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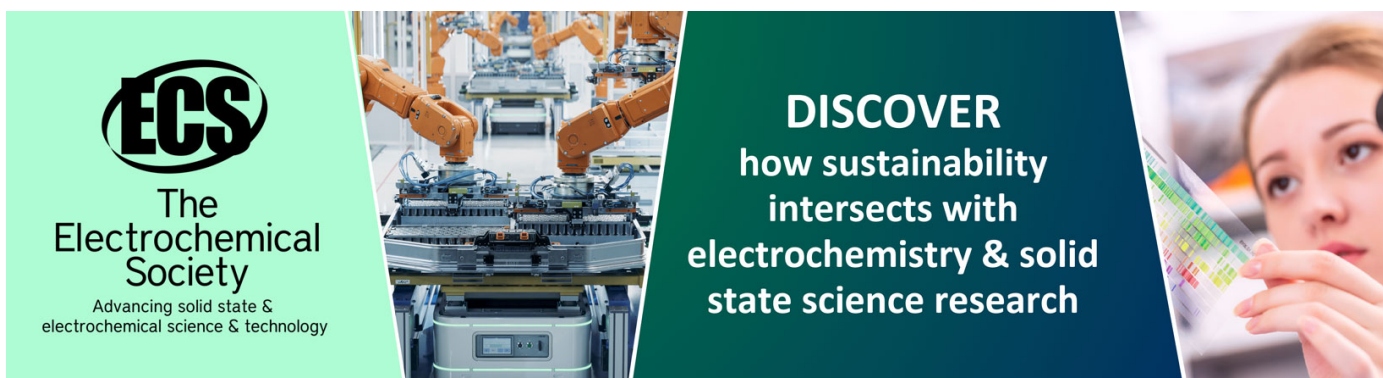
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A Review Analysis on Face Recognition System with User Interface System

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Abstract: Face recognition is the most advanced way of authentication and authorization and it has been developed a lot since the last decade and such systems are now popular in fields such as security and commerce. This work revolves around facial recognition based automated user management system with active learning features the proposed work uses a combination of a couple of technologies to build such a system for user keeping which is foolproof and secure it also adds active learning to counter the problem of changing faces in youngsters. The system is recommended for schools, universities, corporate offices, and prisons.

Keywords: Automated User management system, Face recognition system, Machine learning, FACENET, MTCNN.

1. Introduction

The conventional methods of keeping user in use are manual roll call and fingerprint-based biometrics [1]. However, there exist some advanced methods too, for example, barcode [2] and QR code [3] based systems but some of these are highly vulnerable to security as authentication can be compromised and many require manual human interaction, therefore, user systems can be improved to overcome such issues.

User can be managed by using an automated system or manual system. A manual system involves a human or supervisor while an automated system can function independently without any human interactions.

This paper aims to introduce facial recognition based automated user management systems. The face is unique to an individual and hence can be used to mark user [4], automating this process helps the organizations in many ways by saving time and providing a highly secure system. Machine learning [5] and deep learning are used to detect and recognize faces. In addition to that image processing will also be required to assist the whole process.

Face Recognition is already being proposed for user systems but face recognition is relatively a new field and is in continuous development [6], along with that it is known that the facial features of young children and teenagers change with their growth, thus, it requires such a system that can continuously maintain and improve its performance with the changing features of the users. This paper provides a method to improve the facial recognition system with changing facial features [7].



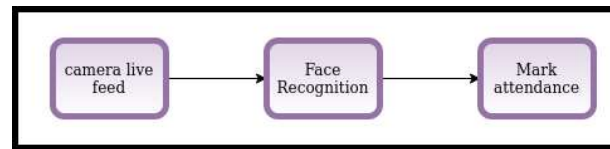


Figure 1. A Basic architecture of user system

2. Literature Review

QR/ Bar Code based user requires the user to scan their card and register their presence. The system can be easily fooled by placing someone else's card. This may affect the marking criteria of many universities [8] and schools where user contributes to grades. The fingerprint biometric systems are still the most reliable in this case but it has one flaw that it requires manual input of the user fingerprint and thus it results in the formation of queues [9] as a large number of users rush to mark their user at locations where the device is placed. Additionally, when there is a large number of users in the organization [10] multiple devices need to be installed. Hence, fingerprint user consumes time and can be costly [20-22].

