Task B

Facial Identity Verification Using Deep Embedding Similarity

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1. Purpose of the Project

This task involves determining whether two facial images represent the same individual. The approach treats the problem as a binary classification—identifying each image pair as either a match (same identity) or non-match (different identities)—based on deep feature representations.

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2. Methodology Summary

- **Face Localization:** Facial regions are first identified using **MTCNN** for accurate cropping.
- **Feature Encoding:** A **pretrained InceptionResnetV1** model (based on FaceNet) generates deep embeddings for each detected face.
- **Pair Construction:** Identity-based image pairs are formed—both positive (same individual) and negative (different individuals).
- **Similarity Measure:** The **cosine distance** between embedding pairs is used to assess identity closeness.
- **Threshold Optimization:** The optimal decision boundary is determined using **ROC curve analysis** applied to the training data.

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3. Data Structure

- Image files are grouped by identity under the `train/` and `val/` directories.
- Pairs for training and testing are systematically generated using all available identities.
- Embedding vectors are stored and reused to reduce computation time.

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4. Testing Approach

- Each image pair receives a cosine similarity score.
- The decision threshold is derived from the ROC curve to balance false positives and false negatives.
- A split of **80% training and 20% testing** is applied to the set of generated pairs for model evaluation.

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5. Performance Indicators

Training Results:

- **Accuracy:** 88.25%
- **Precision:** 92.54%
- **Recall:** 83.18%
- **F1 Score:** 87.61%

Validation Results:

- **Accuracy:** 88.26%
- **Precision:** 92.56%

- **Recall:** 83.26%
- **F1 Score:** 87.67%

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6. Conclusion

This face verification system integrates FaceNet embeddings with cosine-based similarity scoring to assess identity correspondence between image pairs. It consistently reaches over **88% accuracy** across both training and validation phases, with high precision and balanced recall.