Real-Time Face Authentication for Attendance Management with Anti-Spoofing Integration

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***Abstract*—The increasing demand for automated attendance systems in the school and corporate industries led to the development of a Real-Time Smart Attendance System based on facial recognition and anti-spoofing. Fingerprint scanners and roll calls are unsanitary, time-consuming, and prone to errors. Our system is utilizing BlazeFace to recognize faces in real-time, FaceNet to make accurate recognition, and an anti-spoofing CNN-based system to cancel out fake check-ins. The solution offers a contactless, real-time, and scalable answer with low intervention that ensures safe tracking of attendance. There is a cloud central database that enables administrators to monitor attendance easily.**

***Keywords*—Face Recognition, Anti-Spoofing, BlazeFace, FaceNet, Convolutional Neural Network (CNN), Attendance System.**

I. INTRODUCTION

Keeping good attendance records is still an incredibly high priority in offices and schools too—except for the age of computers today. Old systems such as sign-in sheets or roll calls of missing names all consume valuable time and are also very error-prone. All these old systems add up to usually proxy attendance, where individuals take attendance for others, and creating records barely reliable. While other companies have moved to biometric technology such as fingerprint readers, those also have their fallacies. In the COVID era, cleanliness and contactless interaction are paramount, and sharing the same devices is a disadvantage. Even RFID card technology or QR code scanning has the potential to be abused, as one can easily swap cards or trade codes in order to mimic their presence.

Facial recognition is a touch-less and more secure option. Artificial intelligence and deep learning have progressed so well that it can now be achieved to recognize faces in real-time with very good accuracy. Such systems are even susceptible to very serious attack: spoofing. People can use printed images, videos, or even 3D masks to trick the system into giving them unauthorized access. Such loopholes can completely discredit the authenticity of automated attendance systems. To counter all the above drawbacks, this project proposes a smart attendance system with the incorporation of best-class anti-spoofing and real-time face recognition feature. Detection application makes use of software such as BlazeFace, FaceNet for identification, and Convolutional Neural Networks (CNN) for classifying the input as real or fake. Secure and optimized utilization of real-time access and storage through a central cloud-based database is available. This blended system not only increases the speed and accuracy but also eliminates human errors and ghost entries. Its scalability makes it apt for schools, enterprises, and other institutions searching for an attendance management system which is contactless and secure.

II. PROCEDURE FOR PAPER SUBMISSION

Various researchers have explored the development of automated attendance systems using varied input modes, data handling approaches, and control structures. Joshi et al. [1] used a facial recognition-based system that facilitates real-time attendance monitoring. While it guarantees secure access, cloud storage can cause latency and raises data security issues. El-Mashad et al. [2] proposed a smart university campus with deep learning models to improve recognition accuracy. However, the system demands enormous computational power, and therefore scaling the system is a problem. Yang et al. [3] proposed an anti-spoofing approach using CNNs to recognize real faces from fake ones, which prevents proxy check-ins. Chaudhary et al. [12] also used CNN-based spoof detection to reduce the risk of proxy attendance. Bayar et al. [4 thought of BlazeFace as a lightweight model for quick facial recognition, especially suitable for embedded devices. However, the model has limitations when handling large-scale data. Dammalapati et al. [5] have put forth an OpenCV-based Python face recognition system. Inexpensive and easy to implement, it is suboptimal in low light with lesser accuracy. All these papers bring forth the scope and limitation of existing AI-based attendance systems. While some show immense potential in live environments, issues such as spoofing, computation overhead, and environment dependency remain to be addressed. To that effect, this paper offers a hybrid approach integrating FaceNet for recognition, MTCNN for detection, and CNN-based anti-spoofing techniques. The emphasis lies in delivering a secure, scalable, and extremely accurate automated attendance solution that is reliable in real-world environment.

III. PROPOSED METHODOLOGY

After critical analysis of some face recognition methods, we designed a practical and secure automated attendance system. We are using BlazeFace for face detection, FaceNet for face identification, and a CNN-based model for detecting spoofing to increase system security.

