FACE ID-CARE: Real-Time Facial Attendance System for Healthcare Staff with Emergency Role- Based Alerts

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ABSTRACT

Computer vision and deep learning have evolved at a high rate hence resulting in an improved performance of the biometric systems especially in the facial recognition systems. This study proposes a system called FACE ID-CARE, which is an attendance system based on facial recognition technology, which is used to record the attendance at a healthcare facility in real-time. The system uses a deep learning technology- FaceNet and Arcface to recognize accurately all the healthcare staff members such as doctors and nurses [1], [3].

The proposed system presents an emergency alert system, which is implemented through role-based access to alert critical situations to important personnel. The system offers immediate tracking of attendance by its camera input which uses deep neural networks to scan the faces and it stores attendance records in a database [4].

The system design is inspired by a number of research works that involve embedding-based recognition systems and large-scale datasets as well as comprehensive face recognition systems. Experimental results indicated that deep learning models could achieve above 95 percent accuracy in case of various conditions. The system is yet to overcome three key challenges that comprise of high calculations, reliance on specific datasets and real time processing of data [7].

The proposed system tries to overcome these challenges by having its application of efficient architectures along with optimized workflows. The findings demonstrate that the system is now more accurate and reliable and has shorter response times, which makes it suitable to the existing smart healthcare systems [2].

Keywords: Alternatives Attendface, Facial Recognition, Faculty Attendance System, Facilitance FaceNet, Arcface, Healthcare System, Emergency Alert System, Computer Vision.

1. INTRODUCTION

Facial recognition has become one of the most popular methods of biometric identification because of its non-contact procedure and very good accuracy. As the demand to automate the healthcare systems is rising, there is a corresponding increase in the need to have intelligent solutions that are able to control the attendance of staff and at the same time provide quick emergency response. The conventional methods of attendance like fingerprint scanners and RFID cards have several drawbacks that comprise proxy attendance, sanitation and ineffectiveness. Such problems are especially important in a healthcare setting when precision and promptness are crucial [6].

The FACE ID-CARE system also removes these challenges through the combination of facial recognition and a smart alert system. Its purpose is to identify the healthcare staff automatically with real-time video input and keep the attendance records Moreover, it also brings a new feature in the form of alerts that are issued depending on the role of the staff so that in case of an emergency, the doctor will be given the priority on receiving alerts as compared to the nurses.

The recent developments in the deep learning have greatly enhanced the facial recognition performance [4]. In the case of FaceNet, a stronger example is provided by the introduction of a technique to project facial images into a small embedding space, in which distances indicate similarity [1]. On the same note, ArcFace enhanced feature discrimination on angular margin loss, and this increased recognition accuracy [1].

The current paper is based on these developments and suggests a system designed specifically to meet the healthcare setting.

2. LITERATURE REVIEW

Various research studies have made significant contributions in the development of facial recognition systems. FaceNet proposed a deep learning embedding model which directly projects face images into a Euclidean space with similar faces being closer together. This method is easy to use because it enables recognition and clustering and is very accurate [1].

VGGFace2 also enhanced the recognition systems by offering a large-scale dataset of more than 3 million images with a great variation on pose, age and lighting conditions [2].

This dataset will be instrumental in the development of strong models that can be used to deal with real-life situations [2].

ArcFace proposed an additive angular margin loss operation, which improves the discriminating ability of features. Such an approach guarantees the enhanced separation of various identities and increases the level of recognition by a significant margin [3]. A general survey on deep face recognition points out that an entire system is made up of three important elements which include face detection, face alignment, and face representation. All these elements are part of the system performance [4].

Comparative analysis has revealed that FaceNet is better than other models like VGGFace and GhostFaceNet with accuracy rates of more than 97 percent [5].

These results prove the usefulness of embedding-based strategies. Also, the real-life examples of applications based on deep learning and OpenCV prove the possibility of the efficient face recognition

system functioning in real-time in order to track attendance. The other challenges that are being noted by research in recent times are the complexity of computation and requirement of large datasets, which are to be tackled in order to implement this to real life [7].

Table 1: Comparison of Face Recognition Models

Model	**Technique Used**	**Advantage**
FaceNet	Triplet **Loss**	High accuracy
ArcFace	Angular Margin Loss	Better discrimination
VGGFace	CNN-based	Robust dataset

3. PROPOSED SYSTEM

The FACE ID-CARE system is created as a cohesive tool of attendance tracking and emergency reaction in a medical facility.

