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A Review Article of ANN and Adaboost Based Effective Face Recognition and Improvement of Classification Training

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***Abstract*- The Face Recognition (FR) is growing as a major research area because of the broad choice of applications in the fields of commercial and law enforcement. Traditional FR methods based on Visible Spectrum (VS) are facing challenges like object illumination, pose variation, expression changes, and facial disguises. Unfortunately these limitations decrease the performance in object identification and verification. To overcome all these limitations, the Infrared Spectrum (IRS) may be used in human FR. So it leads and encourages the researchers for continuous research in this area of FR. Simultaneously, the present study emphasizes the use of three dimensional cubic dataset i.e. Multi/ Hyperspectral Imagery Data in FR. The IR based Multi/ Hyperspectral Imaging System can minimize the several limitations arise in the existing and classical FR system because the skin spectra derived with cubic dataset depicts the unique features for an individual. Multi/ Hyperspectral Imaging System provides valuable discriminants for individual appearance that cannot be obtained by additional imaging system that's why this may be the future of human FR. This paper also presents a detailed and time to time review of the literature on FR in IRS.**

Keywords- Artificial Neural Network (ANN), Convolutional Neural Network (CNN), Deep Neural Network (DNN), Face Recognition.

I. INTRODUCTION

An Artificial Neural Network (ANN) was designed by the inspiration of biological neuron system in a human brain. ANN was designed to do things in a way human does. As human brain has millions of neurons, artificial neural network was made of many neurons called nodes. Like dendrites and axon in biological neuron, artificial neuron has input and output. The very first neural network had one input layer, one hidden layer and one output layer. Next, a Multi-Layer Perceptron with input, output and many hidden layers was developed.

Later for making the network to learn more, the numbers of features are increased by convolution operation, thus formed convolutional neural network. Now, the trend is deep convolutional neural network normally referred as deep learning.

In the earlier recognition system, the features are extracted manually prior to the network using any of the following algorithms such as PCA, HOG, SIFT, SURF, Viola Jones algorithm, etc and those extracted features are fed to the network which classifies the features and identifies the corresponding classes. Then, neural network was used to extract features and also for classification.

When the neural network is used only for feature extraction, different algorithm has been adopted for classification. In few works, features are extracted using any of the above mentioned algorithm and classification was done with neural networks.

Later, a single neural network was made to perform both feature extraction as well as classification when a preprocessed image is given as input. But in case of deep learning which is emerging now, a raw input image is given to the network as it has. The network does all processes like preprocessing, feature extraction, detection, classification and recognition.

When the input image is given, the network produces output without any manual assistance or hand-crafted features. In deep learning, when the image passes through the deep network, more deep and strong features are extracted. These features are useful in classification and recognition.

Face Recognition becomes one of the most biometrics authentication techniques from the past few years. Face recognition is an interesting and successful application of Pattern recognition and Image analysis. Face recognition system has two main tasks: verification and identification.

Face verification means a 1:1 match that compares a face images against a template face images whose identity being claimed. Face identification means a 1:N problem that compares a query face image against all image templates in a face database.

Machine recognition of faces is gradually becoming very important due to its wide range of commercial and law enforcement applications, which include forensic identification, access control, border surveillance and human interactions and availability of low cost recording devices. Various biometric features can be used for the purpose of human recognition like fingerprint, palm print, hand geometry, iris, face, speech, gaits, signature etc.

The problem with finger print, iris palm print, speech, gaits are they need active co-operation of person while face recognition is a process does not require active co-operation of a person so without instructing the person can recognize the person. So face recognition is much more advantageous compared to the other biometrics. Face recognition has a high identification or recognition rate of greater than 90% for huge face databases with wellcontrolled pose and illumination conditions.

II. MOTIVATION

The following two problems associated with AdaBoost motivated us to investigate into a more effective boosting learning algorithm: First, AdaBoost minimizes an exponential (or some other form of) function of the margin over the training set [1]. This is for convenience of theoretical and numerical analysis [2]. However, the ultimate goal in applications of pattern classification is usually to minimize a cost directly (usually linearly) associated with the error rate.

A strong classifier learned by AdaBoost is suboptimal for applications in terms of error rate. This problem has been noted, e.g., by [3], but no solutions have been found in the literature. Second, AdaBoost leaves a challenge of learning weak classifiers to the practitioner's choice. Learning the optimal weak classifier, such as the log posterior ratio given in [4], [5], requires estimation of densities in a feature space.

This by itself is a difficult problem, especially when the dimensionality of the space is high. An effective and tractable weak learning algorithm is needed. In this paper, we propose a novel learning procedure, called FloatBoost (Section 2), to bridge the gap between the goal of conventional boosting learning (maximizing the margin) and that of many applications (minimizing the error rate) by incorporating Floating Search [1] into AdaBoost.