A. Face Detection

Our system begins with BlazeFace, a fast and lightweight deep learning model specifically tuned for real-time face detection. The images are resized to 128 × 128 pixels so that they are processed uniformly. The model uses bounding boxes to identify the face locations after scanning the image with 896 anchor points. For improved accuracy, it uses a process called Non-Maximum Suppression (NMS) that removes overlapping detections. BlazeFace is chosen because it is fast and efficient on low-resource devices, making it appropriate for embedded or mobile systems.

B. Anti-Spoofing Mechanism

To confirm that the face detected is authentic and not a video or an image, the system has introduced a Silent Face Anti-Spoofing model. The technique uses deep CNNs to pass through textures, depth pattern, and subtle motion features that differentiate live human faces from spoofing activities like printed images or face masks. The model is created to maintain low false-positive rates and operates at a high level of confidence by setting threshold scores for decision-making.

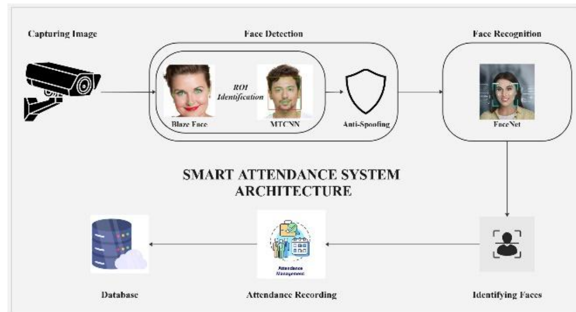

Fig. 3.1 System Architecture

C. Face Recognition

FaceNet algorithm is used to match the identified face with known identities. Each face is translated into an embedding of 128 dimensions of a deep CNN model. Accuracy is improved through a triplet loss function by keeping similar faces at a close distance. Identification occurs through the use of threshold-based comparison in order to be able to determine reliable identification without too much human efforts.

IV. IMPLEMENTATION

Smart Attendance System is a systematic modular system that combines face detection in real time, recognition of identity, and anti-spoofing. BlazeFace for face detection, FaceNet for recognition, and CNN-based anti-spoofing for authenticating only real individuals are enrolled as present. The system boasts real-time functionality and offers smooth, fast, and secured attendance processing. Following is a step-by-step walk-through of each module implementation:

A. Image Capture

To initiate the attendance process, live video streams are collected from the strategically placed CCTV cameras. The system is continuously getting these video streams and is parsing them for frames to process A face is identified by processing each frame. When a face is identified, it is eliminated from the picture and moved on to the following step for confirmation. Here, the system checks whether the face is real or a spoofing attempt, i.e., if a person is trying to fool it using an image, a video recording, or even a mask.

B. Face Detection with BlazeFace

BlazeFace is a facial recognition module used in our software. It is a light-weight yet highly effective model that was built with real-time calculations in mind. Input images are padded to 128 x 128 pixels for standardization, and BlazeFace outputs 896 anchor points for face area detection.

For duplicate or overlapping detection prevention, it employs Non-Maximum Suppression (NMS), where less accurate detections are eliminated. Deployed in the MediaPipe framework, BlazeFace runs smoothly even on low-power embedded devices, and is thus highly portable and scalable.

