“CliniScan: Lung-Abnormality Detection on Chest X-rays using AI”

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INTRODUCTION

1.1 Project Overview

Chest X-ray (CXR) imaging is one of the most widely used diagnostic tools in healthcare for identifying pulmonary diseases such as pneumonia, tuberculosis, fibrosis, lung opacities, nodules, and masses. However, analyzing CXRs is challenging because abnormalities are often subtle, overlapping, and require expert radiological interpretation.

CliniScan is an AI-powered system designed to assist radiologists by automatically detecting, classifying, and localizing lung abnormalities on chest X-ray images. Using advanced deep learning models, CliniScan enhances diagnostic accuracy, reduces interpretation time, and provides visual explanations for better clinical interpretability.

1.2 Objective of Project

To develop an AI–powered system that automatically detects and localizes lung abnormalities from chest X-ray (CXR) images. The system assists radiologists by identifying key findings such as opacities, consolidations, fibrosis, and masses, with potential classification of diseases like pneumonia or tuberculosis.

1.3 Problem Statement

Chest X-rays are widely used but require expert interpretation. Delays or misinterpretations can impact diagnosis. An AI-assisted system can enhance early diagnosis, reduce workload, and support radiologists in clinical settings.

1.4 Expected Outcome

- Classification of abnormalities in chest X-rays
- Localization using bounding boxes
- Visualization using Grad-CAM or detection overlays
- Optional web-based deployment
- Clinically interpretable outputs

PROJECT DESCRIPTION

To develop an AI-powered system that can automatically detect and localize lung abnormalities from chest X-ray images using deep learning techniques. The system aims to assist radiologists and healthcare providers by identifying key pathological findings such as opacities, consolidations, fibrosis, and masses, and optionally classifying related pulmonary conditions like pneumonia or tuberculosis. The solution will be trained on the VinDr-CXR dataset and optimized for clinical relevance, interpretability, and deployment readiness in real-world diagnostic settings. Project Workflow: Lung-Abnormality Detection on Chest X-Rays.

PROJECT WORKFLOW

3.1 Data Acquisition

The project uses the VinDr-CXR dataset available through PhysioNet, It includes:

- 18,000+ chest X-ray images in DICOM format
- Bounding box annotations for 14+ abnormalities
- Multi-label classification tags
- Metadata such as patient age, sex, and view position

Components of VinDr-CXR:

- train/: DICOM files for training
- test/: test image files
- annotations.csv: bounding box labels
- findings.csv: image-level abnormality labels
- metadata.csv: patient + image technical details.
- The dataset supports both classification and detection tasks.

3.2 Data Preprocessing

Preprocessing is the most important step in pipeline because:

- DICOM files must be converted into usable images
- Medical images require normalization, resizing, and enhancement
- Bounding-box annotations must be converted into YOLO/COCO formats
- The dataset must be organized for training.

This is one of the most critical steps. It ensures consistency, interpretability, and proper input formatting for the model.

1. DICOM Loading

- Each image is read using pydicom to extract:
  - Pixel array
  - DICOM metadata (e.g., view position, modality)

2. Image Conversion

- Convert DICOM → PNG/JPEG to make images model-compatible.

3. Grayscale Conversion

- Chest X-rays are fundamentally grayscale. If the source DICOM is multi-channel, convert using:

  gray = mean(RGB channels)

4. Image Normalization

- Normalize pixel values from:

  0–4095 (DICOM range) → 0–255 (PNG range)

5. Resize

- Prepare images for training:
  - **YOLO models:** 640 × 640
  - **CNN models:** 224 × 224 or 256 × 256

6. CLAHE Enhancement

- Apply Contrast Limited Adaptive Histogram Equalization to improve visibility in darker or low-quality X-rays.

7. Annotation Conversion

- VinDr-CXR bounding boxes are in absolute pixel coordinates. Convert them into YOLO normalized format:

  class_id x_center y_center width height (all normalized 0–1)

8. Train/Val Split

- Split images + labels:
  - 80% training
  - 20% validation