Face Recognition with Partial Face Recognition and Convolutional Neural Network

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Abstract - **Biometrics is a system in which we used to recognize human on the basis of its physical or behavioral characteristics. Face recognition has been a dynamic research area in the pattern recognition and computer vision domains. Each face in this world has uniqueness. Therefore it is an identity of human. This identity due to its uniqueness can be used for authentication and access control in different application. In this review paper the face recognition and facial feature is a key area of investigation. Therefore this paper includes the survey of different recently developed face recognition technique and methods which are claimed to provide an effective and accurate method of face recognition. In addition of that a new model for recognizing face is also introduced in this paper. That model is implemented in near future and their performance is compared with similar approach.**

Index: Face Recognition, LDA, CNN, Deep Learning, Feature Extraction, Face Images

I. INTRODUCTION

Deep learning provides a natural way to obtain feature representations from data without relying on hand-crafted descriptors. Biometric security systems based on facial characteristics face a challenging task due to variability in the intrapersonal facial appearance of subjects traced to factors such as pose, illumination, expression and aging. Humans often use faces to recognize individuals and advancements in computing capability over the past few decades now enable similar recognitions automatically [1]. Humans have the ability to recognize faces easily and effortlessly but in the area of image analysis and computer vision it remained as a difficult problem on which many years of research is going on. It is often useful to have a machine perform pattern recognition. In particular, machines which can read face images are very cost effective. The domain of machine learning and data analysis is frequently used in various real world applications. Some of them are used for providing ease in reducing the amount of data during intelligence system development and some of them are used for directly producing the outcomes to the applications. Among them the recognition and classification is a classical issue of machine learning. As a major technology in human face information processing, human face detection is the most important process in applications such as video surveillance, face recognition, and computer-aided manufacturing. However, due to the variations in background, illumination, pose and facial expressions, face detection is still a great challenge in real world [2] [3].

Therefore this paper review about the face recognition system and recent work done in this field along with we provided proposed concept which is dedicated to find the solution for face recognition using neural network based applications. During investigation of the face detection approaches in our research work we will implement face recognition technique using deep leaning of neural network strategies that will enhance figures are found to be better than some of the work reported in literature.

II. BACKGROUND

The background of a study is an important part of our research paper. It provides the context and purpose of the study. Hence there is need for background study that contributes to prepare proposed system.

A. Face Recognition

Face recognition is becoming an active research area spanning several disciplines such as image processing, pattern recognition, computer vision, neural networks, cognitive science, neuroscience, psychology and physiology. It is a dedicated process, not merely an application of the general object recognition process. It is also the representation of the most splendid capacities of human vision. Face recognition has been one of the most interesting and important research fields in the past two decades. The reasons come from the need of automatic recognitions and surveillance systems, the interest in human visual system on face recognition, and the design of human-computer interface, etc [4].

Face recognition describes a biometric technology that attempts to establish an individual's identity. Also known as facial recognition or face detection, the process works using a computer application that captures a digital image of an

individual's face (sometimes taken from a video frame) and compares it to images in a database of stored records. Face recognition describes a biometric technology that attempts to establish an individual's identity. Also known as facial recognition or face detection, the process works using a computer application that captures a digital image of an individual's face (sometimes taken from a video frame) and compares it to images in a database of stored records [5].

B. Face Recognition Structure

Typical structures of face recognition system consist of three major steps, gaining of face data, extracting face feature and recognition of face. Figure 1 shows typical structure of face recognition system in which subject under consideration given to the system for the recognition purpose this is consider being acquisition of face image. Later on feature is extracted from the image and finally it is given for the recognition purpose. These steps are elaborated as follow [6].

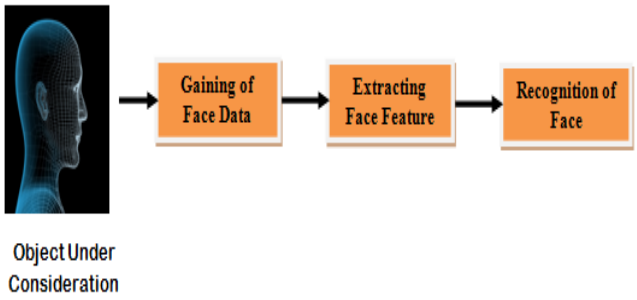

Figure 1: Face Recognition Systems

(i) Gaining of Face Data

Acquisition and Processing of Face Data is first step in the face recognition system. In this step face images is collected from different sources. The sources may be camera or readily available face image database on the website. The collected face images should have the pose, illumination and expression etc variation in order to check the performance of the face recognition system under these conditions. Processing of face database require sometimes otherwise causes serious affect on the performance of face recognition systems due changes in the illumination condition, background, lighting conditions, camera distance, and thus the size and orientation of the head. Therefore input image is normalized and some image transformation methods apply on the input image [7].