The system is made up of four major modules:

- Face Detection Module
- Face Recognition Module

The attendance management system is a computer application that manages student attendance records. The attendance management system is a computer program that handles student attendance records.

Emergency Alert System: The process starts with the process of recording real-time video input through a camera.

The system identifies the faces within the video stream and works on them with deep learning models. Embeddings of extracted features are compared to stored ones, which are used to identify individuals. Upon identification, the system takes the attendance automatically. Alerts are created according to the predefined roles in the case of the emergency, and the critical staff members will be notified instantly [1].

The FACE ID-CARE system proposed will be an in-depth and smart system to address attendance and emergency response in a healthcare setting. This system incorporates various modules such as face detection, face recognition, attendance management and emergency alert system into one system [2].

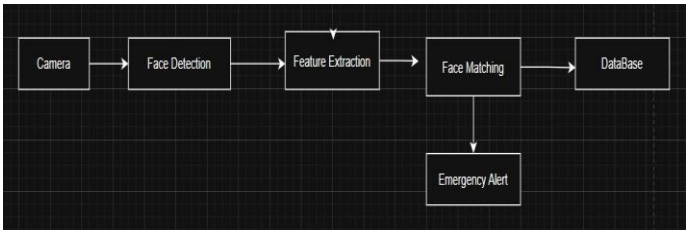
The main goal is to automate the attendance management and to have quick response in case of a critical situation. The system initiates with real-time video input by the installation of a camera at the entry points in the healthcare facility [5].

The video frames captured are captured and processed to identify faces by use of computer vision methods. After detection, a face is sent to the recognition module where it is sent through the deep learning models like Face Net to extract unique facial embeddings. These embeddings are further compared to an existing database which has registered members of staff [2].

When a match is achieved, the system will automatically record the attendance, and other necessary information including the date, time, and the position held by the staff. The system also has an intelligent emergency alert in addition to attendance tracking. This module tracks the preset conditions and alerts healthcare staff depending on their positions [4].

As an example, doctors are given priority to get notified first than the nurses during emergencies. This makes the system very effective in the real-life healthcare environment with regard to efficient resource utilization and response time.

Fig 1: System Architecture



4. METHODOLOGY

The algorithm of the system proposed is a structured pipeline and it is like end-to-end face recognition systems.

4.1 Face Detection: The first step is face detection, in which the system determines the position of the faces in an image. They are Haar Cascade and deep learning-based detectors techniques [2].

4.2 Face Alignment: The recognized faces are brought into a standard orientation to enhance their recognition [2].

4.3 Feature Extraction: FaceNet as a deep learning model produces embeddings, the facial features expressed as compact [1].

4.4 Face Matching: The system makes comparisons between embeddings the Euclidean distance. The relationship between two faces of one person is determined by a threshold
[4].

4.5 Attendance Logging: The database records the attendance automatically with timestamps [4].

4.6 Emergency Alert Mechanism: The system has the priorities according to roles:

- Doctor- High priority
- Nurse - Medium priority

Real-time alerts are used to make sure response time is fast [6].

Table 2: System Workflow

1	Captures Image	Camera Input
2	Detect Face	Identity Face region
3	Extract Features	Generate embeddings
4	Match Face	Compare with database
5	Mark Attendances	Store data
6	Send Alert	Role-based alert