The idea of Floating Search is originally proposed for feature selection [2]. An incorporation of the backtrack mechanism from Floating Search into boosting learning allows deletions of weak classifiers that are ineffective in terms of the error rate. Because the deletions in backtrack are performed according to the error rate, an improvement in classification error is guaranteed. This leads to a strong classifier consisting of fewer weak classifiers [3], [4].

III. PRE PROCESSING

A standard image database which is readily available either in color or gray scale is considered.

In the Pre-processing stage contrast stretching is performed on the acquired image where the white pixels are made whiter and black pixels are made blacker.

IV. FACE DETECTION

After contrast stretching viola-Jones algorithm is applied for detecting the face in the image. Viola-Jones detector was chosen as a detection algorithm because of its high detection rate, and its ability to run in real time. Detector is most effective on frontal images of faces and it can cope with 45° face rotation both around the vertical and horizontal axis.

The three main concepts which allow it to run in real time are the integral image, Ada Boost and the cascade structure. The Integral Image is an algorithm for cost-effective generation of the sum of pixel intensities in a specified rectangle in an image.

It is used for rapid computation of Haar-like features. Calculation of the sum of a rectangular area inside the original image is extremely efficient, requiring only four additions for any arbitrary rectangle size. AdaBoost is used for construction of strong classifiers as linear combination of weak classifiers.

V. LITERATURE REVIEW

Narayan T. Deshpande: The human face is a complicated multidimensional visual model and hence it is very difficult to develop a computational model for recognizing it. The paper presents a methodology for recognizing the human face based on the features derived from the image.

The proposed methodology is implemented in two stages. The first stage detects the human face in an image using violaJones algorithm. In the next stage the detected face in the image is recognized using a fusion of Principle Component Analysis and Feed Forward Neural Network.

The performance of the proposed method is compared with existing methods. Better accuracy in recognition is realized with the proposed method.

The proposed methodology uses Bio ID-Face-Database as standard image database.

K. Susheel Kumar: This paper presents an automated system for human face recognition in a real time background world for a large homemade dataset of persons face. The task is very difficult as the real time background subtraction in an image is still a challenge. Addition to this there is a huge variation in human face image in terms of size, pose and expression. The system proposed collapses most of this variance.

To detect real time human face AdaBoost with Haar cascade is used and a simple fast PCA and LDA is used to recognize the faces detected. The matched face is then used to mark attendance in the laboratory, in our case. This biometric system is a real time attendance system based on the human face recognition with a simple and fast algorithms and gaining a high accuracy rate.

Kalaiarasi P: Face recognition becomes more important in our daily life for various purposes like securing important and personal data, security for a restricted area, for banking purpose and other online applications. Neural network plays a major role in face recognition.

In case of face recognition, neural networks were used for different stages like feature extraction, prediction and classification individually as well as for both. After neural network, convolutional neural network was developed and now it is deep convolutional neural network which makes face recognition very simple and easier. This paper gives the detailed survey on neural networks and its contribution to face recognition in various researches since neural network to current deep neural network.

Rudolfo Rizki Damanik: Absence was a list of documents that the company used to record the attendance time of each employee. The most common problem in a fingerprint machine is the identification of a slow sensor or a sensor not recognizing a finger. The employees late to work because they get difficulties at fingerprint system, they need about 3 – 5 minutes to absence when the condition of finger is wet or not fit.

To overcome this problem, this research tried to utilize facial recognition for attendance process. The method used for facial recognition was Viola Jones. Through the processing phase of the RGB face image was converted into a histogram equalization face image for the next stage of recognition.

The result of this research was the absence process could be done less than 1 second with a maximum slope of ± 700 and a distance of 20-200 cm. After implement facial recognition the process of absence is more efficient, just take less 1 minute to absence.

Diaa Salama AbdELminaam: The development of biometric applications, such as facial recognition (FR), has recently become important in smart cities. Many scientists and engineers around the world have focused on establishing increasingly robust and accurate algorithms and methods for these types of systems and their applications in everyday life. FR is developing technology with multiple real-time applications.

The goal of this paper is to develop a complete FR system using transfer learning in fog computing and cloud computing. The developed system uses deep convolutional neural networks (DCNN) because of the dominant representation; there are some conditions including occlusions, expressions, illuminations, and pose, which can affect the deep FR performance. DCNN is used to extract relevant facial features. These features allow us to compare faces between them in an efficient way.

