

Comparative Assessment of Face Recognition Methods by the use of Artificial Neural Networks

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ABSTRACT: Nowadays face recognition is the most prominent application for the image analysis. As it is widely used in the form of biometric system. In today's world biometric system is used everywhere for authentication purpose. As everyone has highly dynamic face for this a wide range of challenges come across to overcome this problem and to develop a computational model for this has become very difficult. To overcome these problems Artificial intelligence gave many different methods. In this research we will discuss and compare the works done by many authors in the field of face recognition using neural network methods and these methods will be trained by many algorithms like PCA and SVM.

Keywords: Face recognition, Neural networks, Artificial neural network algorithms.

I. INTRODUCTION

At early stages, design detection issues were frequently comprehended by straight and quadratic separates or non-parametric k-closest neighbor classifier. From that point forward, neural systems with at least one shrouded layers can, in hypothesis, be prepared to perform for all intents and purposes any relapse or on the other hand segregation undertaking. Since from 1990's neural systems have progressively been utilized as an option in contrast to exemplary example classifiers and bunching strategies. At the point when no great standard was accessible, [15], [13] the Self Organizing Map (SOM) was included as an intriguing elective for regulated strategies. The job of feed-forward neural systems and SOMs has been stretched out to include likewise low-level picture handling assignments, for example, commotion concealment and picture improvement. Hopfield neural systems were presented as an instrument for finding acceptable arrangements to complex improvement issues like RBF [18]. This makes them a fascinating option in contrast to conventional improvement calculations for picture preparing assignments that can be defined as advancement issues. In this review paper we have discussed about various sorts of Neural Systems techniques utilized in face recognition from 2008 to 2018.

As already discussed in the abstract that in present context(scenario) in image analysis, face detection is becoming the most prominent source. In present situation, face recognition assumes a noteworthy job in security, individual data gets to, enhanced human machine association and customized promoting. As face recognition is very complex task so it needs to be solved by high computer algorithms which includes many techniques. Therefore a system for recognition that, is not much expensive to utilize in any situation, doing perfect matching is required in today's scenario. Now It has become the thing of demand for today to create a robotic system which goes parallels to the human brain for face recognition. Many methods and algorithms are developed for the same purpose for example in the references [3], [8], [17] and [9]. Nowadays biometric authentication (identification) that utilizes computerized strategies to confirm or perceive the personality of

human in view of his/her physiological attributes. In spite of the fact that humans are very great in recognizing known faces, it is difficult to manage a lot of obscure appearances. This human constraint is overwhelmed by the use of computer's extreme type of solid calculations and algorithms. For some applications, the execution of face detection frameworks in controlled situations has now achieved an attractive level; in any case, there are as yet numerous difficulties presented by uncontrolled conditions. In the process of biometric person's finger prints, signatures speech and face are recognized. As in [11] Hang Su Subhransu, Maji Evangelos, Kalogerakis Erik, Learned-Miller has used CNN architecture trainings for 3D shapes recognition. They have used different views of 3D shapes to get desired compact view. They have shown that some 2D shapes can also help in recognizing the 3D shapes.

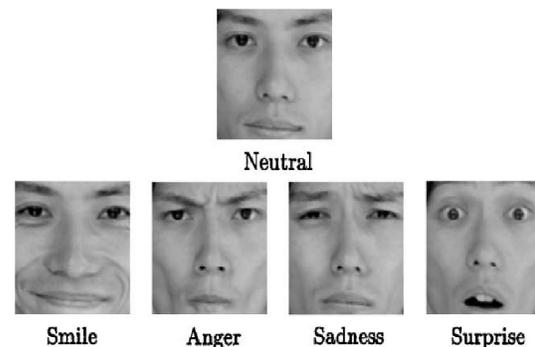


Fig. 1. Different facial expressions of a human.

A portion of these difficulties are presented by the issues caused by varieties in enlightenment, different poses of face at different conditions as shown in figure 1. The effect of variety in these conditions specifically, which causes emotional reflections in the appearance of face is one of those testing problems that a functional identification of face framework needs to confront. As in [12] Schroff., Kalenichenko, Philbin, have used the similarity of hundred pairs of frames and they got the accuracy of 95.12% and by using by evaluating thousand frames they got 95.18% of the accuracy which compared to others (which got 91% and 71% accuracy)

was much reliable to use. In this work we are going to discuss Artificial Neural Network approach that is Soft Computing based approach to solve face recognition or image or pattern recognition problems.

