Task A

Deep Learning-Based Facial Gender Recognition Using EfficientNet

1. Project Overview

This hackathon project focuses on identifying gender from facial imagery through the use of deep neural networks. A pre-trained architecture is fine-tuned on labeled datasets to deliver high accuracy and generalizability across unseen data.

2. Data Description

- **Training Set:** Categorized face images found in the `train/` directory.
- **Validation Set:** Independent, annotated samples provided in the `val/` folder for performance evaluation.

3. Image Preparation Pipeline

- Input images are resized to **224×224** dimensions.
- Pixel values are standardized using **ImageNet normalization parameters**.
- **Data augmentation techniques** applied during training:
    - Random horizontal flipping
    - Color adjustments
    - Random rotation

4. Neural Network Configuration

- The system utilizes **EfficientNet-B0**, pre-trained on a large-scale dataset, as its feature extractor.
- The classification head is customized for **binary output (Male/Female)**.
- Optimization is handled using the **Adam algorithm**, starting at a learning rate of **2e-4**, and learning rate decay is managed via **cosine annealing**.

5. Training Details

- **Batch Size:** 32
- **Number of Epochs:** 6
- **Loss Function:** Cross-Entropy
- Computation is accelerated using **GPU** when accessible, with **PyTorch and torchvision** forming the core framework.
- The most accurate model is preserved as **best gender model.pt**.

6. Performance Metrics

Training Set:

- **Accuracy:** 0.9933

- **Precision:** 0.9980
- **Recall:** 0.9935
- **F1 Score:** 0.9957

Validation Set:

- **Accuracy:** 0.9238
- **Precision:** 0.8739
- **Recall:** 0.9905
- **F1 Score:** 0.9286

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7. Final Remarks

The proposed solution, based on EfficientNet-B0, effectively differentiates between genders in facial imagery. With robust augmentation and tuning, the system achieves **over 99% accuracy during training** and maintains strong generalization with **above 92% accuracy on validation samples**, offering an efficient and deployable model for real-time applications.