Face Mask Detection using Deep Learning

1. Introduction

This project involves the creation of a deep learning model to detect whether a person is wearing a face mask or not. This detection system is built using TensorFlow and Keras, with the data preprocessed using Python's PIL and NumPy libraries.

2. Data Preprocessing

The dataset comprises images of individuals with and without masks. These images are labeled accordingly and split into training and testing sets. Images are resized to 128x128 pixels and normalized by scaling pixel values to the range [0, 1]. Data augmentation techniques such as rotation, shift, zoom, and horizontal flip are applied to increase the robustness of the model.

3. Model Architecture

A Convolutional Neural Network (CNN) model is built using Keras Sequential API. The architecture includes:

- Convolutional layers with ReLU activation.
- MaxPooling layers to reduce spatial dimensions.
- Dropout layers to prevent overfitting.
- A fully connected Dense layer followed by a sigmoid activation function for binary classification.

The model is compiled with the Adam optimizer and binary cross-entropy loss.

4. Training Process

The model is trained using the training set with class weights to handle any class imbalance. A learning rate scheduler is used to adjust the learning rate during training. The model is trained for 15 epochs, with both training and validation data monitored.

5. Evaluation Metrics

The model's performance is evaluated using accuracy, F1 score, confusion matrix, and a classification report. The F1 score provides a balance between precision and recall, while the confusion matrix shows the model's predictions against actual labels.

6. Results and Visualization

The trained model achieved good accuracy on the validation set. Visualizations include training and validation loss/accuracy plots, and predictions on test images are displayed with the corresponding labels.

7. Conclusion

The model successfully detects the presence of face masks in images with reasonable accuracy. Further improvements can be made by experimenting with deeper models or more diverse datasets.