A Model for Unconstrained Face Recognition System

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***Abstract*:- In pattern recognition and computer vision the face recognition has been an important issue. Face recognition has many challenges like illumination variations ,pose variations, facial expressions, occlusion and aging. This paper presents a model for unconstrained face recognition by considering the pose variation and illumination variation. The texture features like Haralick features and log Gabor features are to be extracted. The recognition is to be performed using Support Vector Machine Classifier. The model will provide better accuracy of the recognition with various in the facial pose.**

Keywords — Face Recognition, Pose Invariant, Haralick Features ,Log gabor features,Classifer.

I. INTRODUCTION

Face recognition (FR) is a process in which face of individual is identified by a system. Whenever face recognition is used transversely in the surveillance system it is regularly very difficult to get the faces in restricted environment. Face recognition system has many challenges like illumination variation, Pose variation, Facial expression and occlusion. This paper focuses on pose variations. Hence the system has to be capable of recognizing the captured faces in variations in poses .Moreover, all the techniques are very much affected by variations and their routine get degraded when pose variations are present. The face recognition has advantages of being natural and proactive over other biometric techniques requiring mutual subjects for example fingerprint recognition and iris recognition. To benefit from the non-intrusive nature of face recognition, a system is invented to be capable of identify/recognize an uncooperative face in uncontrolled environment and an random state without the notice of the subject. This most people of environment and situations, though, brought serious challenges to face recognition techniques, e.g., the appearances of a face due to viewing condition changes may differ too much to accept or handle. The fundamental method for face recognition is eigenface which underline the reconstruction of a face image by using only a few eigenvectors.

The face recognition is carried out by facial feature extraction like geometric features, shape features, texture features. In pattern recognition and image processing, feature extraction is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be disreputably redundant, then the input data will be transformed into a reduced representation set of features. Transforming the input data into a set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the feature set will extract the relevant information from the input data in order to perform the desired task using the reduced representation instead of the full size input.

This paper presents the model for the pose invariant face recognition system and proposed model which consists of two phases :Training phase and Testing phase. In the training phase, system takes the input images of different poses of individuals and pre-processing will carried out to remove the noise and after this, fusion of different poses of images will be done which gives the resultant image and next step is feature extraction on the resultant image, this paper focuses on extraction of Haralick features and log gabor features and after feature extraction it will be stored in the Knowledge base constraint. In testing phase, when probe image comes ,first step is pre-processing like face detection and noise removal and second step feature extraction and third step is comparing with knowledge base constraint and finally results are classified using Support Vector Machine(SVM) which gives better recognition rate.

II. LITERATURE SURVEY

In computer vision domain, several works have been carried out towards the facial recognition. Many researchers addressed the issues in face recognition. In this paper some of the methods/algorithms proposed by the researchers is given in the following section;The method for pose-invariant face recognition based on a feature progressing model has been presented. However, facial feature changes with pose can be regarded as a continuous process, meaning that a person’s face image changes from one pose to another pose gradually. A feature progressing model can be applied to obtain features changing with pose and map them to the same person. Active Appearance Model (AAM) is often used to detect the face area of an image and return the position of feature points authors used CMU PIE, MULTI-PIE and FERET Database and result obtained is 91.2% in [1].

The effective approach for the application of Face Recognition using Local Binary Pattern operator has been explained in [2].The face image is firstly divided in to the sub regions to generate the locally enhanced Local Binary Histogram, which provide the features information on pixel level by creating LBP labels for histogram. Global Local Binary Histogram for the entire face image is obtained by concatenating all the individual local histograms. The database CMU-PIE and YALE B has been used for approximation. The recognition rate for CMU-PIE is 81.65%

and YALE B 80.59%.Its ability to recognize face with various constraints can be extended more by applying more enhancement methodologies in future.

For Human-Robot Interaction, the method of embedded system in which face recognition and facial recognition are employed. HMM has been combined with SVM algorithm for purpose of detecting face with a fast and reliable way . To detect the face recognition the full pose from face recognition data base is considered. The two main advantages of using this method are that it does not require manually selected facial landmarks or head pose estimation. The algorithm is presented for classifying whether a given face image is at a frontal or non frontal pose ,which helps to improve performance of pose normalization method in face recognition . Performance of the face recognition reaches to 99.617% in [3].

In many cases a user might not pose to a camera for the purpose of being recognized, perhaps not even knowing that a face image is being captured. To address this issue it is important for the system to handle faces with in plane and in depth rotations. Rotation invariant face recognition is an important area of research because of its many real-world applications, especially in creating a more robust recognition system for commercial and government technologies. Authors used Facial Recognition Technology (FERET) database and the Sheffield face database (previously called the "UMIST face database") and recognition rate obtained is 91.2% in [4].