II. APPROACHES FOR FACE RECOGNITION

As face recognition is becoming extremely significance in numerous applications as in the reconnaissance and checking, the customary biometric strategies will flop with respect to clear reasons one can't request that everybody come and put his/her thumb on a slide or something comparable. So we require a framework which is comparable to the human eye in some sense to recognize a man. To fulfill this need and utilizing the perceptions of human psychophysics, confront acknowledgment as a field evident [6, 7]. Different approaches have been attempted by a few gatherings, working around the world, to illuminate this issue. Numerous business items have likewise discovered their way into the market utilizing either method. In any case, so far no framework/procedure exists which have appeared acceptable outcomes in all conditions. There are three main approaches for face recognition

A. Feature Based

FB face recognition methods comprises local features of face like eyes, mouth, chin, nose and head outline are used for the required purpose [10]. Then by using training networks and graphs these features are used for the purpose of matching these features with another image from the given dataset. As explained in [2] it is used in Gabor Filter Wavelet Algorithm [4] for detection /recognition of face.

B. Soft Computing-Based

Soft computing strategies viz. **Artificial Neural Networks, Genetic Algorithm , and Fuzzy Logic** have risen as a critical strategy for investigation in computing vision look into. Artificial Neural Network is a great instrument to determine the nonlinearity forced by various imperatives. Essentially, Fuzzy Logic is utilized for displaying human reasoning and observation. It is entrenched that the adequacy of the human mind isn't just from exact perception yet additionally from examination in light of Fuzzy set. Vulnerability is constantly associated with genuine application limitations and this is a typical issue in design acknowledgment. Examination in view of Fuzzy Logic has demonstrated to produce considerable change in design acknowledgment results. GA is a great pursuit and enhancement calculation, which depend on the hypothesis of characteristic advancement. GA is proficient in lessening calculation time for a colossal pile space.

III. WHY TO USE NEURAL NETWORK IN PATTERN/FACE RECOGNITION

The fundamental attributes of neural systems are that they can learn complex nonlinear info yield connections, utilize successive training techniques, and adjust to the information. The most generally utilized group of neural systems for design order undertakings is the feed-forward system as discussed in [3] by Allaf and Tamimi in their work they have used 50 images of 5 different persons i.e. 10 different poses per person in their process and applied six different training algorithms, which incorporates MLP and RBF systems. Another prominent system is the SOM, which is mostly utilized for information grouping and highlight mapping as in [14]. PCA is a standout amongst other worldwide

minimal portrayals [4]. The learning procedure includes refreshing system design and association weights with the goal that a system can productively play out a particular order/bunching assignment. The expanding notoriety of neural system models to take care of example acknowledgment issues has been essentially because of their apparently low reliance on area particular information and because of the accessibility of proficient learning calculations for specialists to utilize. Artificial Neural Network (ANNs) give another suite of nonlinear calculations for include extraction (utilizing shrouded layers) and arrangement. Likewise, existing element extraction and characterization calculations can likewise be mapped on neural system designs for proficient (equipment) execution.

A. Principle Component Analysis (PCA with ANN)

PCA or Principle Component Analysis is a typical measurable system for calculating the design in wide dimensional dataset and is used for model the linear variation [19]. Highlight extraction, is finished by PCA used for mainly three principle causes as to diminish the measurement of information to manageable limits, to catch notable class-particular highlights of the information and for redundancy elimination purpose. PCA was invented by Pearson and Hotteling. It was first applied in ecology by Doodall for the Factor Analysis. Basically [4] PCA is used to mold the dataset to lower dimension such that characteristics of dataset is preserved. As in proposed work [5] by Mohammad Abul Kashem, Md. Nasim Akhter, Shamim Ahmed, and Md. Mahbub Alam, they used to combine PCA with BPNN to get the better results. By doing this combination non-linear images recognized easily. In this research work they compared acceptance ratio and execution time by taking different number of images from the database in Table 1. It is calculated here that when number of images are 40 then acceptance ratio of PCA is 92.4 % and PCA combined with BPNN is 96.5% which is maximum i.e. more than 90% acceptance ratio and in less execution time. It is also explained by corresponding graph that when the PSA is combined with BPNN the results are more accurate and fast than only with PCA. Also Agarwal, M., Agrawal, H., Jain, N., & Kumar, M. in the proposed work [1] compared their results of PCA with other methods like K-means and recognition rate is 86.75 , and recognition rate for Fuzzy C-means with Fuzzy Ant is 94.82, while the proposed results are more accurate i.e.97.018% than the compared methods.

