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REVIEW AERICLE

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A REVIEW ON FACE RECOGNITION TECHNIQUE USING THE ARTIFICIAL NEURAL NETWORK

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Abstract: Face recognition is one of the classical domains of research and development. Significant contributions on face recognition technique are available in literature. There are various kinds of techniques and methodologies which can be divided in two major categories i.e. feature classification based approach and reconstruction based approaches. In this paper, we are first providing the survey on existing efficient and recent techniques of face recognition. Additionally on the basis of concluded consequences a new model for recognizing the partial face. In this context a new model using LDA based features and BPN (back propagation neural network) based is introduced. Additionally their functional aspects are discussed. Finally the conclusion and future working guidelines are provided.

Keywords: face recognition, partial faces, neural network, LDA, survey, machine learning.

I.INTRODUCTION

Now in these days the machine learning and its techniques are played essential role in various real world applications. These applications are used for pattern recognition, classification, categorization, prediction, motion detection and various others [1]. Additionally the machine learning algorithms also works well with the images for motion detection, activity recognition and others. Among them the face recognition is one of the most essential applications. That is used in wide range of security, surveillance, monitoring and authentication [2].

Face is one of the most essential identities, which is almost different and unique for all the individuals. In a number of applications it is used as a biometric identity and utilized for authentication and access control [3]. But these applications are feasible if the recognition of the faces becomes accurate. The low rate of face recognition can degrade the performance of these applications. The basic issues of these systems are the pose variation, partial capturing of faces, small changes on faces, low resolution images, noisy images and others [4]. Due to these, improvements on the traditional face recognition systems are required. The proposed work is intended to design and develop an accurate face recognition technique that works on different variants of faces and can able to recognize any of the pose obtained by the user data [5].

Therefore in this paper the ORL dataset is used for designing and developing the face recognition system which contains different poses of faces of the same class. In addition of that the LDA (linear discriminant analysis) technique is used for computing face features. The multi-pose based features are used with the back-propagation neural network for training of faces. After training of the neural network the system is able to accept any of the training face pose and can recognize accurately.

This section provides the basic overview of the proposed methodology and the next section provides the essential contributions placed for recognizing the faces. Further the literature summary is offered. Additionally on the basis of concluded facts a new face recognition model is proposed. Finally the conclusion and future directions of the work is provided.

II. LITERATURE SURVEY

This section provides the collection of recently available contributions and efforts that are promising for accurately recognizing the faces.

S. S. Farfade et al [6] consider the problem of multi-view face detection. Current state-of-the-art approaches for this task require annotation of facial landmarks, or annotation of poses. They also require training dozens of models to capture faces in all orientations. Authors propose Deep Dense Face Detector (DDFD), a method that does not require pose/landmark annotation and able to detect faces in a wide range of orientations using a single model based on deep CNN. The method has minimal complexity; and not requires additional components. They analyzed scores of the face detector for faces in different orientations and found that 1) method is able to detect faces from different angles, 2) there seems to be a correlation between distribution of positive examples in the training set and scores of the given face detector. The method's performance was improved using better sampling and sophisticated data. Evaluations on benchmark datasets show that

single-model face detector has better performance compared to the previous methods.

Automatic affect recognition is a challenging task due to the various modalities emotions. Applications can be found in many areas i.e. multimedia retrieval and human computer interaction. ***P. Tzirakis et al [7]*** propose an emotion recognition system using auditory and visual modalities. To capture the emotions for various styles of speaking, robust features need to be extracted. This purpose, authors utilize a CNN to extract features from the speech, for visual modality a deep residual network (ResNet). Additionally, a machine learning algorithm needs also to be insensitive to outliers while being able to model the context. To tackle this, Long Short-Term Memory networks are utilized. System is then trained in an end-to-end fashion where – by also taking advantage of the correlations of the each of the streams – author manage to outperform the traditional approaches based on auditory and visual handcrafted features.

Recently, CNN have demonstrated excellent performance on various tasks, including classification of two-dimensional images. ***W. Hu et al [8]***, deep CNN are employed to classify hyper-spectral images. More specifically, the architecture of the classifier contains five layers with weights which are the input layer, the convolutional layer, the max pooling layer, the full connection layer, and the output layer. These layers are implemented on each spectral signature to discriminate against others. Results based on several data sets show that the method can achieve better performance than traditional methods, such as SVM and traditional deep learning- methods.

Z. Yu et al [9] report image based static facial expression recognition method for the Emotion Recognition. Authors focus on the sub-challenge of the SFEW 2.0 dataset, where seeks to classify a set of static images into 7 emotions. The method contains a face detection module based on ensemble of three face detectors, followed by a classification module with the ensemble of multiple deep CNN. Each CNN model is initialized randomly and pre-trained on a larger dataset. The pre-trained models are then fine-tuned on the training set. To combine CNN models, author present two schemes for learning: by minimizing the log likelihood loss, and by minimizing the hinge loss. The method generates result on the FER dataset. It also achieves 55.96% and 61.29% respectively.

