Project Report

Artificial Intelligence

Name: Esha Asif

Roll. No: 034

Section: BS AI 3-A

Project title: Face Mask Detection

Introduction

The Face Mask Detection project leverages deep learning to classify images into two categories: "with mask" and "without mask." It highlights the importance of image preprocessing, transfer learning, and model fine-tuning in building an efficient classification system. This project also showcases how real-time applications can be developed by extending trained models into deployment scenarios. The relevance of this project is underscored by its utility in health monitoring systems, where automated mask detection plays a pivotal role.

Objective

The primary goal of this project is to create a reliable model that can detect the presence of a face mask in real-time using a webcam or an image. The model should differentiate between two classes:

- **With Mask**
- **Without Mask**

Dataset

We used a dataset that contained two categories of images:

1. **With Mask** - Images of individuals wearing masks.
2. **Without Mask** - Images of individuals not wearing masks.

The dataset was split into:

- **Training Data (80%)**: Used for model learning.
- **Testing Data (20%)**: Used to evaluate model performance.

Methodology

1. **Data Preprocessing**:
    - Images were resized to 224x224 pixels for consistency.
    - Pixel values were normalized using preprocessing from the MobileNetV2 framework.
2. **Data Augmentation**:
    - Techniques such as rotation, zoom, width/height shifts, and horizontal flipping were applied to increase the dataset's diversity and robustness.
3. **Model Architecture**:
    - A **MobileNetV2** pre-trained on ImageNet was used as the base model.

    - Additional layers were added to:
        - Perform average pooling.
        - Flatten the feature maps.
        - Include a dense layer with 128 neurons and ReLU activation.
        - Add a final dense layer with a softmax activation for binary classification.
4. **Training**:
    - The model was trained for 20 epochs with a batch size of 32.
    - Optimizer: Adam with an initial learning rate of 0.0001.
    - Loss Function: Binary cross-entropy, suitable for two classes.
5. **Evaluation**:
    - After training, the model was evaluated using accuracy, precision, recall, and F1-score.
    - A classification report and confusion matrix were generated to analyze performance.

Results

- **Training Accuracy:** High accuracy was achieved during training and validation.
- **Testing Accuracy:** The model performed well on unseen test data, indicating good generalization.
- **Real-Time Detection:** The model was able to detect masks in real-time through webcam input.

Implementation

The model was implemented using:

- **TensorFlow/Keras**: For deep learning.
- **OpenCV**: For real-time video capture and image processing.
- **Matplotlib**: To visualize training results.

The trained model was saved as **mask_detector.h5** for future deployment.

Applications

1. **Public Safety**: Monitoring mask compliance in public places like airports, hospitals, and malls.
2. **Access Control**: Automating entry systems to allow only individuals wearing masks.

Challenges

- Handling images with varying lighting conditions and angles.
- Dealing with occlusions or poor-quality images.

Conclusion

This project successfully developed a robust face mask detection system that combines the power of deep learning with real-time applications. It demonstrates how technology can assist in promoting safety during global health crises.