B. Feed Forward Neural Network (FFNN)

Design of Feed Forward Neural Networks (FFNN) or Multilayer Neural Networks is a much suitable arrangement for image detection, where neurons are inter-associated to shape a layer for the nonlinearly distinguishable raw dataset. As from the name multilayer it indicates that it works on different layers of the perceptrons. Each layer in the system gets contribution from past layer and feed its yield to following layer however the associations with the neurons in the same or past layers are not allowed [2]. While applying FFNN, the neurons are associated with each other in layers form [13]; also training technique is required, in that the weights associated between sequential layers are figured in view of both i.e., the preparation tests and target classes [19]. The weight vector which is calculated by anticipating preparing face picture on Eigen space or fisher space is utilized as a contribution to counterfeit neural system classifier. In FFNN the back substitution or feedback of the resultant

output is not allowed. i.e. no loop is formed in the network. However when in NN feedback of the output is allowed then it becomes recurrent neural network. It is simplest of all the neural networks Later on we will discuss the same network in this work. While applying FFNN, the neurons are associated with each other in layers form [13]; also training technique is required, in that the weights associated between sequential layers are figured in view of both i.e., the preparation tests and target classes [19]. The weight vector which is calculated by anticipating preparing face picture on Eigen space or fisher space is utilized as a contribution to counterfeit neural system classifier. Basically CNN is the class of FFNN as in [12] [14]. In [16] they have represented their work by two normal fully connected neural networks and one convolution and max pooling layer. FFNN recognize different objects by detecting their different features at each layer. For examples as explained in the Figure that this network identified edges in the hidden very first layer. In second one it identified corners and contours and in third one object parts are detected.

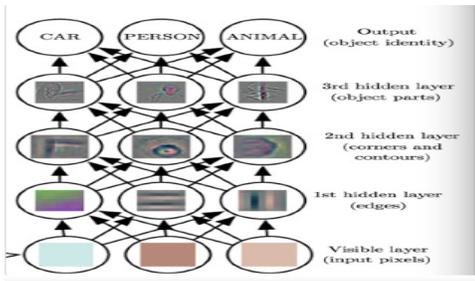


Fig. 2. Functioning of FFNN.

C. Back Propagation Neural Network (BPNN)
 BPNN is a structure defined in layers. It has insert layer, secret layer and the resultant layer as in all the NNs. Then corresponding to each input value a resultant value is calculated. Then according to difference between the resulted value and target value is calculated [5] then error is back propagated and weights are corrected accordingly to get the target value by using activation function fitted accordingly. Back Propagation is the method in which weights are calculated during learning process [17-19]. BPNN can be applied to more than one hidden layer but network can be processed using one layer. In the work proposed [2] by Shweta Mehta, Shailender Gupta, Bharat Bhushan and C. K. Nagpal they used BPNN and compared the results with Cascade Forward Neural Network (CNN) and RNN Recurrent Neural Network and concluded that the results obtained by BPNN are more accurate and are less time consuming than the others. The accuracy rate of BPNN is 83.09% while the rate of CNN and RNN is 65.2% and 62% as shown in Table 2 therefore BPNN is more accurate than the others. Also in time, the time taken in seconds by BPNN is 2.56 while by CNN and RNN is 11.48 and 3.20. Therefore BPNN is much accurate and faster than others. Also as discussed in the PCA algorithm in 3.1 when BPNN is combined with PCA it gives more accurate results and accuracy level is more than 90% which is better than any other.

D. Convolution Neural Network
 Convolution neural Networks are also known by the name deep artificial neural network which arrange

images according to their category, cluster them by closeness, and apply object detection inside scenes.

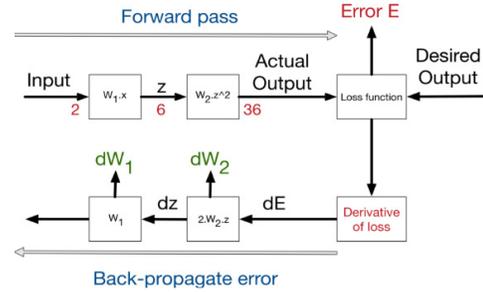


Fig. 3. Proposed features of back propagation.