X. Yin et al [10] explores multi-task learning (MTL) for face recognition. They answer the questions of how and why MTL can improve. First, author propose a multi-task CNN for face recognition where identity classification is the main task and pose, illumination, and expression estimations are the side tasks. Second, they develop a dynamic-weighting scheme to automatically assign the loss weight to each side task. Third, they propose a pose-directed multi-task CNN by grouping different poses to learn pose-specific identity features. They propose an energy-based weight analysis method to explore how CNN-based MTL works. They observe that the side tasks serve as regularizations to disentangle the variations from the learnt identity features. Experiments demonstrate the effectiveness of the approach. The approach is also applicable for pose-invariant face recognition and better performance.

The problems facing by blind people fall in the category of navigating through indoor and outdoor consisting of various obstacles and recognition of person in front of them. Identification of objects or person only with perceptive and audio information is difficult. This helps blind people to navigate with the help of a Smartphone, global positioning system (GPS) and a system with ultrasonic sensors. Face recognition can be done using neural learning techniques. The images of friends, relatives are stored in the database. Whenever a person comes in front of the blind user, the application gives the voice aid to the user. Thus system can replace the regular imprecise use of guide dogs and white sticks to help the navigation and face recognition process. ***P. M. Kumar et al [11]*** have proposed a novel image recognition and navigation system that provides precise and quick messages in the form of audio to visually challenged people.

The complexity of the human face and the changes due to different effects make it more challenging to design and implement a system for face recognition. ***M. A. Abuzneid et al [12]*** presented an approach to improve face recognition using a BPNN and features extraction based on correlation. A key contribution is the generation of a new set called the T-Dataset from the training data set, which is used to train the BPNN. The correlated T-Dataset provides a high distinction layer between the training images, it helps BPNN to converge faster and achieve better accuracy. Additionally authors used LBP histogram to prove that there is potential improvement. They applied five distance measurement algorithms and combine them to obtain the T-Dataset. Authors achieved higher recognition accuracy with less computational cost. Furthermore, author evaluates method on one of the benchmark data set, Labeled Faces, where they produce a competitive face recognition performance.

Thermal face recognition has received increasing attention. The traditional methods for TFR concentrate on the hand-crafted features, which requires more efforts to select and extract features and usually has lower recognition rate. ***Z. Wu et al [13]*** present CNN architecture for TFR. It is a new type of ANN that can learn features from the raw data. Results on face database show that CNN achieves higher recognition rate.

S. Kumaar et al [14] present real-time deep neural network architecture for disguised face verification. The model consists of two ANN, first one being CNN that predicts 20 facial key-points in the image and the second ANN classifies the subject. The accuracies are 67.4% and 74.8% for prediction and classification respectively.

Identification of individual livestock has become a pressing issue as intensification practices continue to be adopted and precise objective measurements are required. Current best practice involves the use of RFID tags which are time-consuming task. To overcome this, non-invasive biometrics is proposed by ***M. F. Hansen et al [15]***. They test this in a farm, on 10 individual pigs using three techniques: Fisher-faces, the VGG-Face pre-trained face CNN model and own CNN model that train using an artificially augmented data. Results show that accurate pig recognition is possible with accuracy rates of 96.7% on 1553 images.

III. LITERATURE SUMMARY

This section provides the summary of the collected literature. The table 3.1 includes the different aspects of the proposed study.

Authors and publication	**Contribution**	**Outcomes**
2015 ACM, S. S. Farfade et al [6]	Consider problem of multi-view face detection and proposed Deep Dense Face Detector. That does not require pose/landmark annotation to detect faces of orientations based on deep CNN. They analyzed scores of face detector for faces in different orientations and found 1) able to detect faces of different angles, 2) a correlation between distribution of positive samples in the training set and scores of the given face detector.	The method's performance was improved using sampling and sophisticated data. Evaluations on datasets show that single-model face detector has better performance.
Journal of Latex Class Files 2015, P. Tzirakis et al [7]	An emotion recognition system using auditory and visual modalities. To capture emotions of speaking. A CNN to extract features from the speech, for visual modality a deep residual network proposed to be insensitive to outliers to model the context. So, Long Short-Term Memory networks are utilized. System trained in an end-to-end fashion and also taking advantage of the correlations.	It outperforms as compared to the traditional approaches based on auditory and visual handcrafted features.
2015 Hindawi, W. Hu et al [8]	Deep CNN are employed to classify hyper-spectral images. The architecture of classifier contains five layers with weights (input, convolutional, max pooling, full connection, and output layer.	Results based on several data sets show that the method can achieve better performance than traditional methods, such as SVM and traditional deep learning-methods.
2015 ACM, Z. Yu et al [9]	Focus on SFEW 2.0 dataset, seeks to classify a set of images into 7 emotions. It contains a face detection module, followed by classification module using ensemble of multiple deep CNN. It is initialized randomly and pre-trained.	First minimizing the log likelihood loss, by minimizing hinge loss. The method generates result on FER dataset. It also achieves 55.96% and 61.29% respectively.
arXiv 9 May 2017, X. Yin et al [10]	They explore multi-task learning for face recognition. A multi-task CNN for face recognition where identity classification is	An energy-based weight analysis to show CNN-MTL work. They observe that the side tasks serve as regularizations to disentangle the variations from

