Pneumonia Detection Using Chest X-ray Images

1. Overview

This project utilizes deep learning to detect pneumonia from chest X-ray images. By leveraging a custom Convolutional Neural Network (CNN) and a fine-tuned pretrained ResNet model, it achieves accurate and reliable classification of X-rays into two categories:

- **Pneumonia-positive**
- **Healthy**

The final model achieves an impressive accuracy of **95%**, making it a significant tool for assisting healthcare professionals in diagnosing pneumonia effectively.

2. Objectives

- To develop an efficient deep learning model for pneumonia detection using chest X-rays.
- To improve classification performance through transfer learning and model fine-tuning.
- To provide a scalable solution for medical diagnosis.

3. Key Features

1. **Custom CNN Model:**
    - A convolutional neural network (CNN) was designed and trained from scratch to extract important features from the chest X-rays.
2. **Pretrained ResNet Model with Fine-tuning:**
    - A pretrained ResNet model was utilized for transfer learning. Fine-tuning enhanced its ability to generalize and adapt to the specific task of pneumonia detection.
3. **High Accuracy:**
    - The fine-tuned ResNet model achieves **95% accuracy**, demonstrating its effectiveness for medical image analysis.

4. Methodology

1. Data Preparation

- Chest X-ray images were preprocessed with the following steps:
    - Resizing and normalization to ensure consistent input dimensions.
    - Data augmentation techniques (e.g., flipping, rotation) to improve model robustness.

2. Model Training

- **Custom CNN:**
    - Designed and trained from scratch for pneumonia classification.
- **ResNet Fine-tuning:**
    - A pretrained ResNet model was fine-tuned using transfer learning to improve feature extraction and classification accuracy.

3. Model Evaluation

- The models were evaluated using standard metrics such as:
    - **Accuracy**
    - **Precision**
    - **Recall**
    - **F1-Score**

4. Final Results

- The fine-tuned ResNet model outperformed the custom CNN in both accuracy and generalization, achieving a final accuracy of **95%**

5. Tools and Technologies

- **Deep Learning Frameworks:** TensorFlow, Keras, or PyTorch.
- **Pretrained Model:** ResNet (Fine-tuned).
- **Data Augmentation:** Image preprocessing libraries (e.g., OpenCV, Keras ImageDataGenerator).
- **Evaluation Metrics:** Accuracy, Precision, Recall, F1-score.

6. Results

- The fine-tuned ResNet model achieved the following:
    - **Accuracy:** 95%
    - High reliability in distinguishing pneumonia-positive and healthy cases.
    - Efficient performance on unseen data.

Future Work

1. **Model Optimization:**
    - Experiment with additional pretrained models such as DenseNet or EfficientNet to explore further accuracy improvements.
2. **Deployment:**
    - Deploy the model as a web or mobile application for real-world usability by healthcare professionals.
3. **Integration with Clinical Systems:**
    - Integrate the solution into hospital management systems for seamless diagnosis assistance.

7. Conclusion

This pneumonia detection project demonstrates the power of deep learning in medical diagnosis. By combining a custom CNN with a fine-tuned pretrained ResNet model, the project achieves high accuracy, providing a scalable and impactful solution for pneumonia detection using chest X-rays.