**Face Recognition-Based Attendance System using Face Recognition Libraries in Python**

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**Abstract**  
**Automated attendance systems have become crucial in educational and organizational settings, offering efficiency, accuracy, and security over traditional manual attendance marking. This paper presents a face recognition-based attendance system that utilizes deep learning techniques to recognize and register student attendance in real time. The proposed system integrates a Streamlit-based user interface for ease of use, supports live face recognition, and processes video uploads for attendance marking. Our approach ensures reliability through preprocessing enhancements, optimized frame selection, and robust model implementation. The system provides structured attendance reports and mitigates false positives by implementing a confidence threshold. Experimental results demonstrate high recognition accuracy, making this system a viable alternative to conventional methods.**

**Keywords: Face Recognition, Attendance System, Deep Learning, Streamlit, Image Processing, Machine Learning**

**1.Introduction**  
 Attendance tracking is an essential process in academic institutions and workplaces. Traditional attendance methods, such as roll

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calls and biometric systems, often suffer from inefficiencies, time consumption, and security vulnerabilities. The advent of deep learning-based face recognition has paved the way for automated, contactless, and reliable attendance marking. This paper introduces a face recognition-based attendance system that enhances accuracy, reduces human intervention, and improves the overall attendance management process. The system is implemented using Streamlit for an interactive user interface, supports face registration, and enables real-time and video-based attendance tracking.

**2.Literature Review**  
Face recognition technology has evolved significantly over the past decades, with applications spanning security, authentication, and attendance systems. Early approaches primarily relied on handcrafted features such as Eigenfaces [1] and Fisherfaces [2], which projected facial images into lower-dimensional spaces for recognition. While effective under controlled conditions, these methods were highly sensitive to variations in lighting, pose, and expression.

With the rise of deep learning, convolutional neural networks (CNNs) have revolutionized face recognition. The introduction of DeepFace [3] by Facebook and FaceNet [4] by Google showcased the power of deep learning in learning discriminative face embeddings. FaceNet, in particular, introduced a triplet loss function that maps faces into an embedding space, minimizing the distance between same-identity images while maximizing the separation between different identities.

More recent advancements include Dlib’s face recognition library, which leverages ResNet-based architectures for high-accuracy face recognition. Additionally, the face\_recognition Python library, built on Dlib, provides an easy-to-use interface for face detection and recognition, making it popular in real-world applications.

Attendance systems utilizing face recognition have also gained traction in educational institutions and workplaces. Previous studies have implemented real-time attendance tracking using OpenCV and Haar Cascades [5], though these methods struggle with occlusion and poor lighting conditions. More recent approaches integrate deep learning-based feature extraction with real-time streaming, improving robustness and accuracy.

However, challenges remain, including handling large-scale datasets, reducing false positives, and improving efficiency for low-powered devices. Research has also explored hybrid approaches, combining CNNs with feature-based techniques such as Local Binary Patterns Histogram (LBPH) for increased robustness.

Our system builds upon these advancements by integrating a high-accuracy face recognition model with real-time processing and CSV-based attendance tracking. Unlike traditional methods, our approach employs preprocessing enhancements such as histogram equalization and frame selection to optimize recognition accuracy while minimizing redundancy.

**3. Proposed System**  
The face recognition-based attendance system consists of the following components:

* **Face Registration:** Students register their faces via a webcam, ensuring high-quality image capture with real-time previews and progress indicators.
* **Face Recognition:** The system processes uploaded videos, extracting 50-100 frames and selecting the most suitable ones for recognition.
* **Preprocessing Enhancements:** Grayscale conversion, histogram equalization, and high-resolution face image extraction improve recognition accuracy.
* **Training Data & Augmentation:** Capturing images from various angles and lighting conditions, along with data augmentation, strengthens the model’s robustness.
* **Attendance Marking:** Recognized faces are recorded in a CSV file, ensuring structured and retrievable attendance data.
* **User Interface & Navigation:** Streamlit’s interactive UI supports real-time feedback, seamless navigation, and user-friendly controls.
* **Accuracy & False Positive Reduction:** A confidence threshold is applied to mitigate misclassification, enhancing reliability.

**4.Implementation**  
The system is developed using Python with key libraries such as OpenCV, dlib, and TensorFlow/Keras. It leverages a pre-trained face recognition model for feature extraction and classification. The application is deployed via Streamlit, enabling an accessible and intuitive interface. The attendance is stored in CSV format, allowing easy retrieval and report generation.

**5.Experimental Results**  
The system was tested on a dataset of student images captured in different lighting conditions and angles. Key performance metrics such as precision, recall, and accuracy were evaluated. The system achieved a high recognition accuracy, with minimal false positives, validating its efficacy over traditional attendance methods.

**6. Conclusion & Future Scope**  
The proposed face recognition-based attendance system offers an efficient, automated, and secure solution for attendance tracking. Future enhancements include integrating cloud storage for remote access, expanding the dataset for improved model generalization, and incorporating multi-factor authentication for enhanced security.

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