LungAware: AI Lung Cancer Detection App

Nikhil Deekonda, M.S. in Artificial Intelligence

FACULTY MENTOR: Youshan Zhang, Ph.D.

Katz School of Science and Health

Introduction

- Artificial intelligence (AI) has significantly transformed the landscape of medical imaging, ushering in a new era of diagnostic precision and efficiency. In the field of oncology, where early and accurate diagnosis is crucial for improving patient outcomes, AI has shown immense potential, particularly in detecting and classifying cancerous lesions from imaging modalities such as computed tomography (CT) scans.

- **Problem Statement:** To develop an AI powered application that automates detection and classification of lung cancer from CT scans, addressing challenges to diagnostic delays and inconsistencies in clinical settings.

- **Research Focus**: This study aims to develop a mobile-based AI tool that classifies lung CT scans into malignant, benign and normal categories. The goal is to enhance early diagnosis, especially in resource-limited settings, by providing an accessible and efficient screening tool.

Method

Approach: The AI model leverages a convolutional neural network (CNN)[1] architecture to predict the type of cancer present. Additionally, it incorporates Grad-CAM[2] for interpretability, allowing users to visualize the key areas influencing predictions. A cosine similarity measure is employed to ensure that only valid lung CT images are processed, improving diagnostic accuracy and user experience.

The **CNN architecture** comprises multiple convolutional layers, batch normalization, and max-pooling layers, followed by fully connected layers. The final classification layer uses a **softmax activation function** to output probabilities for the three classes. The **categorical cross-entropy loss function** is employed for optimization, while **Stochastic Gradient Descent (SGD)**[3] ensures stable convergence during training.

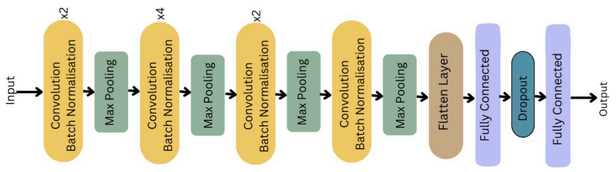

Figure 1: CNN- model Architecture

The study used the IQ-OTH/NCCD[4] lung cancer dataset, which consists of 1190 images representing CT scans categorized into three classes: malignant, benign, and normal.

Figure 2: Different types of cancer images in the IQ-OTH/NCCD dataset

An android mobile application was designed to deliver an intuitive and streamlined user experience, ensuring accessibility and ease of use for both clinical and non-clinical users. Its functionality is tailored to assist users in uploading and analyzing lung CT images for early detection of lung cancer.

Results

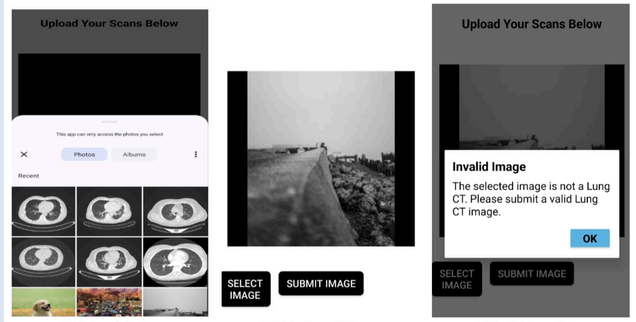

Figure 3: Validation Scenario

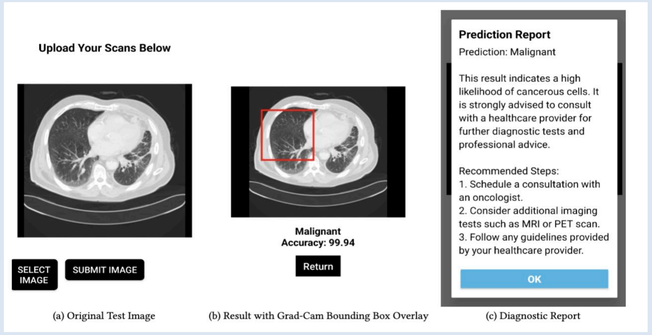

Figure 4: Example of model output

Class	Precision	Recall	F1 Score	Support
Malignant	0.99	1.00	1.00	174
Normal	0.99	0.99	0.99	116
Benign	1.00	0.97	0.99	40
Overall Accuracy			99.4%	

Table 1: Evaluation Metric Results

Table above shows that our model achieves an overall accuracy of 99.4% across all classes. The high F1-scores for each class indicate robust classification performance, with particularly strong results for malignant cases, where early detection is critical.

Results indicate proposed CNN-based AI model is effective in accurately classifying lung cancer types and in providing assistance to clinicians.

Conclusions

- Leveraging convolutional neural networks (CNNs) and Grad-CAM interpretability techniques, the application provides a reliable, user friendly solution for classifying lung CT scans.

- The inclusion of Grad-CAM visualizations enhances transparency by highlighting the critical regions influencing model predictions, bridging the gap between AI diagnostics and clinical decision-making.

- This mobile application represents a significant advancement in democratizing lung cancer diagnostics.

Limitations:

- Despite above achievements, challenges such as dataset diversity, computational efficiency, and regulatory compliance remain to be addressed.

Future Work:

- Future iterations of the application will integrate features such as AI-based medical report generation, secure user account management, and expanded diagnostic capabilities.

- These enhancements will enable the application to provide comprehensive respiratory diagnostics, while compliance with healthcare standards will ensure its safe and ethical deployment.

Acknowledgements

I would like to express my deepest gratitude to the Professor Youshan Zhang (AI Program Director), Dr. Erica Brown (Director, Rabbi Lord Jonathan Sacks-Herenstein Center for Values and Leadership) and Dr. Shira Weiss (Assistant Director, Rabbi Lord Jonathan Sacks-Herenstein Center for Values and Leadership)
for their continuous support throughout the project.

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