(ii) Extracting Face Feature

Feature extraction process can be defined as the process of extracting relevant information from a face image. In feature extraction, a mathematical representation of original image called a biometric template or biometric reference is generated, which is stored in the database and will form the basis (vector) of any recognition task. Later these extracted features used in recognition. A grayscale pixel is considered as initial feature.

(iii) Recognition of Face

Once the features are extracted and selected, the next step is to classify the image. Appearance-based face recognition algorithms use a wide variety of classification methods Such as PCA, LDA. In classification the similarity between faces from the same individual and different individuals after all the face images in database are represented with relevant features. Sometimes feature extraction & recognition process done simultaneously.

C. Linear Discriminant Analysis (LDA)

LDA is widely used to find linear combinations of features while preserving class separability. Unlike PCA, LDA tries to model the differences between classes. Classic LDA is designed to take into account only two classes. Specifically, it requires data points for different classes to be far from each other, while points from the same class are close. Consequently, LDA obtains differenced projection vectors for each class. Multi-class LDA algorithms which can manage more than two classes are more used. Linear Discriminant Analysis (LDA) is most commonly used as dimensionality reduction technique in the pre-processing step for pattern-classification and machine learning applications. The goal is to project a dataset onto a lower-dimensional space with good class-separability in order avoid over fitting ("curse of dimensionality") and also reduce computational costs [8].

D. Different Approaches of LDA

Data sets can be transformed and test vectors can be classified in the transformed space by two different approaches [9].

Class-dependent transformation: This type of approach involves maximizing the ratio of between class variance to within class variance. The main objective is to maximize this ratio so that adequate class separability is obtained. The class-specific type approach involves using two optimizing criteria for transforming the data sets independently.

Class-independent transformation: This approach involves maximizing the ratio of overall variance to within class variance. This approach uses only one optimizing criterion to transform the data sets and hence all data points irrespective of their class identity are transformed using this transform. In this type of LDA, each class is considered as a separate class against all other classes.

III. LITERATURE SURVEY

The various kinds of face detection techniques are available in literature some key contributions which are providing support for design and development of the accurate face

detection some of the essential articles are included in this section.

Wael AbdAlmageed et al. [10] introduce this method and system for face recognition using multiple pose-aware deep learning models. In this representation, a face image is processed by several pose-specific deep convolutional neural network (CNN) models to generate multiple pose-specific features. 3D rendering is used to generate multiple face poses from the input image. Sensitivity of the recognition system to pose variations is reduced since authors use an ensemble of pose-specific CNN features. Authors present extensive experimental results on the effect of landmark detection, CNN layer selection and poses model selection on the performance of the recognition pipeline. This novel representation achieves better results than the state-of-the-art on IARPA's CS2 and NIST's IJB-A in both verification and identification (i.e. search) tasks.

Changxing Ding et al. [11] proposes a novel face identification framework capable of handling the full range of pose variations within ±90° of yaw. The proposed framework first transforms the original pose-invariant face recognition problem into a partial frontal face recognition problem. A robust patch-based face representation scheme is then developed to represent the synthesized partial frontal faces. For each patch, a transformation dictionary is learnt under the proposed multi-task learning scheme. The transformation dictionary transforms the features of different poses into a discriminative subspace. Finally, face matching is performed at patch level rather than at the holistic level. Extensive and systematic experimentation on FERET, CMU-PIE, and Multi-PIE databases shows that the proposed method consistently outperforms single-task-based baselines as well as state-of-the-art methods for the pose problem. Authors further extend the proposed algorithm for the unconstrained face verification problem and achieve top-level performance on the challenging LFW data set.

Deep learning provides a natural way to obtain feature representations from data without relying on hand-crafted descriptors. In this paper, **Xue-wen Chen et al. [12]** propose to learn deep feature representations using unsupervised and supervised learning in a cascaded fashion to produce generically descriptive yet class specific features. The proposed method can take full advantage of the availability of large-scale unlabeled data and learn discriminative features (supervised) from generic features (unsupervised). It is then applied to multiple essential facial regions to obtain multi-channel deep facial representations for face recognition. The efficacy of the proposed feature representations is validated on both controlled (i.e., extended Yale-B, Yale, and AR) and uncontrolled benchmark face databases. Experimental results show its effectiveness.