In[5] presented a novel expression and pose invariant feature descriptor by combining Daubechies discrete wavelets transform and lower order pseudo Zernike moments. A novel normalization method is also proposed to obtain illumination invariance. The proposed method can recognize face images regardless of facial orientation, expression, and illumination variation using small number of features and used the AT&T database. Future works include analysing the performance of the proposed method for other biometric recognition applications such as recognition of ear, palmprint etc.

The method for pose-invariant face recognition is proposed by combining curvelet-invariant moments with curvelet neural network. First a special set of statistical coefficients using higher-order moments of curvelet are extracted as the feature vector and then the invariant features are fed into curvelet neural networks. Finally, supervised invariant face recognition is achieved by converging the neural network using curvelet as the activation function of the hidden layer neurons and used the FERET , LFW and CMU-PIE and recognition rate are for FERET =89.9%,LFW =63.9%,CMU-PIE=90.23% in [6].

The multi-view face detection based on head pose estimation has been presented in [7].Which is the combination of eigen face method and Support Vector Machine (SVM) are investigated to detect the face image. An input face image is normalized to frontal view using the irises information. Use Affine transformation parameters to align the input pose image to frontal view. The proposed method can achieve a recognition rate of over 93% when head rotation is within 45 degrees from the sample view. The performance of the proposed method was evaluated using the CAS-PEAL face database. For future works on the method, plan to test the performance of the method on larger rotation angles and to test how well the method handles interpolation and extrapolation between views

The robust, real-time executable, person independent, component-based, scale and pose invariant a face recognition system explained in [8]. In order to align face images, Constrained Local Models (CLM) has been employed. Features have been extracted using Gabor Wavelets from face images aligned with CLM as holistic-based and component based. After features extraction, the features have been classified by linear Support Vector Machines and results obtained is 91.75%
Subsequently ,in[9] proposed a novel algorithm for general 2D image matching, which is known to be an NP-complete optimization problem. With algorithm, the complexity is handled by sequentially optimizing the image columns from left to right in a two-level dynamic programming procedure. On a local level, a set of hypotheses is computed for each column, while on a global level the best sequence of these hypotheses is selected. The optimization on the local level is guided by a look ahead that gives an estimate about the not yet optimized part of the image and used the face recognition databases like CMU-PIE and CMU-Multi PIE and recognition accuracy obtained is 94:6%.

By using Markov random fields (MRFs) and an efficient variant of the belief propagation algorithm in [10] proposed a method for reconstructing the virtual frontal view from a given non frontal face image .The input face image is separated into a grid of overlapping patches, and a globally optimal set of local warps is estimated to synthesize the patches at the frontal view. A set of potential warps for each patch is achieved by aligning it with images from a training database of frontal faces In the Fourier domain the arrangements are performed efficiently by using an extension of the Lucas–Kanade algorithm that can handle illumination variations. The difficulty of finding the optimal warps is then formulated as a discrete labelling problem using an MRF. The reconstructed frontal face image can then be used with any face recognition technique. The two main benefits of their method are that it does not require manually selected facial landmarks or head pose estimation. In order to improve the performance of pose normalization method in face recognition, an algorithm for classifying whether a given face image is at a frontal or non frontal pose is required.

Addressed issue of variation in facial appearance due to the viewpoint or pose obviously degrades the accuracy of any face recognition systems. One solution is generating the virtual frontal view from any given non-frontal view. Authors proposed an efficient and novel locally kernel-based nonlinear regression (LKNR) method, which generates the virtual frontal view from a given non-frontal face image. Eventually, after non-frontal face images are converted to virtual frontal view, author used PCA+FLDA method for pose invariant face recognition. They have used the five pose subsets of CMU

PIE and three pose subsets of NCKU CSIE database and recognition rate obtained is 98.5% in[11].

The algorithm for robust detection of facial component-landmarks has been presented in [12].To achieve robust detection for extreme poses, use a set of independent pose and landmark specific detectors. Each component-landmark detector is applied independently and the information obtained is used to make inferences about the layout of multiple components and they have used the Multi-PIE database. Proposed method is tuned to detect 12 component-landmarks, which contain both anatomy- and pose-related characteristics. Each landmark corresponds to a range of poses where its location variation is confined within predefined limits. For instance, the "side nose" landmark is associated with yaw range [45;90], whereas the "nose" landmark is associated with [0;60]. These ranges were found experimentally based on the training error of the detector. The frontal and side landmarks may be present simultaneously for an intermediate range of poses and results obtained is 82.6%.

Further, in[13] presented a novel face recognition approach that implements cross-dimensional comparison to solve the issue of pose invariance. Their approach implements a Gabor representation during comparison to allow for variations in texture, illumination, expression and pose. Kernel scaling is used to reduce comparison time during the branching search, which determines the facial pose of input images. The conducted experiments prove the viability of this approach, with larger kernel experiments returning 91.6% - 100% accuracy on a database comprised of both local data, and data from the USF Human ID 3D database. In future experiments adapt this approach to use 2.5D (range) images. which will allow to test against larger, publicly available datasets. Since frontal range images have little information for the side of the head, the accuracy will suffer significantly at angles of greater than 60 degree.