CNN is used for picture recognition and categorization test, scene classification and image processing, Natural language processing, Media Recreation. It works on pixels of images. A CNN incorporates nearby responsive fields, shared loads and predispositions, activation and pooling as explained in [12]. A CNN works as a framework much like FFNN that has been intended for less number of prerequisites used for processing. The layers of a CNN comprise layers i.e. input, hidden and output that incorporates numerous convolutional layers, pooling layers, completely associated layers and standardization layers [21,22] by Morales, C. Lucas, N. Blas Gómez, and K. Ivanova., these are shown in Fig. 4. The evacuation of impediments and increment in productivity for picture detection results in a framework that is unmistakably increasingly successful as explained by Fan, Yingruo, Jacqueline CK Lam, and Victor OK Li in [20], less complex to trains constrained for picture preparing and NLP. CNN can also be applied to hand written content and the sound system too. Graphical data can also be handled by using Graphical CNN. CNN works in following steps

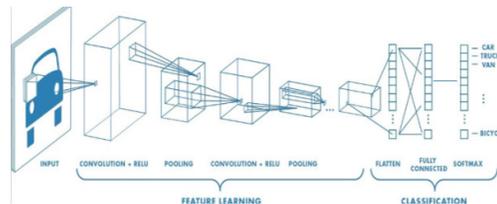


Fig. 4. A Complete Overview of Convolution Neural Network in the framework.

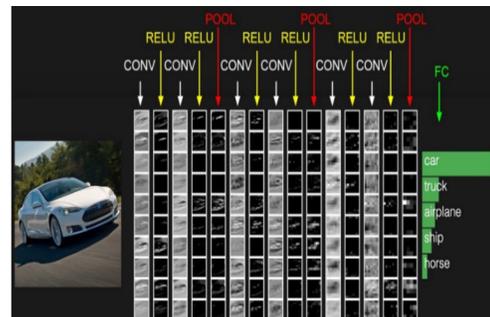


Fig. 5. Sample Recognition of Car using CNN.

E. Self Organizing Map (SOM)/Kohonen's Neural Network

There are circumstances when just a single reference picture is accessible and the test picture is privately mutilated or impeded. In such cases acknowledgment of

face by a machine winds up troublesome. For this case, Self Organizing Maps (SOM) are utilized to perform acknowledgment. SOM is prepared so that a solitary SOM subspace is utilized for every one of the classes and a different SOM is prepared for every individual class. At that point a k-closest neighbor procedure is utilized to locate the unlabeled examples [8]. SOM can be applied in one dimension or multi-dimension. In today's scenario SOM is widely used in predictions also.

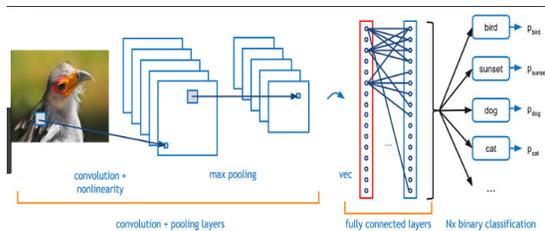


Fig. 6. Bird recognized using CNN.

IV. CONCLUSION

In this proposed work we have observed different methods of face recognition using Artificial neural networks i.e. Soft Computing based Methods. Also we have took a glance on feature based and Appearance based methods. In Neural Network methods we compared the various methods like PCA, FFWD, CNN, BPNN and SOM. By evaluating the results of all the papers discussed, it is concluded that BPNN has much accurate results than others. Its accuracy level exceeds when it is combined with others like in BPNN combined with PCA gives high accuracy rates. Also CNN has its own features of recognition different objects, sound and videos etc. Yet this work is not sufficient to reach any conclusion, we will proceed for further work using more algorithms as in [23] PSO is used.

REFERENCES

[1]. Agarwal, M., Agrawal, H., Jain, N., & Kumar, M. (2010, February). Face recognition using principle component analysis, eigenface and neural network. In *Signal Acquisition and Processing, 2010. ICSAP'10. International Conference on* (pp. 310-314). IEEE.

[2]. Mehta, S., Gupta, S., Bhushan, B., & Nagpal, C. K. (2014). Face recognition using neuro-fuzzy inference system. *International Journal of Signal Processing, Image Processing and Pattern Recognition*, *7*(1), 331-334.

