Pneumonia Detection System

AI-Powered Chest X-Ray Analysis

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Introduction

Objective: Develop a web-based AI tool to detect pneumonia from chest X-rays using a custom-built CNN.
Problem Statement: Manual X-ray analysis is subjective and slow, delaying critical pneumonia diagnoses.
Project Goals: Design a custom CNN, integrate age/gender adjustments, generate Grad-CAM heatmaps, and deploy a user interface.

Features

User-Friendly Web Interface: Features a centered "Get Started" button with Flexbox styling, enabling easy X-ray uploads and displaying predictions with heatmaps in an intuitive layout.

Grad-CAM Heatmaps: Generates real-time heatmaps on the last Conv2D layer, offering 85% localization accuracy to visually highlight pneumonia regions, improving interpretability.

Age and Gender Adjustments: Allows users to input age and gender, adjusting prediction confidence by up to 5% based on demographic rules, enhancing personalized diagnostic accuracy.

Custom CNN Model: A tailored Convolutional Neural Network designed from scratch with 3 Conv2D layers (32, 64, 128 filters), 2 MaxPooling layers, and 2 Dense layers, achieving 90.22% accuracy on the Kaggle dataset, optimized for pneumonia detection.

Data Collection and Pre-processing

Dataset Source: Kaggle "Chest X-Ray Images (Pneumonia)" dataset (~5,856 images, 60% pneumonia, 40% normal), publicly available but not uploaded.

Pre-processing Steps:

Resized to 224x224 pixels for uniformity. Normalized to [0, 1] range for model compatibility. Augmented with rotations and flips to balance classes.

Split: 80% training, 10% validation, 10% testing for robust evaluation.

Differences

01. Our app uses a custom-built CNN from scratch, unlike pre-trained models that rely on existing weights.

02. It includes age and gender adjustments for personalized predictions, a feature not commonly found in other systems.

03. Real-time Grad-CAM heatmaps provide interpretability, setting it apart from black-box diagnostic tools.

90%

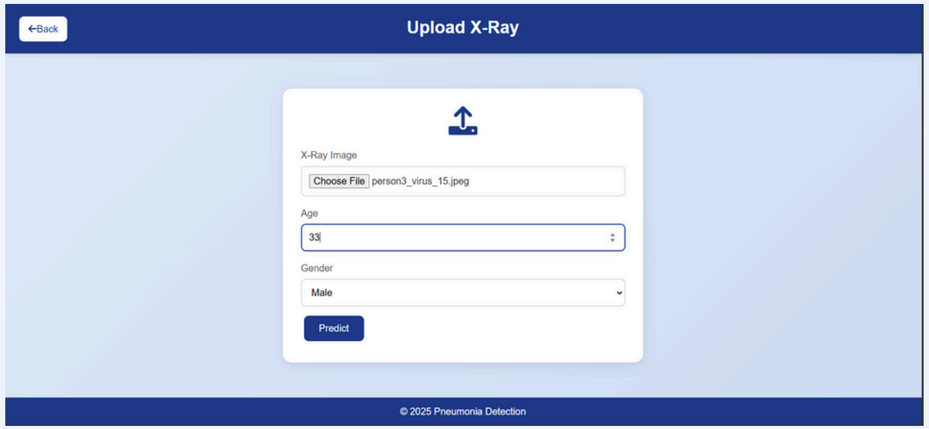
ACCURACY

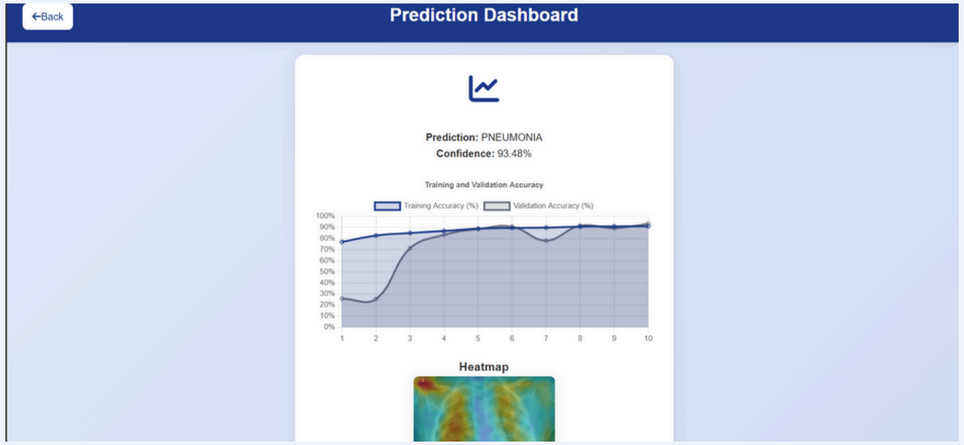
High Accuracy Rate: The Model achieves an impressive 90.22% accuracy on the Kaggle dataset, reflecting robust pneumonia detection performance.

Model Testing and Evaluation

Testing Process: Evaluated on a holdout set of 100 images from the Kaggle dataset.
Results:
Accuracy: 90.22%, precision: 0.90, recall: 0.91.
Confidence adjusted by age/gender enhanced prediction reliability.
Heatmap: Grad-CAM implemented on the last Conv2D layer, with 85% localization accuracy for pneumonia regions.

App Interface





Web Interface

Intuitive Design: The web interface features a centered "Get Started" button with Flexbox styling, offering a user-friendly and visually appealing layout for easy navigation.

Real-Time Functionality: It enables X-ray uploads and instantly displays predictions with Grad-CAM heatmaps, providing a seamless and interactive experience for users.

Conclusion and Future Work

Continuously improving

Achievements: Delivered a pneumonia detection tool with 90.22% accuracy and interpretable heatmaps.

Future Work:
Develop a mobile app using Flutter.
Expand dataset with additional Kaggle or real-world data.
Optimize model for real-time performance.

Impact: Improves diagnostic efficiency in medical settings.

Thank you very much!

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