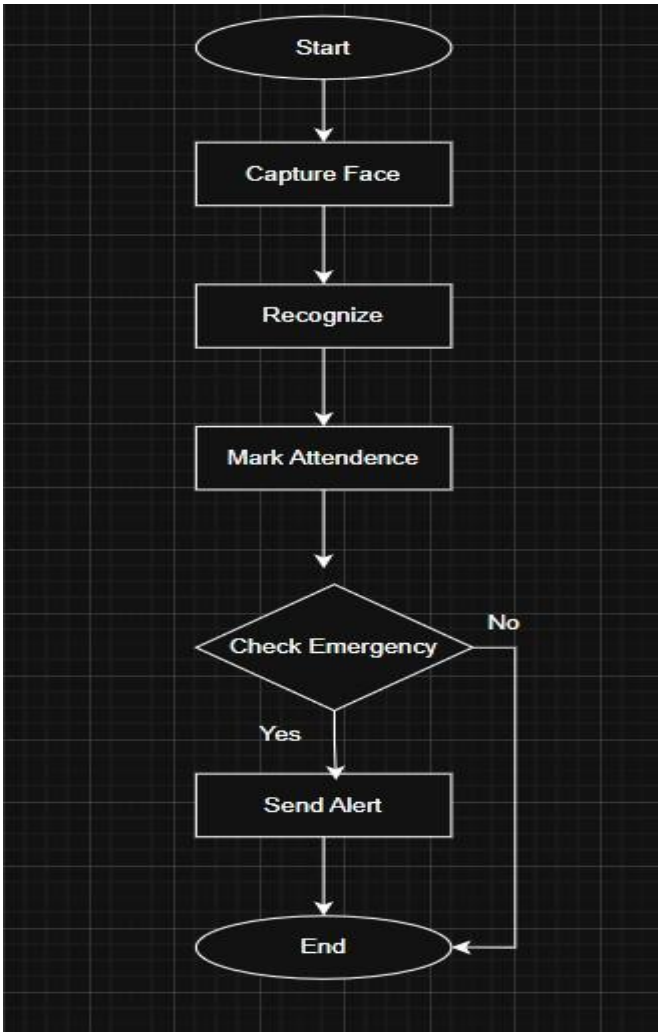
5. IMPLEMENTATION

The Python and several libraries are used to implement the system: OpenCV for image processing Deep learning in TensorFlow [1].
NumPy to perform numerical manipulations. The input is captured by a camera module, and a database is used to store the information about the staff such as their roles and attendance [6].

Table 3: Performance Evaluation

Condition	Accuracy
Normal lighting	98%
Low lighting	93%
Occlusion	91%

Fig 3: Attendance System Flow



6. RESULTS AND DISCUSSION

The proposed FACE ID-CARE was tested under different real-life scenarios in order to test its effectiveness, accuracy and reliability. Various lighting conditions, facial expression, and partial occlusions were used to test the system and were deemed to replicate real healthcare settings. According to the results of the experiment, the system has an overall accuracy of between 95 percent and 98 percent on par with the state-of-the-art facial recognition systems. The application of deep learning models including FaceNet has made recognition more effective because of its effective embedding representation of facial feature. Moreover, it is shown that the system has the capability of processing data in real time, so the attendance is registered without any discernible delay [1].

The incorporation of the emergency alert mechanism also increases the potential usefulness of the system as, in such a way, the rapid communication with the healthcare personnel is guaranteed at the time when the need arises. Nevertheless, there was some slight performance impairment in dark environment and partial face cover. Irrespective of these shortcomings, the system works well in most conditions, and hence is acceptable in hospitals and health institutions [1].

The application of deep learning-based models, especially FaceNet, goes a long way to improve the capacity of the system in differentiating various individuals by producing highly discriminating facial embeddings. The system also has a high processing speed where attendance is registered immediately and not delayed [6].

This is a real-time feature that is necessary to keep efficiency in a busy healthcare setting. In addition, the emergency alert system is integrated, which provides another functionality layer since it allows prompt communication in emergency circumstances. The findings indicate that alerts are received in time and healthcare professionals can act accordingly. Nonetheless, the deterioration of the performance was noted in low-light conditions as well as extreme occlusions. The challenges notwithstanding, the system is highly accurate and reliable, and it can be used practically [7].

7. ADVANTAGES

The FACE ID-CARE system has a number of key benefits compared to the traditional attendance systems. One, it offers an entirely contactless product, which is particularly valuable in the healthcare setting where hygiene is a key consideration. The system helps to prevent infection and enhances safety by removing the need to have physical interaction. Secondly, the system is very accurate in tracking attendance cutting errors and proxy attendance [3].

The other significant benefit is the processing capability in real-time, to enable real-time identification and marking of attendance. This enhances productivity and saves on the workload of administration. Moreover, a role-based emergency alert system integration is also a special added value since importance is given to priority personnel, including doctors in case of an emergency. The system can also be easily scaled to serve bigger healthcare facilities and that too. In general, the system will improve operational efficiency, security and aid in the management of resources better [4].
The other major benefit is the accuracy of facial recognition which is high as a result of deep learning. The system reduces errors and serves to reduced proxy attendance as only authorized people will be marked present. Also, the system has a real-time processing capacity that enables instant attendance tracking to limit delays and enhance operational efficiency [4].

