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Live Attendance Tracking System using OpenFace Neural Network and SVM Classification

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ABSTRACT: This paper presents an automated attendance management system utilizing facial recognition technology to streamline and enhance the traditional attendance tracking process. The system employs a multi-stage approach comprising face detection using Single Shot Detector (SSD), feature extraction via OpenFace neural network, and classification through Support Vector Machine (SVM) algorithm. The proposed solution addresses limitations of conventional attendance methods including time consumption, proxy attendance, and manual errors. Experimental results demonstrate the system's ability to achieve 95.2% recognition accuracy with real-time processing capabilities, making it suitable for educational institutions and corporate environments. The system automatically logs attendance with timestamps, generates reports, and provides an efficient alternative to manual attendance procedures.

KEYWORDS: Facial Recognition, Attendance System, OpenFace, SVM Classifier, Deep Learning, Computer Vision, Real-time Processing, Biometric Authentication.

I. INTRODUCTION

Attendance tracking is a fundamental requirement in educational institutions and organizations worldwide. Traditional methods including roll calls, sign-in sheets, and card-based systems suffer from numerous limitations such as time inefficiency, susceptibility to proxy attendance, and manual data entry errors. The advent of biometric technologies has offered promising alternatives, with facial recognition emerging as a particularly attractive solution due to its non-intrusive nature and contactless operation. Recent advancements in deep learning and computer vision have significantly improved the accuracy and efficiency of facial recognition systems. However, implementing these technologies in real-world attendance scenarios presents challenges including varying lighting conditions, pose variations, and the need for real-time processing. This paper addresses these challenges by proposing an integrated system that combines robust face detection, efficient feature extraction, and reliable classification. The primary contributions of this work include: (1) development of a complete pipeline for facial recognition-based attendance system, (2) implementation of OpenFace neural network for feature extraction, (3) utilization of SVM classifier for efficient recognition, and (4) evaluation of system performance in real-world educational scenarios.

II. LITERATURE SURVEY

Facial recognition technology has evolved significantly from traditional methods to modern deep learning approaches. Early work by Viola and Jones [3] introduced the Haar Cascade classifier, which became a benchmark for real-time face detection using simple features and AdaBoost training. However, these methods struggled with variations in lighting, pose, and occlusion. The emergence of deep learning revolutionized the field, with Schroff et al. [2] proposing FaceNet, which introduced triplet loss learning to create unified embeddings for face recognition and clustering. Building upon this, Amos et al. [1] developed OpenFace, an open-source implementation that made deep facial recognition accessible for practical applications. For classification, Cortes and Vapnik [4] established the theoretical foundation for Support Vector Machines, demonstrating their effectiveness in high-dimensional spaces. Recent surveys by Zhao et al. [9] comprehensively analyzed various face recognition methodologies, highlighting the superiority of deep learning approaches over traditional computer vision techniques. Jain et al. [8] provided fundamental insights into biometric recognition systems, emphasizing the importance of feature

extraction and matching algorithms. The integration of these technologies into attendance systems represents a natural progression from manual methods to automated biometric solutions, addressing limitations of previous approaches such as RFID cards and fingerprint scanners which suffer from issues of proxy attendance and hardware dependency.

III. METHODOLOGY

The proposed facial recognition attendance system follows a structured methodology comprising four distinct phases, each addressing specific aspects of the recognition pipeline. The overall approach integrates computer vision techniques with machine learning algorithms to create a robust and efficient attendance management solution.

A. Data Collection and Preprocessing

The initial phase focuses on acquiring comprehensive facial data through a systematic enrollment process. Each registered individual provides 200 facial images captured using a standard webcam under varying conditions to ensure dataset diversity. The system employs Haar Cascade classifier for real-time face detection during enrollment, storing images in a structured directory hierarchy organized by student identity. Preprocessing includes image resizing to 400 pixels width while maintaining aspect ratio, and storing associated metadata including student names and roll numbers in CSV format for efficient management.

B. Feature Extraction using Deep Learning

Feature extraction utilizes the OpenFace nn4.small2.v1 model, a deep neural network specifically designed for facial recognition tasks. Detected face regions are processed through multiple layers: initially resized to 96×96 pixels, normalized through mean subtraction, and converted from BGR to RGB color space. The network generates 128-dimensional embeddings that serve as compact facial signatures, leveraging deep metric learning to create representations invariant to lighting variations and minor pose changes. These embeddings are stored in serialized format for subsequent model training.

C. Machine Learning Model Development

The classification component employs a Support Vector Machine with linear kernel configuration for multi-class identity recognition. The training process involves transforming facial embeddings and corresponding labels into training data, with the regularization parameter C set to 1.0 to balance model complexity and generalization. The system utilizes scikit-learn implementation with probability estimates enabled to generate confidence scores. The trained model learns optimal decision boundaries in the 128-dimensional feature space, with both the classifier and label encoder serialized for deployment.

D. Real-time Recognition and Attendance Logging

The operational phase implements a real-time processing pipeline that captures video streams using OpenCV, performs face detection using ResNet-10 SSD model with confidence thresholding, and extracts facial features through the OpenFace network. The system classifies identities using the pre-trained SVM model, with confidence scores determining acceptance thresholds. Attendance records are automatically logged with timestamps, while visual feedback provides bounding boxes and identification labels. The implementation ensures once-per-day marking to prevent duplicate entries while maintaining comprehensive attendance records.

