Data Preprocessing Report - PCA Based Face Recognition

Section	Description
Data Overview	Load face images from Train/Test directories, count per-person images, and visualize distribution.
Resizing	Resize all images to fixed size (e.g., 128x128).
Grayscale Conversion	Convert all images to grayscale for PCA (since eigenfaces require grayscale input).
Flattening	Flatten 2D face images into 1D vectors for PCA input.
Normalization	Normalize pixel values to [0,1] for stability in PCA & ANN training.
PCA Dimensionality Reduction	Apply PCA with n_components = 50, 100, 150, 200 to extract eigenfaces.
Model Architecture	Feed reduced PCA features into ANN (MLP) with hidden layers (ReLU, dropout).
Compilation	Compile with Adam optimizer, categorical crossentropy loss, and accuracy metric.
Training	Train on PCA features (X_train_pca), validate on test set. Compare results across n_components.
Saving the Model	Save trained ANN model (face_recognition_pca_ann.h5).
Evaluation	Evaluate using accuracy, confusion matrix, precision, recall, F1-score.
Single Image Prediction	Preprocess input → resize → grayscale → flatten → PCA → ANN prediction.