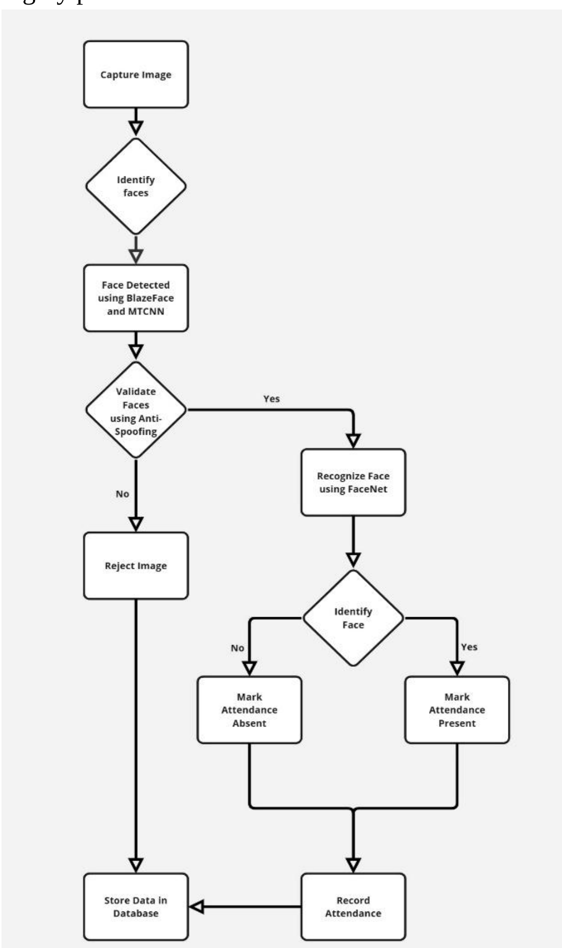

Fig. 4.1 Proposed System Flow Chart

C. Anti-Spoofing using CNN

To guard against impersonation or proxy attendance, we incorporate a Silent Face Anti-Spoofing model. This technique uses a deep CNN to analyze facial textures, motion dynamics, and depth to determine if a face is real or spoofed. It is trained on genuine and fake data, such as photos, masks, and videos. The model analyzes several frames and features to detect a genuine human presence or spoofing. A confidence score is assigned to each face so that the genuine users can proceed, and false positives are minimized.

D. Face Recognition using FaceNet

Face recognition using FaceNet follows next, which is a deep learning model that transforms each face into a 128-dimensional vector. These vectors (or embeddings) are projected in a Euclidean space where the similar faces are near one another. A triplet loss function makes faces of the same person near one another, and disparate ones distant. This makes matching extremely accurate. The system cross-checks the input embeddings with the ones in its database, which keeps names and face vectors. The module, which was created using PyTorch, is effective and convenient, and it works with Python-based file management.

E. Recording Attendance

After a face is recognized and verified, the attendance module saves the data in a database that is linked with the cloud. It saves relevant information such as the name of the identified person and the exact timestamp of their checking in. Only the faces that have passed spoof detection are recorded, ensuring absolute reliability.

V. RESULT

The Facial Recognition and Anti-Spoofing Smart Attendance System was rigorously tested to verify its performance, reliability, and response in real time. Real-time testing was done, and the system was highly accurate in recognizing and detecting registered users such as Jai Adithyan, Karthik, Jeevabarathi P, and Kamal D, their attendance was marked with accurate timestamps. One advantage of the system was that it was able to identify multiple individuals in seconds, which ensured that it operated immediately. All attendance records and face embeddings were automatically saved in a structured database—face embeddings, each 512 dimensions long, were added to a special collection, while names of attendance events and time stamps were saved in a special attendance collection. This setting was easy to observe and track attendance history for a given user.

Single-face recognition was also tested successfully. For instance, the system detected and logged Kamal D's attendance at exactly 12:48:07, showing its performance in handling single-user instances with minimal lag. The system also had the ability to identify that there were no faces and eliminate such frames to reduce the chances of raising incorrect entries or false alarms. Real-time processing allowed the system to generate correct attendance records on time, which demonstrated that the system is well compatible with real-time environments. Additional testing on some subjects like Deepa Shree, Deny Gabriel, Kamal D, and Karthik S allowed the system to be used by additional users. They were all correctly identified, and attendance sheets were created from time to time, demonstrating the scalability of the system. The anti-spoofing ability was also excellent. For genuine faces, the system produced as high as 0.95 confidence values, whereas the spoofed inputs such as printed images were rejected with perfect accuracy with less than 0.93 confidence values. All these findings confirm the system to differentiate between genuine and spoofed inputs and determine its security performance.

