

## IMPROVING FACE RECOGNITION ALGORITHM PERFORMANCE USING CNN AND THE ADA BOOST ALGORITHM IN MACHINE LEARNING

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### ABSTRACT

A facial recognition system is a piece of technology that can compare a human face in a digital photo or video frame to a database of faces. Such a technology locates and measures face characteristics from an image and are often used to verify individuals through ID verification services. Systems for facial recognition have been used in automatic picture indexing, video surveillance, and cutting-edge human-computer interaction. This research exhibited a face-matching system that, without the assistance of a human, recognized anatomical characteristics like the chin and determined the ratio of distances between facial features. The technology could not always properly recognize face traits, according to further studies. In this study, a deep learning convolution neural network is the machine learning technique employed for facial identification. CNNs are a type of artificial neural network that are well-suited for image classification tasks. The Ada Boost-based face detection algorithm is an algorithm that is based on integral image, cascade classifier and Ada Boost algorithm. The basic idea is as following: First it uses the integral image to calculate faces Haar-like features quickly.

Index Terms— Ada Boost algorithm, ML, CNN, Face manipulation, extreme pose and expression, high-resolution.

### 1. INTRODUCTION

The "man-machine" moniker for the face recognition project came from the requirement that a person first determine the coordinates of the facial characteristics in an image before the computer could utilize them for recognition [1]. The locations of characteristics on the face, such as the centers of the pupils, the inner and outside corners of the eyes, and the windows peak in the hairline, had to be precisely located on a graphics tablet by a person. Twenty distances, including the breadth of the mouth and the eyes, were calculated using the coordinates [2]. In this way, a person might analyze around 40 images in an hour and create a database of the calculated distances. The distances for each image would then be automatically compared by a computer, which would then determine the distance difference and return the closed records as a possible match.

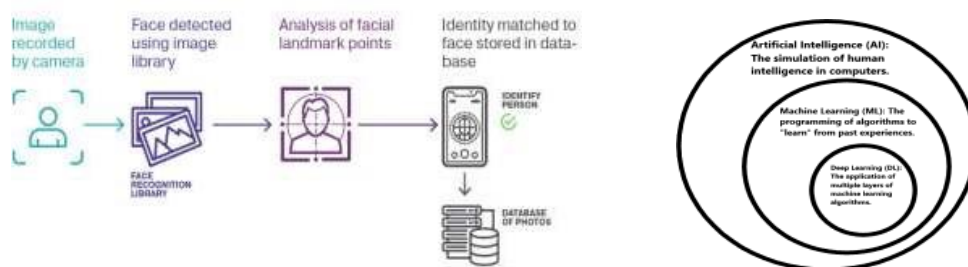


Fig.1. Facial recognition system process

As shown in fig.1. provides the metadata of the faces it has identified. This metadata includes landmark points in the face that help in identifying each unique face. This data is used to match against image

data already stored in a database.

Facial recognition systems are employed throughout the world today by governments and private companies. Their effectiveness varies, and some systems have previously been scrapped because of their ineffectiveness. The use of facial recognition systems has also raised controversy, with claims that the systems violate citizens' privacy, commonly make incorrect identifications, encourage gender norms and racial profiling, and do not protect important biometric data [3]. The appearance of synthetic media such as deep fakes has also raised concerns about its security.

## 2. Methodology

Machine learning is a rapidly growing field and has been used for a variety of tasks, including facial recognition. Facial recognition technology is everywhere these days, even if people are not that aware of it. Many people use facial recognition technology to log onto their smart phones effortlessly [4]. With advanced face detection software, surveillance operators can pick criminal faces out of crowds. What is less well known is the technique and processes behind face recognition. This article provides a look into the fields of machine learning and explains how it has made facial recognition technology, as we use in our product PXL Ident, possible.

