Robust Gender Classification Using MobileNetV2 and Batch Evaluation

This project presents a comprehensive and modular deep learning pipeline for robust gender classification using facial images, built upon the lightweight yet powerful MobileNetV2 architecture. The dataset used consists of RGB facial images categorized into two distinct classes: `male` and `female`. These images were structured in clearly defined training and validation folders to enable supervised learning. As part of the preprocessing stage, all input images were uniformly resized to 224x224 pixels to match the input requirements of MobileNetV2. The images were further converted from BGR to RGB format, normalized using TensorFlow's built-in `preprocess_input()` function for MobileNetV2, and the labels were converted into one-hot encoded vectors using `to_categorical()` to facilitate training with categorical cross entropy loss. The model architecture incorporates a pretrained MobileNetV2 backbone with the top layers removed (`include_top=False`), followed by a `GlobalAveragePooling2D` layer to reduce dimensionality, a `Dropout` layer with a dropout rate of 0.3 to prevent overfitting, and a final fully connected `Dense` layer with two output units activated by softmax for binary classification. The optimizer used was Adam, which allowed efficient training over multiple epochs with a small batch size.

An important innovation in this project is the integration of a full-featured batch prediction and evaluation system. This system enables the user to input a directory containing test images and automatically processes all images, predicts their gender, and visually displays each prediction using `matplotlib` with confidence scores. Ground truth labels are inferred from the folder name (e.g., `male` or `female`), enabling automatic computation of evaluation metrics without manual labeling. The evaluation results include accuracy, precision, recall, and F1 score, as well as a full classification report with per-class breakdowns. This batch evaluation framework not only allows for robust performance assessment but also enhances usability and transparency. Each prediction is also shown visually, making the system highly interpretable.

The project is implemented using a modular design philosophy, with separate Python scripts for training, prediction, utility functions, and configuration, allowing easy experimentation and future extension. The entire workflow is driven through a command-line interface (CLI), making it accessible for both beginners and advanced users. On unseen test images, the trained model demonstrated strong performance, achieving an accuracy of 97%.The result confirms that MobileNetV2, when combined with proper preprocessing, a well-structured architecture, and a powerful batch evaluation tool, offers a lightweight yet effective solution for gender classification in real-world settings.