	the main task. Second, develop a weighting scheme to assign the loss weight. Third, a pose-directed multi-task CNN by grouping different poses to learn features.	the learnt identity features. Experiments demonstrate the effectiveness of the approach. The approach is also applicable for pose-invariant face recognition and better performance.
Springer Nature 2017, P. M. Kumar et al [11]	The problems facing by blind people fall in the category of navigation through indoor and outdoor consisting of various obstacles and recognition of person in front of them.	Stored images of friends, relatives in the database to recognize a person in front of blind user, to gives voice aid to user. It is a face recognition and navigation system. It provides precise and quick messages.
IEEE 2018, M. A. et al [12]	That generates a dataset called the T-Dataset used to train the BPNN. Provides a high distinction layer between training images to converge faster and better accuracy and also used LBP histogram to prove that.	Achieved higher recognition accuracy with less cost. They produce a competitive face recognition performance.
2016 IEEE, Z. Wu et al [13]	Thermal face recognition depends on the hand-crafted features, requires efforts to select features and has lower recognition rate.	CNN architecture for TFR. A new type of ANN can learn features from raw data. Results on face database show CNN achieves higher recognition rate.
2018 IEEE, S. Kumaar et al [14]	It consists of two ANN, first CNN predicts 20 facial key-points in image and	The accuracies are 67.4% and 74.8% for prediction and classification
	second ANN classifies subject.	respectively.
Elsevier 2018, M. F. Hansen et al [15]	Non-invasive biometrics, CNN model that train using an artificially augmented data.	Accurate pig recognition with rates of 96.7% on 1553 images.

Table.1 Review summary

IV. PROPOSED WORK

The proposed work is motivated to study the multiple pose based face recognition system. A number of highly accurate models for recognizing faces in multiple poses are presented in recent years by different contributors, but most of the techniques either less accurate or computationally cost effective. Therefore the proposed work is focused on exploring the accurate pose based face recognition model. Additionally the proposed model is extended to offer the technique for partial face recognition. Thus we established solution for two limitations of the current available approaches:

1. Recognition of partial faces
2. Recognition of face after small change in face images (i.e. smiling face, crying face)

Basically, even small changes in face can impact on the performance of the learning algorithm for face recognition. Therefore need to be developing a feature selection and classification method by which we achieve the required consequences. Therefore the required model is demonstrated in figure 3.1.

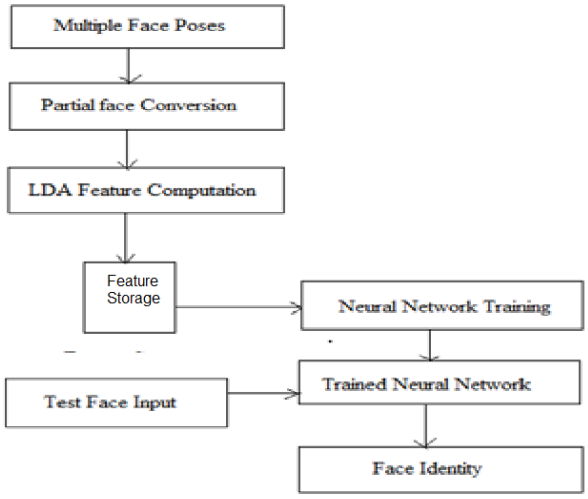

Figure.1 proposed model

The proposed model works in two modules. In first the training is provided to the model and then testing module is provided. Thus to demonstrate the required model ORL dataset is used. In this dataset we consider on 40 classes or identities and for each class we use 10 different poses. Means total of 400 images of 40

people is used. Among them the 70% of randomly selected images are used to train the model and 30% of data is used for testing. The system accepts the input sample images and for partial pose recognition the images are partitioned. These partitioned dataset is used for training and testing of the system.

Further the features from the face images are computed and stored in a database. In order to compute the features the LDA is used. The stored image features in database are learned by the artificial neural network (ANN). After learning the ANN is able to classify the data or faces by producing the test image samples. Finally based on the classification outcomes the performance of the model is computed. The proposed partial face recognition model is used in various other tasks also using multi-pose face recognition technique.

1. Biometric identity based authentication system
2. Identification of faces even some changes on face are found

This section provides the overview of the proposed model which is being developed in further.

V. CONCLUSION & FUTURE WORK

The face recognition is a classical domain of research and development. Therefore a review of existing tools and technology is presented and summarized first. According to the summary of face recognition models we concluded a number of different domains and applications. A significant developments are contributed in this domain i.e. authentication, navigation, and others. But a number of challenges are remaining to fix. In this work we consider the issue of changes in faces to recognize the multiple poses and also able to recognize the identity by partially captured face images. Therefore in this presented work an artificial neural network is employed for recognizing the human partial faces. Those concept usages the LDA based feature extraction to carry out this task. By using this we demonstrate the model for future development and implementation. The proposed model implemented in near future and their performance is measured and reported.

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