AI for Lung Cancer Detection:

By : Akshay Singh(E23CSEU0806)

This project explores the development of an AI system designed for early lung cancer detection, a critical factor that can significantly improve patient survival rates by up to 70%. Targeted at B.Tech second-year students, the project aims to build a robust AI model capable of analyzing lung nodules in CT scans.

Combining state-of-the-art machine learning techniques with medical imaging data, this initiative strives to enhance diagnostic accuracy and contribute to impactful healthcare advancements.

Understanding Lung Cancer and Detection Methods

Types of Lung Cancer

Lung cancer primarily falls into two categories: small cell and non-small cell, each with distinct characteristics affecting detection and treatment approaches.

Screening Techniques

Low-dose CT scans are the current standard for screening, offering detailed images of the lungs but suffering from high false-positive rates.

Challenges

Approximately 96% of detected nodules are benign, making it essential to distinguish harmful growths accurately. AI models can help by reducing false positives and enhancing diagnostic precision.

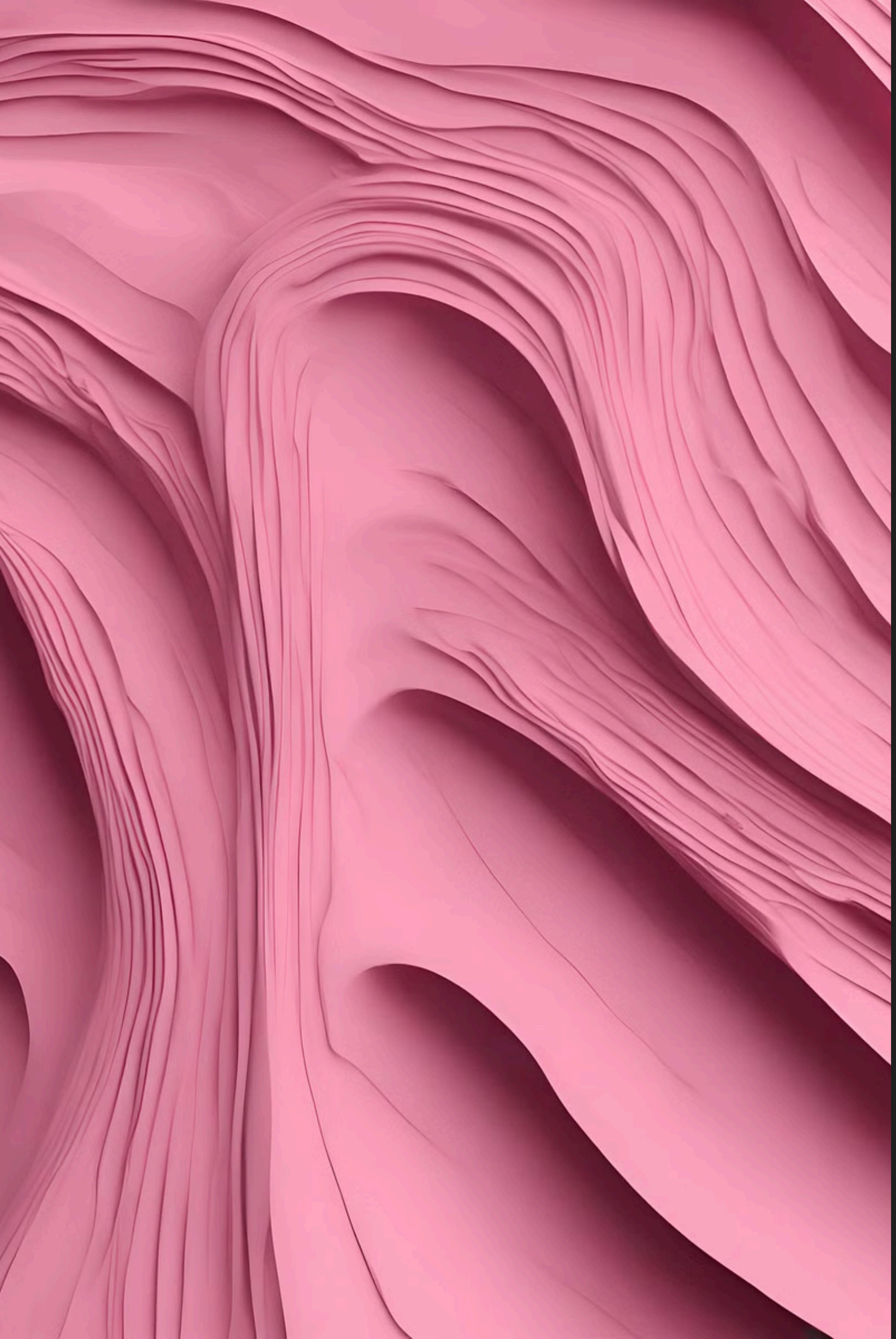
Project Dataset: LIDC-IDRI

Data Source

The dataset used is the Lung Image Database Consortium image collection (LIDC-IDRI), containing 1,018 patient cases with high-resolution chest CT scans.

Annotations and Volume

Each case includes multiple nodule annotations from four expert radiologists. The dataset's size exceeds 1.2 TB, with nodules ranging from 3 to 30 millimeters.



AI Model: Convolutional Neural Network (CNN)

CNN Architecture

Employing CNNs, particularly the U-Net model, to classify and segment lung nodules for precise localization.

Input & Output

The model processes 2D or 3D CT scan slices, producing probability maps that highlight potential nodules.

Training Objective

Optimized using the Dice coefficient as a loss function to maximize segmentation accuracy.

Implementation and Training

1. ### Development Tools

   Utilizing Python programming along with TensorFlow and Keras libraries to build and train the AI model.

2. ### Hardware Setup

   Training requires powerful GPUs, specifically NVIDIA Tesla cards, to handle intensive computations efficiently.

3. ### Data Preparation

   Includes normalization and data augmentation to enhance model generalization and robustness.

4. ### Training Parameters

   Model trained with a batch size optimized for hardware and a learning rate set to 0.001; evaluation employs precision, recall, F1-score, and AUC metrics.

Results and Evaluation

Performance Metrics

The AI model achieved 92% sensitivity and 85% specificity, outperforming average radiologist accuracy which ranges between 80-85%.

Impact on Diagnosis

This AI aid can reduce the workload on radiologists and support faster, more accurate patient diagnoses, potentially leading to improved treatment outcomes.

Challenges and Future Work

Dataset Bias

Addressing variability in imaging equipment and patient demographics to improve model fairness and effectiveness.

Model Robustness

Enhancing the model's ability to generalize across different clinical environments and imaging protocols.

Integration

Incorporating clinical data such as patient history to refine AI predictions and aid clinical decision-making.

Deployment

Aiming for real-world clinical tool integration to assist radiologists in routine lung cancer screening workflows.

Conclusion: AI Transforming Healthcare

Early Detection Benefits

AI technology empowers early and precise lung cancer detection, dramatically improving survival chances.

Educational Opportunity

This project serves as a practical and impactful learning experience for B.Tech students, bridging AI with healthcare innovation.

Future Prospects

Students can contribute to ongoing research and development, advancing AI tools for life-saving clinical applications.