**PNEUMONIA DETECTION**

**Problem Statement:**

Pneumonia is a major cause of mortality worldwide, especially in children and elderly patients. Manual diagnosis from chest X-rays is time-consuming and requires expert radiologists. This project aims to develop a deep learning-based model to automatically detect pneumonia from chest X-ray images, benchmark CNN vs Transfer Learning approaches, provide visual explainability through Grad-CAM, and deploy an interactive web application for real-time detection.

## **🔹 Final Implementable Enhancements**

1. **Transfer Learning**
   * Use a pre-trained model like **VGG16** or **ResNet50**.
   * Freeze initial layers and fine-tune the last few layers.
   * Boosts accuracy with less training time.
2. **Explainability with Grad-CAM**
   * Add **Grad-CAM heatmaps** to show which lung regions influenced the prediction.
   * Adds interpretability (very impressive for healthcare applications).
3. **Hyperparameter Optimization (Basic)**
   * Tune **learning rate, batch size, and number of epochs** using **Keras Tuner**.
   * Makes your model more reliable and avoids overfitting.
4. **Advanced Image Augmentation**
   * Add techniques like **rotation, brightness/contrast, zoom, Gaussian noise**.
   * Improves model generalization.

## **🔹 Keep as Future Scope**

* **Multiclass Classification (bacterial/viral/fungal pneumonia)**
* **3D Medical Data (CT scans)**
* **Training on NIH/RSNA/Stanford datasets**