3. Proposed Work

The proposed system gives an approach to mark an individual's user using their facial features. It functions through frame by frame processing of live feed obtained from a camera to find a face [11]. Upon face detection, the area in frame occupied by face is considered as the region of interest, and various operation like color-correction and face alignment is done to obtain better results followed by feature extraction [12]. Collected features are then processed by the trained model which yields the result subjected to the confidence score. An Illustration of the proposed architecture is given in Fig 2. The proposed system uses MTCNN (Multi-Task Cascaded Convolutional Neural Networks)[4]. The performance and accuracy of MTCNN is state of the art and is being used in the development [23].

The process of feature extraction from the region of interest is done using **FACENET** [5]. It is developed by Google and used to extract the features from the face which is very crucial for facial recognition [24]. The proposed system also has self-learning capability and thus it works by updating the model automatically after regular intervals to perform efficiently with changing features of the children and adults. The user data will be stored on a server and can be retrieved when required using APIs (application programming interfaces).

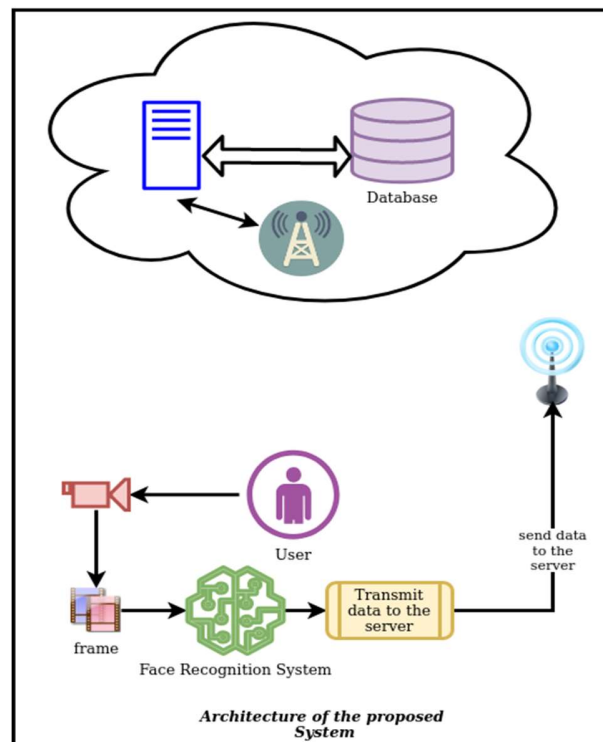


Figure 2. Proposed System architecture

4. Methodology

The automated user management system involves many steps which include face recognition, Active learning and database. Each of the parts is explained in great detail further in this paper.

4.1 Face Recognition

It is a two-step process first the face data or features are collected and stored to train a machine learning model and second the model is used to recognize the trained faces. The detailed description of each step is described below.

Registration in the proposed system is the one time process of collecting the required data (pictures of each person) and train the machine learning model such that it can be used for recognition. The registration in face recognition can be divided in to further steps:

- *Data collection:* In this phase, several photos of each individual will be captured and stored in a directory.
- *Preprocessing:* In this phase, faces will be detected and aligned. Only the region of interest will be stored.
- *Embedding collection:* The dataset to be trained consists of the collection of embeddings derived from every image from pictures.
- *Training:* In this phase, the model will be trained on the collected data.

Recognition gives the user information based on that their presence will be marked. The recognition in face recognition involves further steps:

- *Data collection:* Live feed from the camera will send individual frames for processing.
- *Face detection and alignment:* This phase is responsible for face detection, followed by which the face will be aligned to improve the accuracy of the recognition.