The system can be trained to recognize a set of people and to learn via an online method, by integrating the new people it processes and improving its predictions on the ones it already has. The proposed recognition method was tested with different three standard machine learning algorithms (Decision Tree (DT), K Nearest Neighbor (KNN), Support Vector Machine (SVM)).

The proposed system has been evaluated using three datasets of face images (SDUMLA-HMT, 113, and CASIA) via performance metrics of accuracy, precision, sensitivity, specificity, and time. The experimental results show that the proposed method achieves superiority over other algorithms according to all parameters. The suggested algorithm results in higher accuracy (99.06%), higher precision (99.12%), higher recall (99.07%), and higher specificity (99.10%) than the comparison algorithms.

Supriya D. Kakade: With data and information accumulating in abundance, there is a crucial need for high security. Face recognition has been a fast growing, challenging and interesting area in real time applications. A large number of recognition algorithms have been developed in last decades.

In this paper an attempt is made to review a wide range of methods used for face recognition comprehensively. This include PCA, LDA, ICA, SVM, Gabor wavelet soft computing tool like ANN for recognition and various hybrid combination of this techniques. This review investigates all these methods with parameters that challenges face recognition like illumination, pose variations, facial expressions. Due to the significant development of machine learning, the computing environment, and recognition systems, many researchers have worked on pattern recognition and identification via different biometrics using various building mining model

strategies. Some common recent works on FR systems are surveyed here in brief.

Singh, D et al. proposed a COVID-19 disease classification model to classify infected patients from chest CT images. a convolutional neural network (CNN) is used to classify COVID-19-infected patients as infected (+ve) or not (−ve).

Additionally, the initial parameters of CNN are tuned using multi-objective differential evolution (MODE). The results show that the proposed CNN model outperforms competitive models, i.e., ANN, ANFIS, and CNN models in terms of accuracy, F-measure, sensitivity, specificity, and Kappa statistics by 1.9789%, 2.0928%, 1.8262%, 1.6827%, and 1.9276%, respectively.

Schiller, D et al. proposed a novel approach to transfer learning to automatic emotion recognition (AER) across various modalities. The proposed model used for facial expression recognition that utilizes saliency maps to transfer knowledge from an arbitrary source to a target network by mostly "hiding" non-relevant information.

The proposed method is independent of the employed model since the experience is solely transferred via augmentation of the input data. The evaluation of the proposed model showed that the new model was able to adapt to the new domain faster when forced to focus on the parts of the input that were considered relevant sources.

Prakash, R et al. [5] proposed an automated face recognition method using Convolutional Neural Network (CNN) with a transfer learning approach. The CNN with weights learned from pre-trained model VGG-16. The extracted features are fed as input to the Fully connected layer and softmax activation for classification.

Two publicly available databases of face images–Yale and AT&T are used to test the performance of the proposed method. Face recognition accuracy of 100% is achieved for AT&T database face images and 96.5% for Yale database face images. The results show that face recognition using CNN with transfer learning gives better classification accuracy in comparison with PCA method.

Deng et al. proposed additive angular margin loss (ArcFace) to accomplish face acknowledgment. The proposed ArcFace has an unmistakable geometric understanding as a result of the specific correspondence to geodesic separation on a hypersphere.

They also introduced the broadest exploratory assessment against the FR method utilizing ten FR datasets. They indicated that ArcFace reliably beats the best in class and can be effectively actualized with irrelevant computational overhead. The verification performance of open-sourced FR models on LFW, CALFW, and CPLFW datasets reached 99.82%, 95.45%, and 92.08%, respectively [6].

Wang et al. proposed a large margin cosine loss (LMCL) by reformulating the SoftMax loss as a cosine loss by L2 normalizing the two highlights and weight vectors to evacuate outspread varieties and using the cosine edge term to expand the choice edge in precise space.

They achieved the highest between-class difference and lowest intraclass fluctuation via cosine choice edge augmentation and normalization. They referred to their model, trained with LMCL, as CosFace. They based their experiment on the Labeled Face in the Wild (LFW), YouTube Faces (YTF), and MegaFace Challenge datasets. They confirmed the efficiency of their proposed approach, achieving 99.33%, 96.1%, 77.11%, and 89.88% accuracy on the LFW, YTF, MF1 Rank1, and MF1 Veri datasets, respectively [7].

Tran et al. proposed a disentangled representation learning-generative adversarial network (DR-GAN) with three different developments. First, the encoder-decoder structure of the generator permits DR-GAN to gain proficiency with a discriminative and generative portrayal, including picture blending.

Second, the portrayal is unraveled from other face varieties—for example, through the posture code given to the decoder and posture estimation in the discriminator. Third, DR-GAN can accept one or various pictures as information and produce one integrated portrayal alongside an arbitrary number of manufactured pictures. They tested their network using the Multi-PIE database.