[3]. Al-allaf, O. N., Tamimi, A. A., & Alia, M. A. (2013). Face recognition system based on different artificial neural networks models and training algorithms. *International Journal of Advanced Computer Science and Applications*, *4*(6).

[4]. Al-Allaf, O. N. (2014). Review of face detection systems based artificial neural networks algorithms. *arXiv preprint arXiv:1404.1292*.

[5]. Kashem, M. A., Akhter, M. N., Ahmed, S., & Alam, M. M. (2011). Face recognition system based on Principal Component Analysis (PCA) with back propagation neural networks (BPNN). *Canadian Journal on Image Processing and Computer Vision*, *2*(4), 36-45.

[6]. Beham, M. P., & Roomi, S. M. M. (2013). A review of face recognition methods. *International Journal of Pattern Recognition and Artificial Intelligence*, *27*(04), 1356005.

[7]. Rahman, M. U. (2012). A comparative study on face recognition techniques and neural network. *arXiv preprint arXiv:1210.1916*.

[8]. Deotale, N., Vaikole, S. L., & Sawarkar, S. D. (2010, February). Face recognition using artificial neural networks. In *Computer and Automation Engineering (ICCAE), 2010 The 2nd International Conference on* (Vol. 2, pp. 446-450). IEEE.

[9]. Shivdas, A. E. (2014). Face recognition using artificial neural network. *heart*, *2*(1).

[10]. Azeem, A., Sharif, M., Raza, M., & Murtaza, M. (2014). A survey: Face recognition techniques under partial occlusion. *Int. Arab J. Inf. Technol.*, *11*(1), 1-10.

[11]. Su, H., Maji, S., Kalogerakis, E., & Learned-Miller, E. (2015). Multi-view convolutional neural networks for 3d shape recognition. In *Proceedings of the IEEE international conference on computer vision* (pp. 945-953).

[12]. Schroff, F., Kalenichenko, D., & Philbin, J. (2015). Facenet: A unified embedding for face recognition and clustering. In *Proceedings of the IEEE conference on computer vision and pattern recognition* (pp. 815-823).

[13]. Ma, L., & Khorasani, K. (2004). Facial expression recognition using constructive feedforward neural networks. *IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics)*, *34*(3), 1588-1595.

[14]. Lawrence, S., Giles, C. L., Tsoi, A. C., & Back, A. D. (1997). Face recognition: A convolutional neural-network approach. *IEEE transactions on neural networks*, *8*(1), 98-113.

[15]. Bouzalmat, A., Belghini, N., Zarghili, A., & Kharroubi, J. (2011). Face detection and recognition using back propagation neural network and Fourier Gabor filters. *Signal & Image Processing*, *2*(3), 15.

[16]. Zeng, M., Nguyen, L. T., Yu, B., Mengshoel, O. J., Zhu, J., Wu, P., & Zhang, J. (2014, November). Convolutional neural networks for human activity recognition using mobile sensors. In *Mobile Computing, Applications and Services (MobiCASE), 2014 6th International Conference on* (pp. 197-205). IEEE.

[17]. Raheja, J. L., & Kumar, U. (2010). Hum an facial expression detection from detected in captured im age using back propagation neural network.

[18]. Sekhon, A., & Agarwal, P. Face Recognition Using Artificial Neural Networks.

[19]. Kasar, M. M., Bhattacharyya, D., & Kim, T. H. (2016). Face recognition using neural network: a review. *International Journal of Security and Its Applications*, *10*(3), 81-100.

[20]. Fan, Yingruo, Jacqueline CK Lam, and Victor OK Li. Video-based emotion recognition using deeply-supervised neural networks. *Proceedings of the 2018 on International Conference on Multimodal Interaction*. ACM, 2018.

[21]. Li, Yong, *et al.*, Occlusion aware facial expression recognition using cnn with attention mechanism. *IEEE Transactions on Image Processing* **28.5** (2019): 2439-2450.

[22]. Morales, C. Lucas, N. Blas Gómez, & K. Ivanova. Pattern Recognition with Convolutional Neural Networks: Humpback Whale Tails. (2019).

[23]. Kaur, A., & Singh, M. D. (2012). An overview of pso-based approaches in image segmentation. *International Journal of Engineering and Technology*, *2*(8), 1349-1357.