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# Facial Recognition in Public Areas

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## Abstract

*The security of information nowadays is very significant and difficult, so there are a number of ways to improve security. Especially in public areas like airports, railway stations, Universities, ATMs, etc. and security cameras are presently common in these areas. So, in this paper, we are presenting how Facial recognition can be used in public areas like airports, toll gates, offices, etc. We are comparing or matching a face of a person who we want to detect, with the video which is recorded through CCTV. There are certain algorithms to detect faces from video like through HAAR cascades, eigenface, fisher face, etc. open-source computer vision library is used for facial recognition.*

## Keywords

*Eigen face, haar cascades, fisher face, Face recognition.*

## 1. Introduction

We are using python language and using openCV library i.e Open-Source Computer Vision Library for detecting an image. This library was started by intel in 1999 and in 2008 Willow George [22] took over support and after that openCV now comes with a programming language interface i.e c, c++, python.

The Problem with detecting faces is the location of key points on the face or what should be the match to detect the face. Like a few years back we are using some holistic methods like detecting length between the eyebrows and certain other things which are not accurate as these methods fail to detect the facial changes of the person, we are matching certain other key points which give accurate results. There are many algorithms which are being used for facial recognition, since deep learning is quite trending and in some amount is accurate, so it is good to use but it requires some good amount of hardware. Methods like convolutional neural networks use a multiple layer's cascade to extract the information of an image.

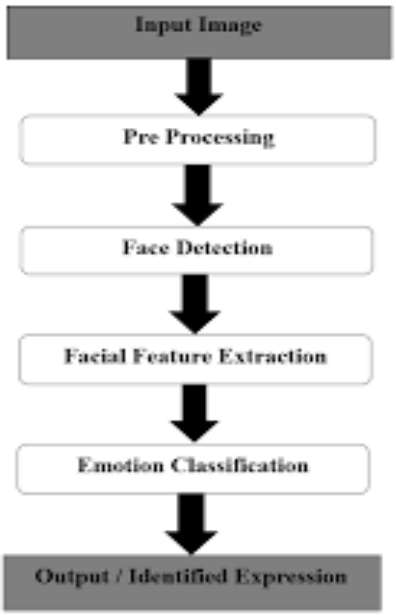


**Figure. 1** Basic Process of Face Recognition

## 2. Motivation in the field

A human face is the most practical way to recognize a person. As we all know that there are some parts of the human body that can be used to identify a person like face, retina scan, fingerprints. Face recognition is the most interesting and important field for research, this is because face recognition helps in automatic recognition and surveillance systems. The face recognition includes fields like computer vision, image processing, pattern recognition and machine learning [17-21]. The surveillance cameras are installed at most public places nowadays, but it is not very efficiently used because all the footage is manually seen. If these systems are upgraded with automatic recognition software systems, these cameras can help the authorities to arrest the criminals whose records are present earlier in the criminal database. The system will be much more efficient than a human because of some factors like it will work every time without a break, the single system can process a lot of camera footage, and hence saving a lot of manpower. This system will not be limited to only catching the criminals but with further improvements it can help in preventing the illegal immigrants that come inside the country boundaries from the neighboring countries.

## 3. Application

The face recognition system has many applications like face recognition in mobile phones and computers for authentication purposes, in offices, schools it is used for marking attendance and many more [5]. But in our project, we will be focusing on using face recognition techniques for providing public security. In this the system will be capable of automatically processing the cameras installed at public places and it will process the video to get any criminal whose image is present in the database. These places would include airports, railway stations, parks, toll booths etc. Also, after more enhancement it can also help in telling the illegal immigrants that are staying in our country [5].

## 4. Challenges Involved

In our project while researching we got many challenges that directly affect the automated face recognition system. We have discussed some of them below.

- Change in facial expression: In this as we know that at different emotional states a human face seems a bit different for example on happiness, fear, anger, excitement in all these states a face may appear different therefore it is every important to design our model in such a way that beside having different facial expression it should be able to accurately recognize the human face [19].


**Figure. 2**. Different facial expressions

- Pose variations: If the camera takes pictures from different angles of the same face e.g., from sideways and from front. We can see this in the figure below. Then for an automated face recognition system it can lead to substantial change in the face appearance and also in the processing it can lead to two different faces. So, some techniques should be applied to correct the pose of the face, like rotation of the image etc. [20].


**Figure. 3.** Different Pose variations in face recognition

- Different lighting conditions: The face recognition system does not work much efficiently in low lighting conditions because in low lighting shadows can appear on the face and the model can recognize facial features much accurately from them. Also, if it is very much bright, it can lead to over exposure of the image. Therefore, in both these cases the image should be first processed through image illumination normalization techniques, e.g., through histogram equalization or through some other machine learning methods [19].

- Ageing: Another challenge in face recognition is ageing, as we all know that through ageing facial features changes a lot. For example, the shape of face changes, skin gets floppy, double chin also appears, hairstyle changes. To remove this facial ageing patterns should be taken into consideration [20].

