

Face Recognition and Criminal Face Detection System

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Abstract: *Face recognition technology has emerged as a powerful tool in security and surveillance systems. This literature survey focuses on face recognition and criminal detection systems using modern machine learning and deep learning techniques. The primary objective is to analyze various algorithms such as Haar Cascade, Eigenfaces, Fisherfaces, Local Binary Patterns (LBP), and Convolutional Neural Networks (CNN). This paper reviews multiple research works that highlight the effectiveness, accuracy, and limitations of these techniques in real-world applications. The study also explores how these systems are used in criminal identification by comparing captured facial images with stored databases. Challenges such as lighting variations, pose differences, and real-time processing are discussed. The survey concludes by identifying research gaps and suggesting future improvements for developing more efficient and accurate face recognition systems.*

Keywords: Face Recognition, Criminal Detection, OpenCV, CNN, Haar Cascade, Machine Learning, Deep Learning

I. INTRODUCTION

Face recognition is a biometric technology used to identify or verify a person based on facial features. It plays a crucial role in modern security systems, especially in detecting criminals. Traditional systems rely on manual identification, which is time-consuming and prone to errors.

With advancements in artificial intelligence and computer vision, automated face recognition systems have become more accurate and efficient. However, challenges such as varying lighting conditions, facial expressions, and image quality still affect performance.

This literature survey aims to review existing techniques used in face recognition and criminal detection systems, analyze their strengths and weaknesses, and identify research gaps.

II. METHODOLOGY

The literature survey was conducted using the following approach:

Databases Used: IEEE Xplore, Google Scholar, ScienceDirect

Keywords Used: Face Recognition, Criminal Detection, Deep Learning, OpenCV

Selection Criteria:

Papers published between 2015–2024

Relevant to face recognition and security systems

Number of Papers Reviewed: 10–15 research papers

III. BACKGROUND / THEORETICAL FRAMEWORK

Face recognition involves two main steps:

Face Detection – Identifying the face in an image

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335

Face Recognition – Matching the detected face with stored data
 Common techniques include:
 Haar Cascade Classifier – Used for face detection
 LBP (Local Binary Pattern) – Used for feature extraction
 CNN (Convolutional Neural Networks) – Used for deep learning-based recognition

IV. EXISTING METHODS / TECHNOLOGIES / APPROACHES

4.1 Haar Cascade Algorithm

Developed by Viola-Jones, it is widely used for real-time face detection. It is fast but less accurate in complex environments.

4.2 Eigenfaces Method

Uses Principal Component Analysis (PCA) to reduce image dimensions. It is simple but sensitive to lighting changes.

4.3 Fisherfaces Method

An improved version of Eigenfaces using Linear Discriminant Analysis (LDA). It provides better accuracy in varying lighting conditions.

4.4 Local Binary Pattern (LBP)

LBP is used for texture-based feature extraction. It is robust and widely used in real-time systems.

4.5 Convolutional Neural Networks (CNN)

CNN-based models provide high accuracy and are used in modern applications like surveillance and criminal detection.

V. COMPARATIVE ANALYSIS

Method	Accuracy	Speed	Advantages	Disadvantages
Haar Cascade	Medium	Fast	Real-time detection	Less accurate
Eigenfaces	Low	Fast	Simple implementation	Sensitive to lighting
Fisherfaces	Medium	Moderate	Better than Eigenfaces	Complex
LBP	High	Fast	Good accuracy	Limited feature depth
CNN	Very High	Slow	Best accuracy	Requires high computation

VI. CHALLENGES AND LIMITATIONS

Poor image quality affects recognition accuracy
 Variations in lighting and facial expressions
 Real-time processing requires high computational power
 Large datasets are needed for training deep learning models.

VII. DISCUSSION

From the reviewed literature, it is clear that traditional methods like Haar Cascade and Eigenfaces are faster but less accurate. On the other hand, deep learning methods such as CNN provide higher accuracy but require more resources. There is a need to balance accuracy and performance for real-time criminal detection systems.

VIII. FUTURE RESEARCH DIRECTIONS

Integration with cloud-based systems
 Use of AI + IoT for smart surveillance
 Development of mobile-based face recognition apps
 Improving accuracy in low-light conditions
 Use of 3D face recognition technology



IX. CONCLUSION

This literature survey highlights various techniques used in face recognition and criminal detection systems. Traditional methods are simple and fast but less accurate, while deep learning techniques offer high accuracy with increased complexity. Future research should focus on improving real-time performance and handling environmental challenges.

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