable predictions along with confidence scores and visual heatmaps. This approach not only enhances diagnostic efficiency but also supports medical professionals in making informed decisions with improved accuracy. In addition to its technical strengths, the project addresses real-world challenges associated with early lung cancer diagnosis by providing a cost-effective and accessible solution. The inclusion of heatmap-based visualization enhances transparency and interpretability of model predictions, thereby increasing user trust and system reliability. The application can be further extended by integrating larger datasets, improving model accuracy, and incorporating real-time clinical data for enhanced performance.

The system architecture has been carefully designed to ensure modularity, scalability, and maintainability, incorporating essential components such as image preprocessing, prediction, visualization, and report generation. The use of modern technologies including Python, Flask, and PyTorch ensures seamless interaction between frontend and backend modules. Furthermore, the implementation of structured testing methodologies—including unit, integration, system, and acceptance testing—ensures that the system performs consistently and meets the desired quality standards.

In conclusion, this project successfully achieves its objective of developing an intelligent and efficient system for lung cancer detection using artificial intelligence. It holds significant potential for future enhancements and practical deployment in healthcare environments. The system not only reflects strong technical implementation but also demonstrates its relevance and impact in addressing critical healthcare needs, making it a valuable contribution at the undergraduate engineering level.

REFERENCES

[1] G. A. Sandag and D. T. Kabo, "Comparative Analysis of Lung Cancer Classification Models Using EfficientNet and ResNet on CT-Scan Lung Images," CogITo Smart Journal, vol. 10, no. 1, 2024.

[2] V. Kumar et al., "Unified Deep Learning Models for Enhanced Lung Cancer Prediction with ResNet-50–101 and EfficientNet-B3 Using DICOM Images," BMC Medical Imaging, vol. 24, 2024.

[3] A. Sharma and N. M. Kandoi, "Accurate Lung Cancer Prediction From CT Scans Using Advanced Deep Learning Methods," American Journal of Clinical Oncology, 2025.

[4] M. A. Baqir et al., "A Lightweight CNN for Enhanced Non-Small Cell Lung Cancer Classification Using CT Scan Image," Scientific Reports, 2026.

[5] K. Lakshminarasimha et al., "Enhancing Lung Cancer Diagnosis: An Optimization-Driven Deep Learning Approach with CT Imaging," Cancer Investigation, vol. 43, no. 7, 2025.

[6] M. Mahmoud et al., "Evaluation of Recent Lightweight Deep Learning Architectures for Lung Cancer CT Classification," Frontiers in Oncology, vol. 15, 2025.

[7] T. Alam et al., "Lung-EffNet: Lung Cancer Classification Using EfficientNet from CT-Scan Images," Engineering Applications of Artificial Intelligence, vol. 126, 2023

[8] "Deep Learning-Based Approach to Diagnose Lung Cancer Using CT-Scan Images," Intelligent Biomedical Engineering, 2024.