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Access Control using Face Recognition

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Abstract:
Though there have been significant advances in the face recognition field recently, efficient implementation of face recognition and verification has been a serious challenge for current techniques. In this paper, we are using an architecture, called FaceNet, which can directly learn mapping images of faces to a Euclidean space, where distances correspond directly to a measure of similarity of faces. After the Euclidean space is produced, various tasks can be implemented easily, such as face recognition, verification and clustering, where standard techniques are used with FaceNet embeddings as feature vectors. In our method, we use a deep convolutional network that is trained to directly optimize the embedding, instead of the bottleneck layers which were used in previous deep learning approaches.

Keywords: FaceNet, Euclidean space, face recognition, deep convolutional network.

I. INTRODUCTION:

This project aims at facilitating Face based access control. We are leveraging state of art Deep Learning techniques to design our face recognition system. There are many benefits of using this system over the conventional card-based systems. Some of the benefits are high level of security, smooth passage, hence increasing the speed of transit over the section. We have achieved the benchmark response time of our systems to give access to a person entering the system. We are using an ensemble model, which being said means we are harnessing the combined decision of two individual state of art models so as to minimise the error rate to as minimum as possible. Our business trade-off between Precision and Recall has been towards achieving higher recall rates hence minimising false acceptance rate or chance of trespassing. Our Face Recognition (FR) system is an ensemble of two face recognition systems, namely FaceNet and dlib. FaceNet implementation is in TensorFlow (Python) and dlib library is written in C++. ZMQ is a port-based communication API that can be used to communicate between two processes. A single main thread initializes all the parameters and configurations.This thread runs the dlib detection and recognition module. For FaceNet, a different process is run and separate thread is created to communicate between the two processes i.e. the thread that calls FacenetStack. Here, ZMQ binding is done and the FacenetStack sends the information back to the main thread. The main thread waits for both dlib and FaceNet to complete their detection and feature extraction phase. Now, the best match for the produced embeddings/feature vectors is obtained from the database using Linear Search/ KNN Search. RELATED WORK:

[1]. Face Detection and Recognition using Viola-Jones algorithm and Fusion of PCA and ANN
The purpose of this study is to present a methodology for human face recognition based on the features which are obtained from an image. This technique can be implemented in two phases. In the first phase, Viola-Jones algorithm is used for the process of human face detection. In the next phase, the recognition of the face detected in the image takes place with the combination of Principle Component Analysis(PCA) and a neural network which is fed forward. When the performance of this method is compared with other methods, better accuracy is found.

[2].Pose Normalization based on Kernel ELM Regression for Face Recognition
The objective of this work is to generate a front virtual view from its corresponding non-front face image. This method assumes that there is a presence of an approximate mapping between the two views as mentioned, i.e., the front and non-front views. In the linear mapping technique, we encounter a regression problem while estimating the mapping between the two views of the images. Whereas in the non-linear mapping technique which is used in this method, Kernel Extreme Learning Machine(KELM) regression is used for generating the virtual front view.

[3].Techniques and Implementation of Face Spoof Recognition: Perspectives and Prospects
This work aims at addressing the main concern regarding automatic face recognition, i.e., face spoof attacks, where access gained by unauthorized people with the help of an image or a video of an authorized person. An algorithm for detection of face spoof is proposed, which is very much efficient. This algorithm is based on Image Distortion Analysis (IDA). An IDA feature vector is formed. There is also an ensemble classifier present, which is trained to distinguish between live images and spoofed images. This method can also be implemented for face spoof detection in multiframes.

[4]. Face Recognition System Using PCA, LDA & Jacobi Method
This work makes use of Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA) to develop an efficient face recognition model. Two important features, namely Eigen values and Eigen vectors are obtained by a method called Jacobi method. These two features play a very important role in PCA and LDA algorithms. This paper explains the processes of Image preprocessing, color code conversion and face recognition. Authorized and unauthorized images can be distinguished by finding the Euclidean distance between known and unknown images.

II. METHODOLOGY:

A. Image capturing and Face detection:

The first step in this process is to capture the image of the subject. A high-resolution camera is used. The captured image is processed by our facial recognition system and the face of the subject is detected. For the face detection process, convolutional neural network is used. A 3-Dimensional pose estimation technique is implemented to obtain a frontal view of the face.

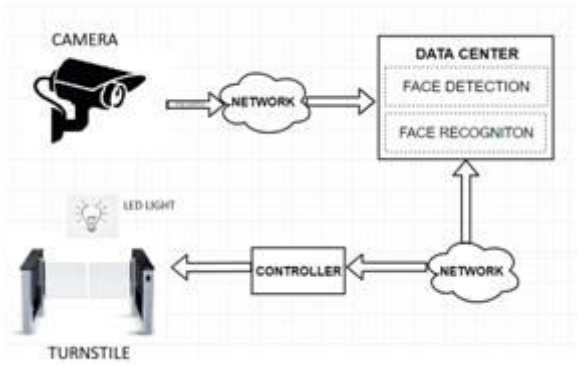
B. Feature extraction:

In this step, the feature extraction process is applied for the frontal view of the face which is obtained in the previous step. The extracted features are converted into a 32x32 Euclidean vector sample of 128bit size. This sample is passed to the pre-trained FaceNet model.

C. Comparison of Euclidean sample:

In the final step, the obtained Euclidean vector sample is compared with the images in the database. Now, the best match for the produced feature vectors is obtained from the database using Linear search/KNN search. After the inferencing is done, i.e., identification of the person in front of camera, access is given to the person based on their existence in the database.

III. SYSTEM ARCHITECTURE:



The architecture diagram shows the work flow of the system. A high-resolution camera is used to capture the image of the subject. The captured image will de passed to the database through the internal network. In the data center, feature extraction process takes place. A vector sample is created from the features that are extracted. This sample is sent to the FaceNet model. After this sample is passed to the pre-trained model, it is compared with the images present in the database. After the comparison, the necessary actions to be taken is controlled by the controller. If there is a match, a positive signal will be sent to the controller, which in turn converts the signal and passes it to the external access system i.e., in our case the gate or turnstile to open and give access. If there is no match, a negative signal is sent and the gate will not open to give access.

IV. ADVANTAGES OF THE SYSTEM:

1. The top benefit of using this method over other forms of biometrics is that it provides a process where there is no contact between the subject and any of the devices. This technique makes it easier to capture the faces of the people even from longer distances.

2. Another benefit of the system is its fastness and higher accuracy. The users are able to experience high recognition rates and reduced processing time. Hence, making this an effective method.

3. Reliability is another benefit provided by this system. Since 3-D facial recognition technologies and high-resolution cameras are used, the success rate will be higher.

4. Full automation can be provided which reduces human dependence and hence reducing the error rates.

5. This system can be easily integrated into the existing system infrastructures. This saves a lot of time and cost on software development.

V. CONCLUSION:

Face recognition technologies have always been associated with expensive and state-of-art applications for providing security. But due to the evolution in technologies and higher processing power in recent years, the cost of resources and equipment is gradually decreasing. We have developed a system that is highly reliable due to increased security level and accuracy, hence reducing the total expenditure. We have implemented deep learning techniques to train our model, which gives an accuracy rate of over 90%. This can be improved over time. This system has a huge scope in our country. It can be implemented in various situations such as identifying mugshot albums, duplicate voters, and other unique identification and verification of individuals. It can be used in both public and private sector. Our model can be integrated to other existing systems without any significant upgrade cost, which leads to better security. There is also room for improvement in the technology.

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