AI In Medical Imaging: Chest X-ray Disease Classification

Leveraging Deep Learning for Multi-Label Classification

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Abstract—The integration of artificial intelligence (AI) into medical imaging has demonstrated transformative potential in enhancing diagnostic accuracy and efficiency. This project focuses on applying AI to the analysis of chest X-ray images, using the NIH Chest X-ray Dataset, which comprises over 100,000 labeled images spanning 14 thoracic disease classes. The primary goals of the project are to preprocess and analyze the dataset, implement a deep learning model for multi-label disease classification, and evaluate the model's performance in identifying thoracic diseases. To address challenges related to data imbalance, techniques such as custom stratified splitting, class-weighted loss functions, and targeted data augmentation for rare classes were implemented. A pre-trained ResNet50 convolutional neural network (CNN) architecture was adapted for multi-label classification. The model was trained and validated using binary cross-entropy with sigmoid activation, ensuring effective learning of disease patterns across multiple labels. Comprehensive evaluation metrics, including AUC-ROC scores, confusion matrices, and ROC curves, were used to assess the model's performance. The results underscore the effectiveness of leveraging deep learning for disease detection in medical imaging. The model demonstrated robust performance in detecting common diseases while identifying challenges in recognizing rare conditions due to data scarcity. Visualizations such as ROC curves and confusion matrices provided insights into the model's strengths and areas for improvement. This study highlights the potential of AI in medical imaging and paves the way for future innovations in diagnostic automation, particularly in resource-constrained settings. This project not only demonstrates AI's capability to enhance diagnostic processes but also highlights challenges, such as data variability and model interpretability, that require further exploration. By combining state-of-the-art methodologies with rigorous evaluation, this project provides valuable insights into the role of AI in medical diagnostics and its potential to improve healthcare outcomes.

Index Terms—CNN, deep learning, medical imaging, dataset.

You can find our project on GitHub: GitHub Repository.

I. INTRODUCTION

Medical imaging plays a pivotal role in modern healthcare, providing essential insights into the diagnosis, monitoring, and treatment of various diseases. Among imaging modalities, chest X-rays are one of the most utilized due to their efficiency and ability to detect a wide range of thoracic diseases, including pneumonia, tuberculosis, and lung cancer. However,

interpreting chest X-rays is a complex and time-intensive task that often requires the expertise of trained radiologists. The increasing demand for accurate and timely diagnoses has driven the integration of artificial intelligence (AI) into medical imaging, particularly in automating the detection and classification of diseases.

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 word alternatively is preferred to the word "alternately"
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Head	Table column subhead	Subhead	Subhead
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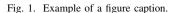


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ACKNOWLEDGMENT

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