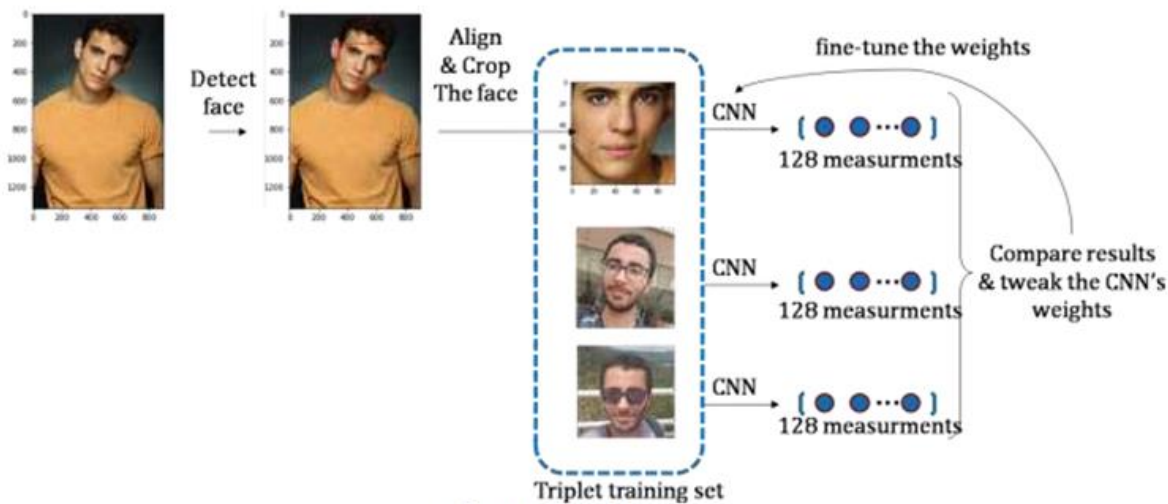


Fig. 2. Trained data sets

As shown in fig.2. growing societal concerns, Meta announced that it plans to shut down Facebook facial recognition system, deleting the face scan data of more than one billion users. This change will represent one of the largest shifts in facial recognition usage in the technology's history [5,6]. Facial recognition systems have seen wider uses in recent times on smart phones and in other forms of technology, such as robotics. Because computerized facial recognition involves the measurement of a human's physiological characteristics, facial recognition systems are categorized as biometrics. Although the accuracy of facial recognition systems as a biometric technology is lower than iris recognition and fingerprint recognition, it is widely adopted due to its contactless process [7]. Machine learning algorithms learn from data to solve problems that are too complex to solve with conventional programming.

Deep learning is a subset of machine learning which is derived from running multiple layers of machine learning algorithms together at the same time.

Note: The terms machine learning and deep learning are often used interchangeably. Most machine learning today is conceived at the deep learning level.

## 3. Related Work:

Machine Learning:

Machine learning is growing with many applications in areas such as computer vision, natural language processing, and predictive analytics. Probably, you already use multiple products or services in your everyday life that employ machine learning technologies as a growing number of companies are

leveraging machine learning over an exceedingly wide variety of industry verticals[8,9].

In this work, several scientific contributions that have demonstrated good results and provided good methods in the field of face recognition are being considered with some modifications in order to pick the most effective solution and ensure that the recognition performance is extremely interesting compared to the state-of-the-art.

#### PCA analysis

PCA is a statistical approach used for reducing the number of variables in face recognition. In PCA, every image in the training set is represented as a linear combination of weighted eigenvectors called eigenfaces[10]. These eigenvectors are obtained from covariance matrix of a training image set.

As shown in fig.3. Principal Components Analysis (PCA) is a mathematical formulation used in the reduction of data dimension[11]. Thus, the PCA technique allows the identification of standards in data and their expression in such a way that their similarities and differences are emphasized.

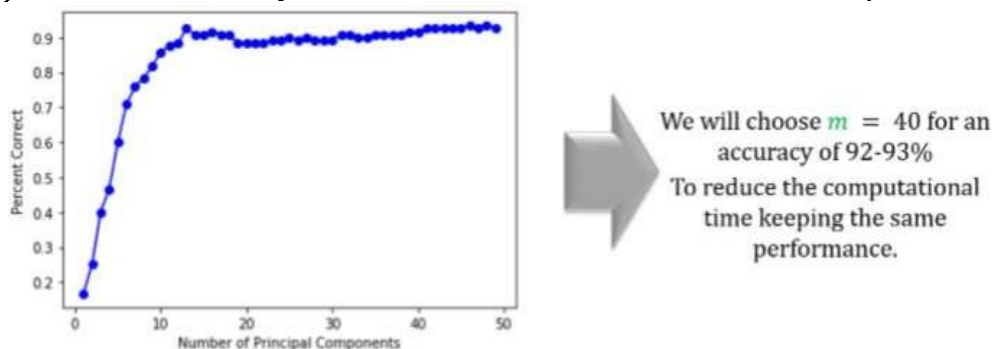


Fig. 3 PCA Analysis

#### Data set:

We will be using two different datasets, one for the PCA method, and another custom Dataset of faces for the CNN approach. Our purpose is to make a facial recognition system which needs as less training data as possible[12]. The main reason behind this constraint is the fact that it is more useful for a supervisor to have train the model with one or few pictures for each student rather than having to make a large Dataset with many images for the same person. We will be comparing two main face classification models, PCA dimensionality reduction, and pretrained CNNs.