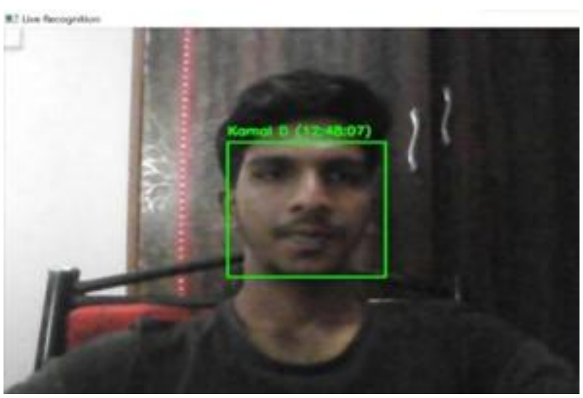

Fig. 5.1 Recognizing Single Face

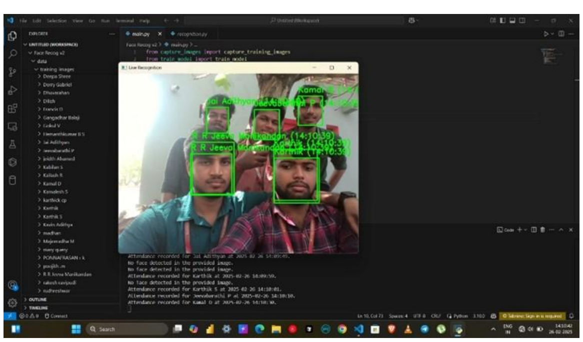

Fig. 5.2 Recognizing Multiple Faces Using FaceNet

Overall, the smart attendance system worked well in real-world environments. It uses a balance of scalability, high performance, and database-backed storage to achieve a stable and accurate solution. With strong face recognition, anti-spoofing, and multi-user capability, the system is a suitable option for real-world deployment in institutions or organizations where attendance accuracy matters.

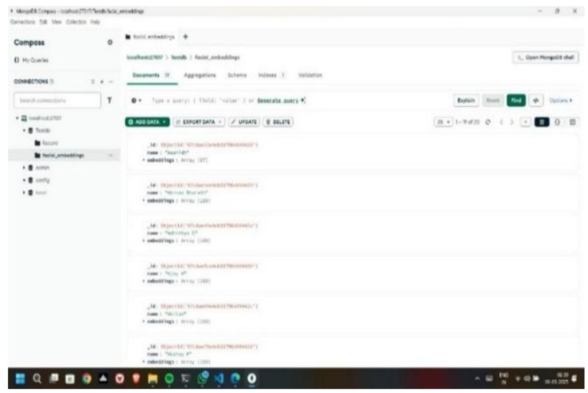

Fig. 5.3 MongoDB Management System

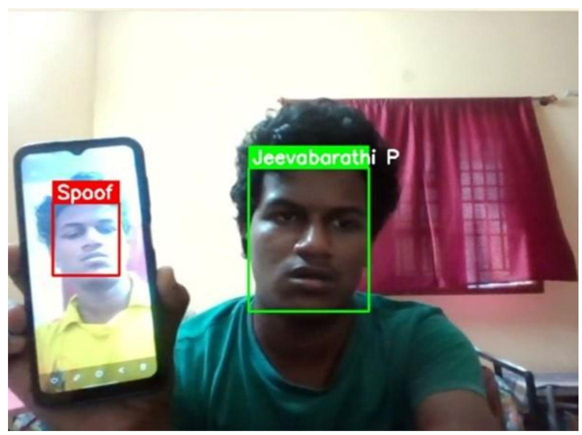

Fig. 5.4 Detecting Spoof Images

VI. CONCLUSION

Facial recognition technology based smart attendance installation is a huge leap towards the automation and increase in efficiency in attendance records of institutions like schools, offices, and organizations. Old practices like roll calls, ID card swipes, and fingerprint readers not only are out of date but also face time wastage, data errors, as well as proxy usage. Through the integration of newer technologies such as BlazeFace [4] for detection and MTCNN [15] for stable facial landmark tracking, the system avoids these constraints through a contactless, fast, and accurate method.

One of the strongest strengths of this system is its anti-spoofing capability, powered by neural networks like FaceNet [5] and deep CNN architectures. These techniques ensure live, genuine users only are identified and recorded, significantly enhancing security and integrity of attendance records. Real-time cloud database synchronization guarantees that attendance records are real-time, available, and scalable to large-scale environments. Adminstratively, the system conserves manpower, removes likely human errors, and facilitates attendance management. Its touchless operation is also commensurate with contemporary hygiene processes, offering a hygienic option in the aftermath of post-pandemic settings. Coupled with real-time validation, the automation offers genuine, real-time, and tamper-free recording of attendance. Lastly, the proposed facial recognition-based system not only improves operation efficiency but also allows for transparency and digitalization. It is a novel solution which is ideally well-suited for the growing need of smart automated systems in contemporary institutions and businesses seeking trustworthy attendance monitoring systems.

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