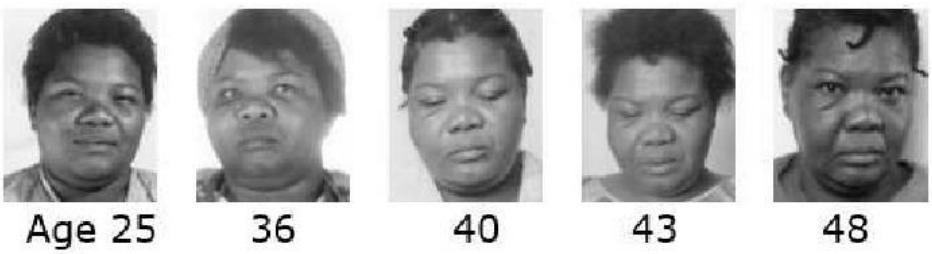


**Figure 4.** Ageing effect on facial features

## 5. Summarized Review on Current Development

The essential step to detect a person's face from image and video is facial recognition. In the facial recognition analog information i.e. image is transformed into digital data or information which is based on the facial feature of that image [7].

Camera sensors take the photo of an individual and then convert it into digital information and the facial recognition algorithm is applied for face detection or face matching [17]. These Methods can be used to identify or check the identity of individuals based on their facial features: distance b/w both eyes, nose, the contour of the lips, ears, chin, etc. [17].

They can even detect faces in the middle of a crowd and within dynamic and unstable environments. The performance of the system which can detect faces in these unstable environments can be seen in Thales' Live Face Identification System (LFIS), an advanced solution resulting from our long-standing expertise in biometrics [8].

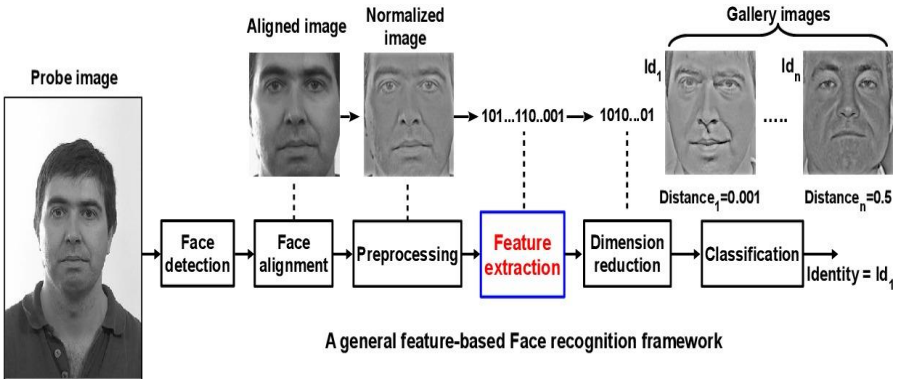


**Figure 5.** Detailed processing of system

## 6. Limitation and Important of Existing Projects

Some limitations of existing work of pose estimation are small and hardly visible parts, strong articulations, illumination effects, and occlusions, that make it difficult to identify the key points of the body so in these cases pose estimation may not be able to give an accurate result. Poor image quality limits facial recognition's effectiveness, small image sizes make facial recognition more difficult, different face angles can throw off facial recognition's reliability, data processing and storage can limit facial recognition tech there are numerous importance of facial recognition technology for federal agencies, especially law enforcement, defense and intelligence agencies. However, it can also help civilian agencies in humanitarian work.

## 7. Evaluation Criteria

Our Evaluation is based on the training set i.e. the number of images which are stored in our data set and how accurate it is. We measure accuracy on the basis of how many and what type of images it can detect or recognize [4]. Performance Evaluation Method can be used to test the performance. It is the method which is created to analyze and arrange the criteria to be considered in building up the performance evaluation model. It analyzes and arranges the criteria to evaluate the performance of the software [1].