To perform face recognition, the following steps will be followed:

- Detecting all faces included in the image (face detection).
- Cropping the faces and extracting their features.
- Applying a suitable facial recognition algorithm to compare faces with the database of students and lecturers.
- Providing a file recording the identified attendants.

#### AdaBoost algorithm:

AdaBoost is one of the first boosting algorithms to be adapted in solving practices[13]. AdaBoost helps you combine multiple –weak classifiers into a single –strong classifier. As shown in fig.4

**Initialization:**

1. Given training data from the instance space  
 $S = \{(x_1, y_1), \dots, (x_m, y_m)\}$  where  $x_i \in \mathcal{X}$  and  $y_i \in \mathcal{Y} = \{-1, +1\}$ .

2. Initialize the distribution  $D_1(i) = \frac{1}{m}$ .

**Algorithm:**

**for**  $t = 1, \dots, T$ : **do**

Train a weak learner  $h_t : \mathcal{X} \rightarrow \mathbb{R}$  using distribution  $D_t$ .

Determine weight  $\alpha_t$  of  $h_t$ .

Update the distribution over the training set:

$$D_{t+1}(i) = \frac{D_t(i)e^{-\alpha_t y_i h_t(x_i)}}{Z_t}$$

where  $Z_t$  is a normalization factor chosen so that  $D_{t+1}$  will be a distribution.

**end for**

Final score:

$$f(x) = \sum_{t=1}^T \alpha_t h_t(x) \text{ and } H(x) = \text{sign}(f(x))$$

Fig.4. AdaBoost algorithm

**Convolutional Neural Network (CNN):**

Face recognition is achieved using Deep Learning's sub-field that is Convolutional Neural Network (CNN)[14]. It is a multi-layer network trained to perform a specific task using classification. As shown in fig.5 Transfer learning of a trained CNN model that is AlexNet is done for face recognition. It has an accuracy of 98.5% using 2500 variant images in a class [15,16].

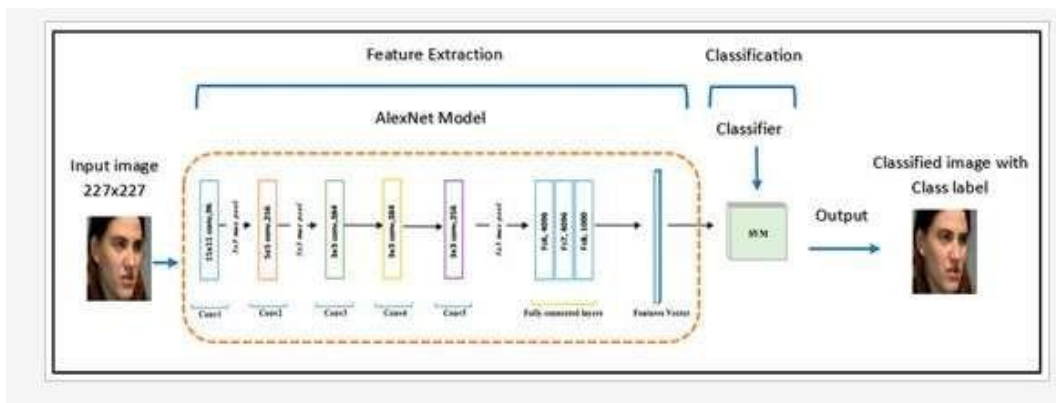


Fig.5 Convolutional Neural Network (CNN)

**Conclusion**

The derived characteristics from the prior work on facial recognition are less well-recognized, and object detection requires a high level of computing complexity, which is one of the main issues. Faster CNN has promising performance on a number of object detection benchmarks as the newest generation of region-based generic object detection techniques. Faster CNN can automatically learn a function representation from data. In order to determine the optimal model, the AdaBoost Algorithm, often referred to as Adaptive Boosting, is employed in ensemble modeling in machine learning. It was discovered to be a very difficult problem on how to improve the efficacy of the detection due to the real-time demand for object detection. Therefore, this study recommended adopting Faster R Convolution Neural Networks and Principal Component Analysis (PCA) to implement a face recognition method. To extract features from the facial database we used the Principal Component Analysis (PCA). The Faster Convolutional Neural Network algorithm was used to classify patterns in the dataset through neural network training. This demonstrates the superiority of the proposed model performance-wise as against state-of-the-art, both in terms of accuracy and fast recognition.

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