Subsequently, in[14] proposed methodology which works the energy of the established match among a pair of images as a criterion of goodness-of-match and it is based on the MRF-based classification. The system is made robust to moderate global spatial transformations, by incorporating an image matching technique as part of the recognition process. The approach draws on the technique in which has the possible to cope with pose changes but a direct application of which suffers from several shortcomings. In order to overcome these problems, a number of enhancements are proposed. First, by assuming a multi-scale relaxation scheme built on super coupling transform, the inference using successive tree re-weighted message passing method is accelerated. Subsequently, by taking benefit of a statistical shape prior for the matching, the results are regularized and constrained, making the system robust to spurious structures and outliers. For classification, both textural and structural similarities of the facial images are taken into account and used CMU-PIE and FERET database and results obtained is 97%.

For the probability distribution functions (PDF) of pixels in different color channels in[15] method presented for new and high performance pose invariant face recognition system . The PDFs of the equalized and segmented face images are used as statistical feature vectors for the recognition of faces by minimizing the Kullback–Leibler distance (KLD) between the PDF of a given face and the PDFs of faces in the database. To combine feature vectors obtained from dissimilar color channels in HSI and YCbCr color spaces to improve the recognition performance ,the Feature vector fusion (FVF) and majority voting (MV) methods have been employed . The proposed system has been tested on the FERET and the Head Pose face databases. The recognition rates obtained using FVF approach for FERET database is 98.00% compared with 94.60% and 68.80% for MV and principle component analysis (PCA)-based face recognition techniques, respectively.

III. PROPOSED MODEL FOR POSE INVARIANT FACE RECOGNITION

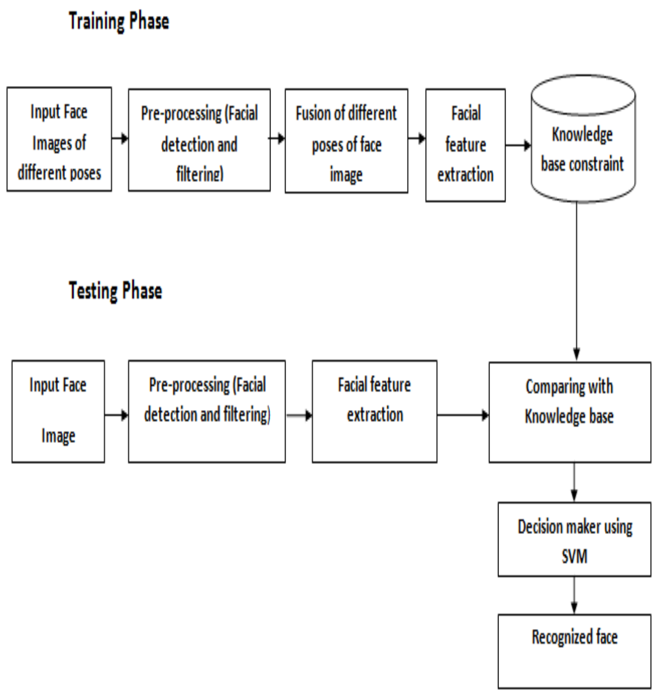

Fig. 1 Block diagram

The block diagram of Pose Invariant Face Recognition System has shown in Fig 1.The block diagram consists of two phases :Training Phase and Testing Phase.

In training phase, different poses of individual face image has to be given as input to the system and pre-processing is to be carried out on the different poses of face image which includes like face detection by using Viola and Jones method and filtering ,next step is fusion of different poses of face image which gives the resultant image and features like haralick and log gabor features are extracted on the resultant image and storing in to a knowledge base constraint .In testing phase ,once probe image comes to system the pre-processing has to be carried out on the probe and feature extraction. Once done with feature extraction it is going to be compare with the knowledge base constraint features and results are classified by using Support Vector Machine(SVM) and finally labeling of recognized face.

The Haralick features which gives texture information of the face. There are fourteen haralick features which are Angular second Moment, Contrast, Coorelation, Sumofsquares: variance, Inverse Difference moment, Sum of average, Sum of variance, Sum of Entropy, Entropy, Difference Variance, Difference Entropy, Info .measure of correlation 1, Info.measure of correlation 2, Max. correlation coeff.

IV .CONCLUSION

The prominent problem in face recognition viz. pose variation received extensive attentions in the research community of computer vision and pattern recognition. A number of promising techniques have been proposed to tolerate and/or compensate image variations brought by pose changes. However, achieving pose invariance in face recognition still remains an unsolved challenge, which requires continuing attentions and efforts. After performing the literature review of around twenty research articles/papers many issues/challenges are identified. The pose-variation is one of the major issues in face recognition system. Hence, there is a scope to address the pose variation problem and to build an efficient model for pose invariant face recognition system and achieve the better recognition rate.

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