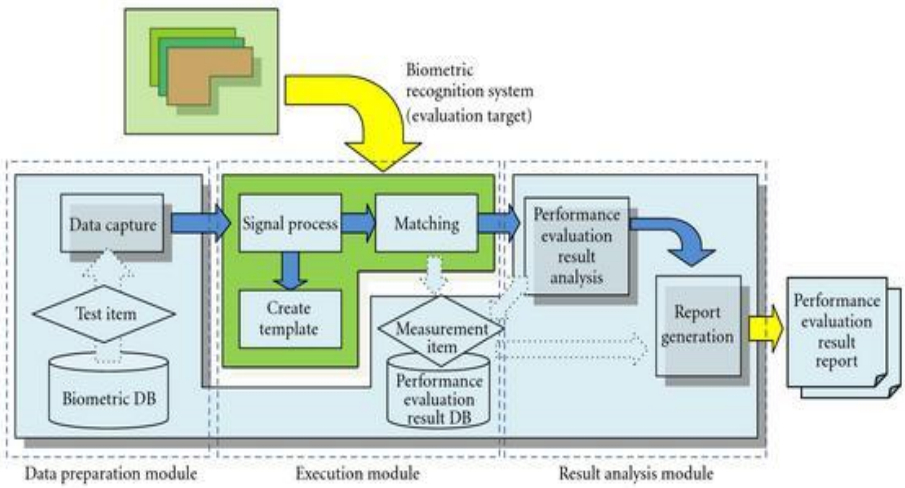


**Figure 6.** PEM Framework

## 8. Comparative Literature and Differentiating Features

**Table 1.** Table depicting comparison between different researches.

| Method | PublicTime | Loss | Architecture |
|---|---|---|---|
| Deep face | 2014 | softmax | Alexnet |
| Deep ID2 | 2014 | Constructive loss | Alexnet |
| Deep ID3 | 2015 | Constructive loss | VGCNet-10 |
| Face Net | 2015 | Triplet loss | GoogleNet-24 |
| Baidu | 2015 | Triplet loss | CNN-9 |
| VGG face | 2015 | Triplet loss | VGCNet-16 |
| Light-CNN | 2015 | softmax | CNN-9 |
| Center Loss | 2016 | Center loss | Lenet-7 |
| L-softmas | 2016 | L-softmax | VGGNet-18 |
| Range Loss | 2016 | Range loss | VGGNet-16 |
| L2-softmax | 2017 | L2-softmax | ResNet-101 |
| CCL | 2018 | Center invariant loss | ResNet-27 |

## 9. Modules and Software used

Estimating pose using deep neural networks requires high computation and calculation, which can only be possible by using hardware with high configuration. We will use visual studio code as IDE, python as programming language and its various modules and libraries like OpenCV, dlib, etc.

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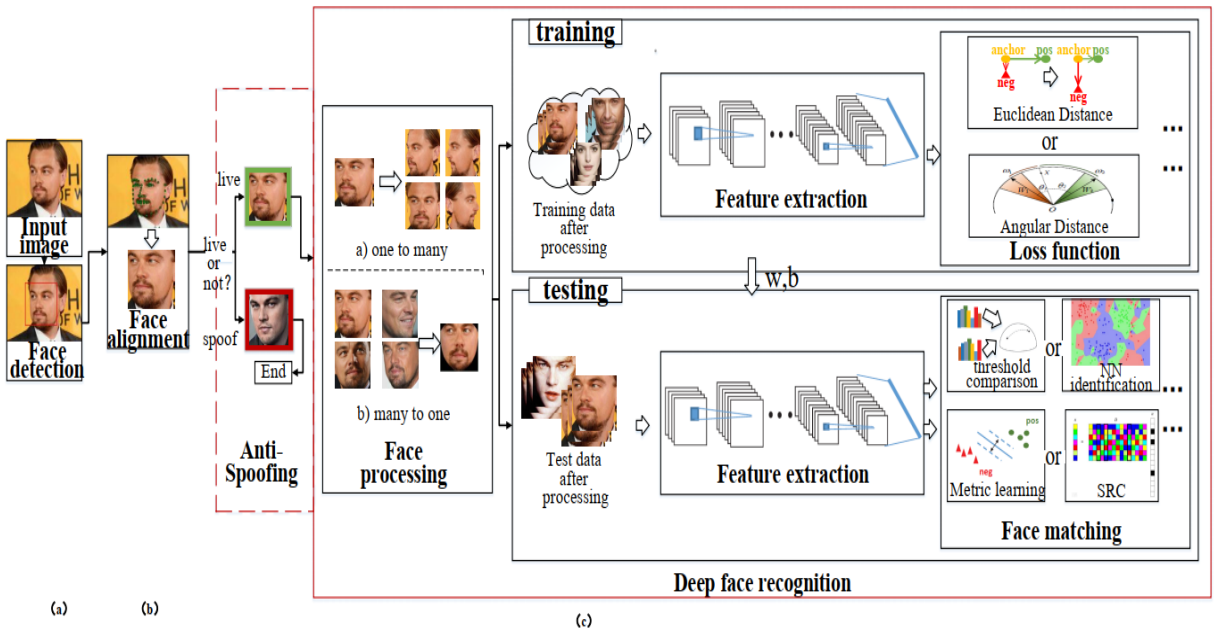


Figure 7. A small basic block diagram of our pose estimation model

## 10. Future Work

The face recognition technology is expected to grow at a massive rate in the coming years. Almost every industry will be using face recognition technology in some way, the surveillance and security will be much important, and this industry will be intensively using this technology. Also, in coming years research will be done to improve the short comes of the current technology. In future we will try to improve our model so that it can process pictures taken from different angles and with accuracy. Also, we would like to implement hardware like night vision and infrared with our system so that efficiency of the system can be maintained in the dark also

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