- *Embedding collection*: in this phase, face embeddings will be collected by processing the region of interest.
- *Face recognition*: In this phase, embeddings will be fed to the trained model, which will yield a label corresponding to the user's identity.

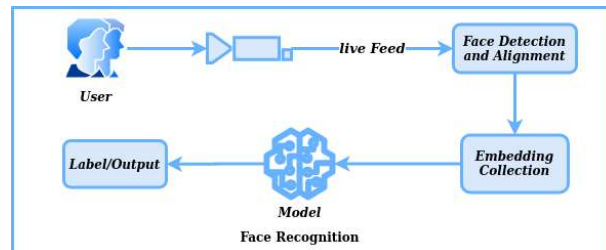


Figure 3. Facial Recognition representation

4.2 Incorporation of Active learning

The facial features of children in their early years have been observed to change at a faster rate as compared to adults and thus, it might impact our system. To counter this issue, we need to design our system in a manner that enables it to keep learning with time. Active learning can be employed to make the system even more powerful so that it can work with changing facial features. To implement active learning, we will store the frame which is responsible for the successful marking of user. In this manner, we will have new data that can be combined with the previous dataset [13] and trained at regular intervals. To make this process even more efficient, cloud resources can be employed to train the new dataset overnight.

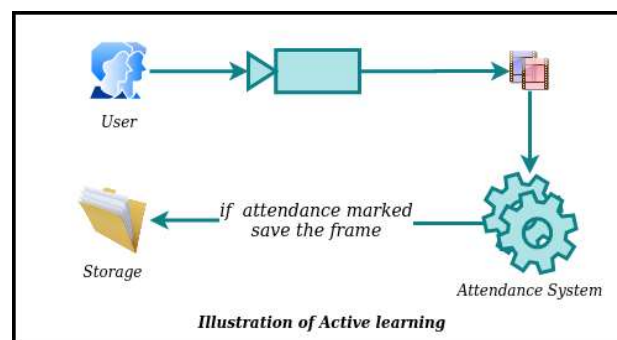


Figure 4. Active learning in the proposed system

5. Availability of Data and Materials

The database implemented on the server contains the information of each user for example name, user id, and other relevant information along with a timestamp. The marking and retrieval of the user can be done using CRUD APIs [14].

6. Results Analysis

The proposed system has been implemented and tested in python programming language and the system works fine. The outcome is shown in figure 5.

The proposed system has some shortcomings though which are mentioned below:

- The system is unable to mark user in a darker room or at night. However, this problem can be fixed by having a light source mounted with the system and when the system detects dark frames it should turn the light source on automatically using.
- The system is slow and lags on the average system. However, with GPU enabled modern computers or using cloud computing this problem can easily be solved.



Figure 5. Face recognizing user interface system

Table 1: Test results analysis on face recognition with user system interface

No. of Test	No. of Person	Time for login (s)	No. of frames for recognition	Average credibility	No. of error recognition
1	A	-	3	0.879	0
2	A	15	7	0.584	0
3	B	-	10	0.693	0
4	A	∞	10	0.920	0
5	A	12	10	0.822	0
6	B	18	11	0.403	0
7	C	-	10	0.921	0
8	A	∞	11	0.784	0
9	C	11	10	0.592	0
10	A	-	10	0.920	0
11	B	-	11	0.738	0
12	A	16	10	0.992	0
13	A	∞	10	0.502	0
14	B	-	7	0.692	0
15	B	17	9	0.962	0
16	B	-	10	0.873	0

Table 1 shows the login time and error detection using user interface system. Numbers of frames are divided to calculate average credibility. Login time consumed as well as well detection area of any object, in terms of object we captured one scene and recognized from the scale of pattern.

7. Conclusion

Face recognition devices are commonly associated with very costly top-secure implementations. Currently, the key devices have evolved and, due to automation and growing computing power, equipment costs are dramatically declining. All applications of the facial recognition technology are now cost-effective, reliable and extremely precise.

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