LungFusion: A Multimodal AI System for Early Lung Cancer Prediction & Detection

Overview

Lung cancer is one of the leading causes of cancer-related deaths globally. Early and accurate detection is critical for improving survival rates.

Traditional methods either analyze clinical data or CT scan images in isolation, which limits their predictive power.

This project introduces LungFusion, a novel multimodal AI system that integrates clinical data analysis with CT scan image classification using Neural Architecture Search (NAS) and ensemble learning techniques. The fusion of these two data types significantly improves the reliability and accuracy of lung cancer predictions.

Problem Statement

Existing detection models:

- Rely only on clinical features or imaging, not both.
- Use fixed deep learning architectures, which may not be optimal.
- Lack robustness and generalizability in real-world scenarios.

Objectives

- Build a hybrid model that analyzes both clinical data and CT scan images.
- Use NAS for discovering optimal CNN architectures.
- Use ensemble classifiers (Voting Classifier) for clinical data.
- Enhance prediction accuracy by combining both model outputs.

Innovation Highlights

1. Multimodal Data Fusion: Combines predictions from clinical and image-based models.
2. NAS: Automatically selects the best deep learning model for CT scan analysis.
3. Ensemble Learning: Clinical data is classified using a Voting Classifier (SVM, Random Forest, AdaBoost).
4. Higher Accuracy & Early Detection: Outperforms single-input models in performance.

Methodology

Clinical Data Modeling

- Preprocessed features like age, gender, symptoms, smoking history.
- Models used: SVM, Random Forest, AdaBoost.
- Final output from Voting Classifier.

CT Scan Image Analysis

- Preprocessing: resize, normalize images.
- NAS is applied to select the best CNN structure.
- Output: probability of malignancy.

Fusion Strategy

- Final prediction combines clinical and image-based results.

Tools & Technologies

- Python, Pandas, Scikit-learn, TensorFlow/Keras, OpenCV
- NAS, Ensemble Learning, Voting Classifier

Results

- Higher accuracy through multimodal fusion.
- Better generalization than single-source inputs.
- Ready for clinical deployment with enhancements.

Applications

- Hospital-based AI systems
- Decision support tools for radiologists
- Lung cancer screening programs

Team

- Pavithran S, Kamalnath S, Kavi Gowtham M, Sanjay S P