Deep convolutional neural networks have recently proven extremely effective for difficult face recognition problems in uncontrolled settings. To train such networks, very large training sets are needed with millions of labeled images. For some applications, such as near-infrared (NIR) face recognition, such large training datasets are not publicly available and difficult to collect. In this work, **Guosheng Hu et al. [13]** propose a method to generate very large training datasets of synthetic images by compositing real face images in a given dataset. Authors show that this method enables to learn models from as few as 10,000 training images, which perform on par with models trained from 500,000 images. Using this approach they also obtain state-of-the-art results on the CASIA NIR-VIS2.0 heterogeneous face recognition dataset.

Biometric security systems based on facial characteristics face a challenging task due to variability in the intrapersonal facial appearance of subjects traced to factors such as pose, illumination, expression and aging. **Hachim El Khiyari et al. [14]** innovates as it proposes a deep learning and set-based approach to face recognition subject to aging. The images for each subject taken at various times are treated as a single set, which is then compared to sets of images belonging to other subjects. Facial features are extracted using a convolutional neural network characteristic of deep learning. This experimental result show that set-based recognition performs better than the singleton-based approach for both face identification and face verification. Authors also find that by using set-based recognition, it is easier to recognize older subjects from younger ones rather than younger subjects from older ones.

IV. PROPOSED WORK

The proposed system architecture for accurate face detection system is described using figure 2. In this figure the key functions and methods are highlighted which are used to process the face image data. Their working process is described as:

According to the given model proposed system accepts three face poses for training purpose. Among them first pose is taken from front, second is from left side and the third face image is taken from right side. All the face images are processed in next phase for bi-parting these images and the entire images are converted into six partial phases. After conversion of these faces into six parts the provision is made to define the image classes. These image classes are used with the LDA feature extraction algorithm. The LDA features and the class definition are preserved in a database. Now a neural network is prepared for training with the extracted features. Therefore first the user provides the setting parameters for the neural network. Now using these parameters system perform training with the features and trained model is prepared. In further this trained data model is used to accept the user face image and image recognition is performed.

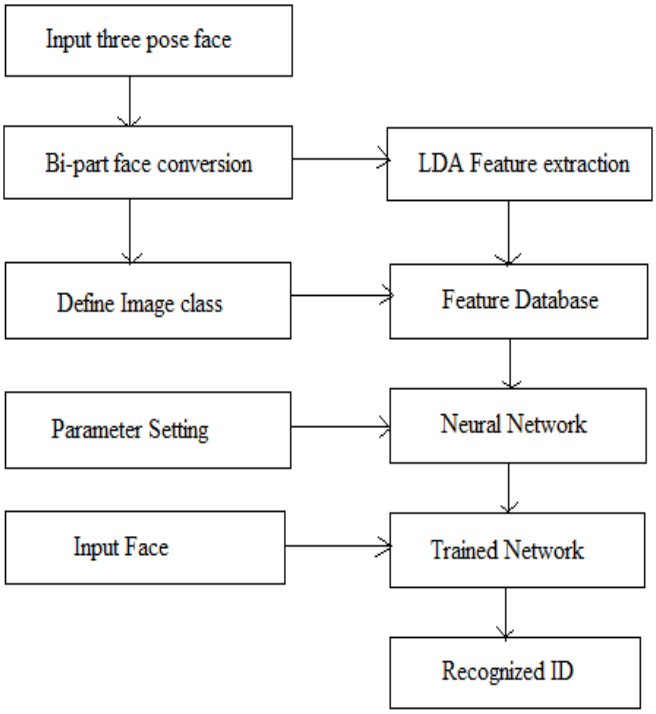

Figure 2: Proposed Work Flow

V. CONCLUSION

The face recognition is a subject of machine learning and pattern recognition. That is frequently used for various different applications for authentication and secure access control due to their uniqueness. The proposed work is dedicated to design and implement a face recognition model that accept the partial or complete face images in order to recognize the face class. In this context the three step process is proposed to work where in first phase the face images are partitioned into multiple face parts this step is termed here as the pre-processing of images. Secondly the images are processed for feature extraction thus the LDA algorithm is proposed to implement. Finally the neural network is proposed to perform training on extracted face features and classes and the trained model is used for recognizing the faces. In near future the proposed model is implemented and their performance is provided.

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