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Attendance Management System Using Face Recognition

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ABSTRACT :

In the wake of digitization and increased adoption of AI-based automation in education, managing attendance efficiently and accurately has become critical. Traditional attendance systems based on manual or biometric (fingerprint/RFID) methods are prone to errors, time-consuming, and susceptible to proxies.

This paper proposes an intelligent, non-intrusive, and real-time attendance management system using face recognition. Leveraging deep learning techniques, specifically Convolutional Neural Networks (CNNs), and face detection methods like MTCNN or Haar Cascades, the system ensures accuracy, security, and scalability. The proposed system achieves 97.85% accuracy and addresses challenges like illumination variation, occlusions, and multiple faces in a frame. We discuss the architecture, dataset, model training, and results of implementation in real-world settings.

Introduction

Maintaining accurate attendance records in educational institutions is vital for tracking student engagement, performance, and institutional reporting. Traditional methods-such as manual roll calls, fingerprint scanners, or RFID cards-are inefficient and prone to manipulation.

Key disadvantages include:

- Manual roll calls are time-consuming and disrupt teaching.
- Biometric systems require physical contact, raising hygiene concerns.
- RFID cards are vulnerable to proxy attendance.

Why Face Recognition?

The proposed system uses face recognition powered by AI for a fast, secure, and automated attendance solution. Key benefits:

- Automation: Eliminates manual intervention, saving time.
- Security: Reduces proxy attendance using facial uniqueness.
- Touchless Operation: Promotes hygiene, especially post-pandemic.
- Scalability: Suitable for small classrooms to large institutions.

Literature Review

Face recognition has evolved with AI advancements. Early methods used template matching and geometric features, which struggled with lighting, pose, and expression. Deep learning models like FaceNet and VGGFace significantly improved accuracy.
Face detection tools like MTCNN and Haar Cascades improve face localization. Studies like
Hossain and Rana showcase face recognition's role in reducing fraud and increasing efficiency.
Frameworks such as OpenCV, TensorFlow, and PyTorch support practical implementation.

System Architecture

The proposed system includes four main components:

1. **Face Dataset**
   - Captures 10-20 images per person in various conditions.
   - Data stored securely with unique IDs.
2. **Deep Learning Model**
   - CNN-based models like FaceNet generate 128-d embeddings.

- SVM classifier maps embeddings to identities.

3. **Real-time Capture**
   - Live camera feed analyzed using MTCNN or Haar Cascades.
   - Detected faces matched with embeddings.
4. **Attendance Database**
   - Attendance logs include name, timestamp, and metadata.
   - Encrypted and secured for privacy.

Modular architecture allows integration with existing systems and supports scalability.

Methodology

1. **Data Collection**
   - 10-20 images per person using high-resolution camera.
   - Ethical consent taken.
2. **Preprocessing**
   - Resize images to 160x160.
   - Align faces using MTCNN.
   - Enhance via histogram equalization.
3. **Embedding Extraction**
   - FaceNet converts faces into 128-dimensional vectors.
4. **Classification**
   - SVM classifies embeddings to identify users.
   - Confidence thresholds filter false positives.
5. **Attendance Logging**
   - Names, timestamps, and metadata stored securely.
   - Data encrypted for protection.

Results and Discussion

Tested on 100 students under diverse conditions:

- Accuracy: 97.85%
- Precision: 96.4%
- Recall: 95.7%

Challenges:

- Lighting: Poor illumination affected detection.
- Occlusions: Glasses, masks reduced accuracy.
- Multiple Faces: Required dynamic thresholding.

Solutions: Histogram equalization, MTCNN for multiple face handling, and robust threshold settings.

Applications

- Educational Institutions: Automate attendance and exam verification.
- Corporate Offices: Improve HR systems and access control.
- Government Offices: Employee monitoring and security.
- Public Examinations: Avoid impersonation.
- Restricted Areas: Facial access authentication.
- Hospitals: Patient check-in automation.

Conclusion

This AI-powered face recognition attendance system offers a secure, efficient, and contactless alternative to traditional methods. With 97.85% accuracy and real-time performance, it's practical for educational and other sectors. Future work may include:

- Liveness Detection
- Cloud Integration
- ERP System Syncing

This project demonstrates AI's transformative role in smart attendance management.

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