**Synthesized Abstract:**

Chest X-ray (CXR) imaging is a critical first-line tool for diagnosing pulmonary diseases, and artificial intelligence is being increasingly leveraged to automate and enhance this process. Research in this area focuses on developing robust deep learning models, primarily using Convolutional Neural Networks (CNNs) and Vision Transformers (ViT), for the rapid detection of conditions such as COVID-19, Tuberculosis (TB), and Pneumonia.

To improve model performance, various advanced techniques are employed. Methodologies include enhancing low-resolution or noisy images using super-resolution networks, as well as applying lung segmentation to ensure the AI focuses only on the relevant anatomical regions, a technique that has pushed classification accuracy as high as 99.9%. The scope of these models is also expanding; while many systems target a single disease, recent efforts are focused on creating models for the joint diagnosis of multiple conditions simultaneously and on developing generalized systems that can classify any CXR as "normal vs. abnormal" before identifying unseen diseases. Across these studies, hybrid approaches combining deep learning for feature extraction with machine learning for classification have also proven highly effective. These AI-driven systems consistently achieve high accuracies, often exceeding 98%, demonstrating their potential to reduce diagnostic turnaround times and serve as powerful decision-support tools in clinical settings.

1. *COVID-19 Detection Using Deep Learning Algorithm on Chest X-ray Images* (Biology, 2021) :

Abstract :

COVID-19 affects lungs, and chest X-ray imaging can assist diagnosis.

The study proposes an automatic CNN-based deep learning model for detecting COVID-19 from chest X-rays.

Dataset: 3,616 COVID-19 images + 10,192 healthy → augmented to 52,000 images.

Eleven CNNs (VGG16, ResNet, DenseNet, MobileNetV2, etc.) were tested.

A modified MobileNetV2 achieved the best performance: **98% accuracy**.

1. *Deep learning for distinguishing normal versus abnormal chest radiographs and generalization to two unseen diseases: tuberculosis and COVID-19* (Scientific Reports, 2021):

Abstract:

Chest X-ray (CXR) is widely used for thoracic disease diagnosis.

Many AI models are trained for specific diseases but fail to generalize to unseen conditions.

This study develops an AI system to classify CXRs as **normal vs abnormal** (not disease-specific).

Trained on **248,445 patients** from India; evaluated on 6 external datasets from India, China, and the U.S.

Tested generalization on unseen diseases: **TB and COVID-19**.

System reduced abnormal case turnaround time by **7–28%** in simulations.

1. *COVID-19 Diagnosis from Chest X-ray Images Using a Robust Multi-Resolution Analysis Siamese Neural Network with Super-Resolution Convolutional Neural Network* (Diagnostics, 2022):

Abstract:

Chest X-ray (CXR) is widely available for COVID-19 diagnosis, but low resolution, noise, and irrelevant annotations reduce model accuracy.

The paper proposes **COVID-SRWCNN**, a **super-resolution Siamese wavelet multi-resolution CNN** framework.

Method enhances low-resolution CXR images using an **Enhanced Fast Super-Resolution CNN (EFSRCNN)**, then extracts deep features via a Siamese multi-resolution CNN.

Validated on public datasets: achieved **98.98% accuracy, 98.96% AUC, 99.78% sensitivity, 98.53% precision, 98.86% specificity**.

Outperforms several pre-trained models and state-of-the-art approaches.

1. Reliable Tuberculosis Detection using Chest X-ray with Deep Learning, Segmentation and Visualization:

Abstract:

This study focuses on the reliable detection of Tuberculosis (TB) from chest X-ray images. The authors created a database of 4,200 images (700 TB-infected, 3,500 normal) from public sources. They employed nine different pre-trained deep convolutional neural networks (CNNs) using transfer learning. The core of the work involved three experiments: lung segmentation using U-Net models, classification using whole X-ray images, and classification using segmented lung images. The results showed that classification based on **segmented lungs** significantly outperformed classification on whole X-rays, achieving an accuracy of **99.9%**. A visualization technique was also used to confirm that the CNNs focused on the lung regions, increasing diagnostic reliability.

1. Joint Diagnosis of Pneumonia, COVID-19, and Tuberculosis from Chest X-ray Images: A Deep Learning Approach:

Abstract:

This study proposes a deep learning model for the

**joint diagnosis** of three fatal lung diseases—Pneumonia, COVID-19, and Tuberculosis—from chest X-ray images, which is a less explored area compared to single-disease diagnosis. Using multiple public datasets from Kaggle, the researchers developed a model capable of classifying images into four categories: COVID-19, Pneumonia, Tuberculosis, and No-findings. The proposed model achieved an overall accuracy of

**98.72%** and demonstrated high recall scores for each class, proving to be a better performer than other state-of-the-art models in the literature for this specific multi-class problem.

1. A Robust Tuberculosis Diagnosis Using Chest X-Rays Based on a Hybrid Vision Transformer and Principal Component Analysis:

Abstract:

This paper addresses the challenges in diagnosing Tuberculosis (TB), such as medication resistance and limited resources, by proposing a computer-aided diagnosis (CAD) system for early and accurate detection from chest X-ray (CXR) images. The novelty lies in its

**hybrid approach**, which combines a **Vision Transformer (ViT)** for deep feature extraction, **Principal Component Analysis (PCA)** for reducing feature dimensions, and traditional **machine learning (ML)** models for classification. The system was trained and evaluated on a TB chest X-ray dataset, achieving outstanding performance metrics, including an accuracy of

**99.84%**, a precision of 99.90%, and a recall of 99.52%. This performance highlights the superiority of the proposed hybrid model over other contemporary classifiers.