They contrasted their strategy and face acknowledgment techniques with Multi-PIE, CFP, and IJB-A and achieved average face confirmation exactness with greater than tenfold standard deviation. They accomplished equivalent execution on frontal-frontal confirmation with ~1.4% enhancement for frontal-profile verification [8].

Masi et al. proposed to build prepared information sizes for face acknowledgment frameworks: domain explicit information development. They presented techniques to enhance realistic datasets with critical facial varieties by controlling the faces in the datasets while coordinating inquiry pictures presented by standard convolutional neural systems.

They tested their framework against the LFW and IJB-A benchmarks and Janus CS2 on a large number of downloaded pictures. They reported the standard convention for unhindered, marked outside information and announced a mean grouping precision of 100% equal error rate.

Ding and Tao proposed a far-reaching system based on convolutional neural networks (CNN) to overcome the difficulties faced in video-based face recognition (VFR). CNN learns obscure highlights by utilizing prepared information comprising misleadingly obscured information and still pictures.

They proposed a trunk-branch ensemble CNN model (TBE-CNN) to improve CNN highlights to present varieties and impediments. TBE-CNN separates data from face pictures and zones picked around facial segments. TBE-CNN removes information by sharing the center and low-level convolutional layers between the branch and trunk systems.

They proposed an improved triplet misfortune capacity to invigorate the influence of discriminative portrayals learned by TBE-CNN. TBE-CNN was tested on three video face databases: YouTube, COX Face, and PaSC Faces.

Al-Waisy, et al. proposed a multimodal profound learning system that depends on nearby element presentation for k-based face acknowledgment. They consolidated the focal points of neighborhood handmade component descriptors with the DBN to report face acknowledgment in unconstrained circumstances. They proposed a multimodal nearby component extraction approach dependent on consolidating the upsides of fractal measurement with the curvelet change, and they called it the curvelet–fractal approach.

The principal inspiration of this methodology is that the curvelet change can expertly present the fundamental facial structure, while the fractal measurement presents the surface descriptors of face pictures. They proposed a multimodal profound face acknowledgment (MDFR) approach, to include highlight presentation by preparing a DBN on nearby element portrayals.

They compared the outcomes of the proposed MDFR approach with the curvelet–fractal approach on four face datasets: the LFW, CAS-PEAL-R1, FERET, and SDUMLA-HMT databases. The outcomes acquired from their proposed approaches outperformed different methodologies including WPCA, DBN, and LBP by accomplishing new outcomes on the four datasets.

Sivalingam et al. proposed a proficient fractional face location strategy utilizing AlexNet CNN to detect emotions based on images of half-faces. They distinguished the key focal points and concentrated on textural highlights. They proposed an AlexNet CNN strategy to discriminatively coordinate the two removed nearby capabilities, and both the textural and geometrical data of neighborhood highlights were utilized for coordination. The comparability of two appearances was changed according to the separation between the adjusted capabilities. They tested their approach on four generally utilized face datasets and demonstrated the viability and constraints of their proposed method [9].

Jonnathann et al. presented a comparison between profound learning and conventional AI strategies (for example, artificial neural networks, extreme learning machine, SVM, optimum-path forest, KNN) and deep learning. For facial biometric acknowledgment, they concentrated on CNNs. They used three datasets: AR Face, YALE, and SDUMLA-HMT. Further research on FR can be found in [10].

Artificial Neural Network (ANN) Multi-Layer Perceptron (MLP) with a feed forward learning algorithms was chosen for the proposed system because of its simplicity and its capability in supervised pattern matching. It has been successfully applied to many pattern classification problems [11]. A new approach to face detection with Gabor wavelets & feed forward neural network was presented in [12].

The method used Gabor wavelet transform and feed forward neural network for both finding feature points and extracting feature vectors. The experimental results, have shown that proposed method achieves better results compared to the graph matching and eigenfaces methods, which are known to be the most successful algorithms.

A new class of convolutional neural network was proposed in [13] where the processing cells are shunting inhibitory neurons. Previously shunting inhibitory neurons have been used in a conventional feed forward architecture for classification and non-linear regression and were shown to be more powerful than MLPs [14] [15] i.e. they can approximate complex decision surfaces much more readily than MLPs.

A hybrid neural network solution was presented in [16] which combines local image sampling, a self-organizing map neural network, and a convolutional neural network.

VI. CONCLUSION

So in this paper, we've wholly reviewed some of the methodologies and we've also learned that way face recognition and different approaches are researched it will be one of the major machine learning applications in the coming future. We've also found that there are various practical methods and approaches to achieve this and to add some greater scope regarding face recognition.

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