

Research on face recognition technique based on the EIGENFACES method

Saysamone Souvannakhamphong

Abstract: This study investigates the application of the Eigenfaces method for facial recognition, a foundational technique in computer vision and biometric identification. The Eigenfaces approach utilizes Principal Component Analysis (PCA) to reduce the high-dimensional space of facial images into a lower-dimensional subspace, capturing the most significant variations among a set of training faces. The research methodology involves constructing a covariance matrix from a database of normalized facial images, extracting eigenvectors (Eigenfaces), and projecting both training and test images into this "face space." Recognition is achieved by comparing the projection coefficients of an unknown face against known individuals using a distance metric, such as Euclidean distance. Experimental results demonstrate the method's effectiveness under controlled conditions with consistent lighting, frontal pose, and neutral expressions, achieving high recognition accuracy. However, the study also identifies limitations, including sensitivity to variations in illumination, head orientation, and facial expressions. The findings confirm that while the Eigenfaces technique provides a computationally efficient and robust baseline for face recognition, its performance degrades significantly in unconstrained environments, highlighting the need for preprocessing or hybrid approaches for real-world applications.

Keywords: Eigenfaces, Face Recognition, Principal Component Analysis, Dimensionality Reduction