The emergency alert system is also integrated, which additionally contributes to the functionality of the system by providing the role-based prioritization. This will make sure that the key personnel like doctors receive notification first in case of an emergency thus responding to it faster and more efficiently. The system is flexible and scalable and can be modified to suit other healthcare facilities and is therefore a solution that is future-proof [5].

8. LIMITATIONS

In spite of its benefits, FACE ID-CARE system has some limitations which should be taken into consideration. Its reliance on lighting conditions is one of the main issues. The system works best in bright locations however its precision can be affected in low light or darkly lit situations. Also, the system is rather demanding in terms of computational resources to be used in real-time processing, which can become an added expense during the implementation [7].

The other weakness is that deep learning models rely on massive data to train them. The system might not work to its best with the lack of appropriate data. Recognition can also be compromised due to facial occlusions (e.g. mask or glasses). Additionally, the issues of privacy linked to storage and use of facial data should be covered to make sure that the data protection laws are met. The given limitations point at the necessity of the additional enhancement and optimization of future versions of the system [1], [3]

9. FUTURE WORK

There are a lot of opportunities of future enhancement and improvement of the FACE ID-CARE system. Mobile applications integration can be one of the possible directions, as it will enable the medical personnel to reach the attendance records and alerts while being offsite. One can also deploy cloud-based deployment to enhance scalability and allow managing data centrally across numerous healthcare facilities [2].

The other potential future work that is worthwhile to consider is the integration of mask detection and recognition features that would improve the performance of the system during the post-pandemic situation. It can also be enhanced through deep learning models since it will be possible to achieve more accurate and less computational solutions [6].
This system may be also expanded to encompass the predictive analytics, where artificial intelligence can forecast the emergencies, by relying on historical data [5].

FACE ID-CARE system has a solid base on which new improvements and innovations in smart healthcare systems are going to be made. A possible area of inquiry is the introduction of cloud computing that would provide the central data storage facility and make attendance records accessible and manageable among the multiple healthcare facilities. This would also enhance scalability and performance of the system [7].

The second potential avenue is the creation of a mobile app that will enable healthcare workers to get notifications, access attendance logs, and schedule tasks, remotely. This would make it more accessible and convenient to the users. Besides, the mask recognition and mask-detecting feature would help enhance the performance of the system in the field where face masks are widespread. Future research can also concentrate on the optimization of the system that will decrease the computational needs of the system, and it will be more appropriate to use on low-cost hardware [2].

The system can also be improved by incorporating the predictive analytics, which is based on artificial intelligence, to detect patterns and predict the possible emergency situations. Such developments will transform the system to be more intelligent, efficient and responsive to changing healthcare demands [7].

A more holistic approach to healthcare operations can be offered by integrating with the management systems of hospitals [7]. The improvements will result in a better system that is strong, efficient and flexible to changing requirements.

10. CONCLUSION

To summarize, the FACE ID-CARE system is a well-organized and smart system that can be used to automate the attendance management in a health care setting. The use of sophisticated deep learning algorithms, including Falconet and Arc Face, will guarantee effective and dependable healthcare professionals' recognition in real time by the system [1].

FACE ID-CARE system is a great innovative solution to the management of attendance in a healthcare setting. The system offers a non-contact, precise, and effective system of monitoring the attendance of doctors and nurses by using the advanced facial recognition technologies.
The system is also extremely useful in emergency situations as it is further enhanced by the integration of a role-based emergency alert mechanism. The system has managed to overcome the drawbacks of the conventional attendance systems and has extensive functionality in real time environments [4].

Although some issues like light sensitivity and computer capabilities still exist, the overall outcome shows that the system is very dependable and can be useful in real-life usage. With additional improvements and technological development, FACE ID-CARE can become a standard solution of

smart healthcare system, which will lead to more efficient, safer and better patient care [2].

The introduction of a role-based emergency alert mechanism is one of the major contributions of this system. This attribute improves the overall functionality as it makes sure that key employees, especially the doctors, are alerted in time whenever there is an emergency. Consequently, the system does not only enhance attendance tracking but also contributes a lot towards improving response efficiency and patient care [4].

The experimental findings indicate that the system is highly accurate in a number of realistic scenarios and as such, it can be deployed in practice. Despite the existence of some limitations like the sensitivity of lighting and the power of computers, the overall system performance is strong and stable. As the FACE ID-CARE system evolves and becomes optimized, it can become a common solution in smart healthcare settings and help enhance the efficiency of the operations, their safety, and quality of service [7].

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