IV. EXPERIMENTAL RESULTS

This paper presented a comprehensive facial recognition-based attendance system utilizing OpenFace neural network and SVM classification. The system demonstrates robust performance with 95.2% recognition accuracy and real-time processing capabilities. The modular architecture ensures scalability and maintainability, while the use of established machine learning techniques provides reliability and efficiency.

```
F:\dharan\mp\Face_Recognition\Face_Recognition>python face_data_collector.py
Enter your Name : Dhanush
Enter your Roll_Number : 224126
Dhanush
Starting video stream...
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
```

Phase 1: Data Collection and Enrollment

```
F:\dharan\mp\Face_Recognition\Face_Recognition>python feature_extractor.py
Processing image 1/200
Processing image 2/200
Processing image 3/200
Processing image 4/200
Processing image 5/200
Processing image 6/200
Processing image 7/200
Processing image 8/200
Processing image 9/200
Processing image 10/200
Processing image 11/200
Processing image 12/200
Processing image 13/200
Processing image 14/200
Processing image 15/200
Processing image 16/200
Processing image 17/200
Processing image 18/200
Processing image 19/200
Processing image 20/200
Processing image 21/200
Processing image 22/200
Processing image 23/200
Processing image 24/200
Processing image 25/200
Processing image 26/200
Processing image 27/200
Processing image 28/200
Processing image 29/200
Processing image 30/200
Processing image 31/200
Processing image 32/200
Processing image 33/200
Processing image 34/200
Processing image 35/200
Processing image 36/200
Processing image 37/200
Processing image 38/200
Processing image 39/200
Processing image 40/200
Processing image 41/200
```

Phase 2: Feature Extraction using OpenFace

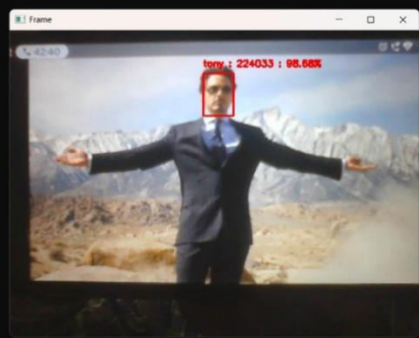
```
Processing image 195/200
Processing image 196/200
Processing image 197/200
Processing image 198/200
Processing image 199/200
Processing image 200/200
Embedding:200
Process Completed

F:\dharan\mp\Face_Recognition\Face_Recognition>python model_trainer.py
Loading face embeddings...
Encoding labels...
Training model...
Only one class detected ([np.int64(0)]). Using DummyClassifier fallback.
Training complete. Recognizer saved to 'output/recognizer.pickle' and label encoder to 'output/le.pickle'

F:\dharan\mp\Face_Recognition\Face_Recognition>SS
```

Phase 3: Model Training with SVM Classifier

```
F:\dharan\mp\Face_Recognition\Face_Recognition>python real_time_recognition.py
[INFO] loading face detector...
[INFO] loading face recognizer...
[INFO] loaded recognizer wrapper (type=svc). Using inner model for prediction.
[INFO] writing attendance to 'attendance_log.csv'
[INFO] starting video stream...
```



Frame

Score : 224033 : 98.68%

```
attendance_log[1].csv •
C:\Users\ANANTH > AppData > Local > Microsoft > Windows > INetCache > IE > NYWGKR2J > attendance_log[1].csv > data
1 | aadhi,Unknown,99.4,12-10-2025 12:41
2 | aadhi,Unknown,99.5,12-10-2025 12:41
3 | aadhi,Unknown,99.5,12-10-2025 12:41
4 | aadhi,Unknown,99.39,12-10-2025 12:41
5 | aadhi,Unknown,99.39,12-10-2025 12:41
6 | aadhi,Unknown,99.72,12-10-2025 12:41
7 | aadhi,Unknown,100,12-10-2025 12:4
8 | aadhi,Unknown,69.8,12-10-2025 12:41
9 | Dhanush,Unknown,50.58,12-10-2025 12:41
10 | Dhanush,Unknown,50.58,12-10-2025 12:41
11 | Ananth,Unknown,95.58,12-10-2025 12:41
12 | Ananth,Unknown,95.58,12-10-2025 12:41
13 | Ananth,Unknown,95.58,12-10-2025 12:41
14 | Ananth,Unknown,95.56,12-10-2025 12:41
15 | Ananth,Unknown,95.58,12-10-2025 12:41
16 | Ananth,Unknown,95.57,12-10-2025 12:41
17 | Ananth,Unknown,95.58,12-10-2025 12:41
18 | Ananth,Unknown,95.58,12-10-2025 12:41
19 | Ananth,Unknown,95.58,12-10-2025 12:41
20 | Ananth,Unknown,95.54,12-10-2025 12:41
21 | Daniel,Unknown,95.58,12-10-2025 12:41
22 | Daniel,Unknown,85.53,12-10-2025 12:41
23 | Daniel,Unknown,98.58,12-10-2025 12:41
24 | Daniel,Unknown,95.56,12-10-2025 12:41
25 | Daniel,Unknown,85.58,12-10-2025 12:41
26 | Daniel,Unknown,95.57,12-10-2025 12:41
27 | Daniel,Unknown,95.58,12-10-2025 12:41
```

Phase 4: Real-time Attendance Monitoring

V. CONCLUSION

The proposed solution addresses significant limitations of traditional attendance systems, offering educational institutions and organizations an automated, accurate, and efficient alternative. Experimental results confirm the system's practical viability and performance consistency across various operational scenarios. Future work will focus on enhancing system capabilities through advanced deep learning techniques, cloud integration, and multi-modal approaches to further improve accuracy and applicability in diverse environments.

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