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Library Management System with Facial Biometric Authentication

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Abstract— In this paper we propose a system that uses the biometric authentication for the users of the Library. It is expected to reduce the time taken to gain access into the Library. The system will help in automating the user ledger by automatically recording the in and out time of the users. The system will enable the user to pick up the book and leave the library without having to wait in the queue for making the entry in the system.

Keywords— Feature extraction, Image Processing and Library Management

Introduction

Biometric authentication system is considered to provide better security when compared to other categories of authentication systems. Biometric access control uses a method to identify unique human characteristics as a means of authenticating individual users. Biometric authentication systems can be implemented in two phases where the first one is to record the biometrics of the users who can gain access. During this phase the key features that could be used to identify the user will be extracted and stored as the template of the user. Second phase is the actual authentication phase during which the system will compare the biometric features of the user trying to gain access with that of the stored data. If there is a match it will allow the user to gain access otherwise it will alert about the unauthorised person trying to gain access.

Some of the biometrics that could be used for authenticating the user are iris, finger print, face, voice, DNA, retina, hand geometry. Of all the biometrics face has started gaining popularity as facial recognition is considered to be relatively inexpensive. Facial recognition is popularly used in various fields like healthcare, access control, security and criminal identification. Facial recognition can be performed either in 2D or 3D manner, each of which have their own advantages and disadvantages.

Generally a facial recognition system has a camera capture the image extract the distinctive features like the position, shape, size of eyes, lips, nose etc.

Computer vision for faces can approximate the human approach of identifying the individual users. Face detection identifies the facial region in the input image (locating the face part in image). Face recognition refers to identifying the user corresponding to the image. Face detection can be primarily based on two approaches namely local and global approaches. Local approach uses facial features such as nose, eye and mouth to associate a face with the person. Face recognition can be done previously using geometric models. Several face recognition algorithms have been developed and used, each has its own advantages and efficiency rates. There are several approaches for face recognition namely fisher faces approach, eigen faces approach and there exists several variations in the methods and algorithms for face recognition.

Here we are proposing a face recognition system built using opencv tool(open source computer vision) for biometric authentication.opencv is an open source computer vision and machine learning library. It consists of nearly 2500 optimized algorithms.These algorithms are used for detecting and recognizing the faces and also used to identify objects and tracking moving objects. This system includes two phases namely dataset generation phase (enrolling the images of valid users in the database) and its second phase includes the process of identifying whether the user is authenticated to access the library or not.In verification phase the input images are compared with the set of

images stored in dataset.Reports about the usage of library resources by the users can be generated. .This system aims to avoid the need for recording the in/out time of the users manually and also reduces the chance of misuse of a person's identity.

Literature Review

Anil Jain et. al.[1], in their paper have discussed in detail about the various biometrics that could be used for implementing authentication systems. They have made a comparative study about the various biometric systems by considering seven factors. They have also discussed about the advantages and disadvantages of the unimodal and multimodal biometric systems.

Khem Puthea et. al.[2], have reviewed the works done for marking attendance using the facial recognition. Their review reveals that Principal Component Analysis (PCA) could be used to reduce the dimensionality of the features that are extracted from the face images.

Hemant Makawana and Taranpreet Singh have discussed about algorithms that could be used for facial recognition. According to them the algorithms could be categorised as Geometry based and appearance based. In their paper they have discussed about the appearance based techniques that too global feature based. They have concluded that PCA occupies more space when compared to Linear Discriminant Analysis (LDA). According to their results, false rejection ratio for LDA increases as the number of samples increases. The false rejection ratio for PCA decreases as the number of samples is increased. However the number of samples considered b y them is too low to arrive at any concrete decision.

Kavitha and Manjeet Kaur done a survey about the facial recognition algorithms. They have discussed that generally facial recognition systems could either be template based or geometric based. Their review indicate that many researchers has worked in this domain. Based on their review it could be inferred that many researchers have worked using template based approaches when compared to that of geometric based approach. They have listed some of the issues that need to be addressed while developing a facial biometric system. The issues are expression change, change in pose, variation in lighting, angle of image capture, presence or absence of accessories and extensions and size of image.

Rakesh Saini et.al., in their paper, have done an analysis of five algorithms that could be used facial recognition. In their work they have made a comparative analysis on memory usage and rate of recognition for five algorithms, along with their merits and demerits. Based on their data it could be concluded that PCA in combination of LDA or Artificial Neural Network (ANN) is better when compared to using PCA alone.

Shakir F. Kak et. al., in their paper, have discussed about the fields in which facial recognition plays a vital role. They have highlighted that the facial feature extraction methods could be broadly classified as Model-based, Appearance-based and hybrid of model and appearance. According to their study many researchers have tried varied techniques using appearance-based facial recognition, whereas few works have been carried out using the model-based techniques. They have stated that model-based techniques can overcome the problem of variation in lighting, size and alignment. They also state that model-based techniques are faster in matching and represent the images in compact manner, however relatively slow in detecting a face. They also concluded that better models need to be proposed so that the problems of expression, occlusion, pose variation and illumination issues could be addressed.

Sushma Jaiswal et. al., they have compared features of these algorithms and mentioned their advantages,disadvantages.They have suggested that eigen face approach is easy to implement and its main idea is to get the features in mathematical sense instead of physical face feature by using mathematical transform for recognition.It primarily involves two phases phases. And added that fisher face approach is better than eigenface approach with improved classification of different classes of images.They stated that elastic bunch graph matching makes use of gabor

feature, which is sensitive to lighting variation and allows for position and facial expression variation.

III.PROPOSED WORK

The proposed system for face recognition includes the following stages :

1.Image Acquisition

2. Pre-processing

3.Feature Extraction

4.Comparison and verification.

This system includes two phases namely data generation phase and recognition phase. Data generation phase means enrolling the images of the valid users in the database.

1.Image Acquisition:

First step of face recognition is to capture the face image of users by using camera having appropriate resolution (4MP camera) and it should be placed at a distance sufficient to capture the images o the users properly.And these images are used to create dataset for training the images. system. The collected face images should have the pose, expression variation in order to check the performance of the face recognition system under these conditions.

2.Pre-processing:

Pre-processing involves rgb to gray scale conversion of the images, Histogram equalization also done in this stage.It can be performed to adjust the brightness levels of the images.Pre-processing reduces the time taken to process the images.

Dimensionality reduction can be achieved by PCA algorithm.LDA also be used for feature extraction in some applications.

3.Feature Extraction:

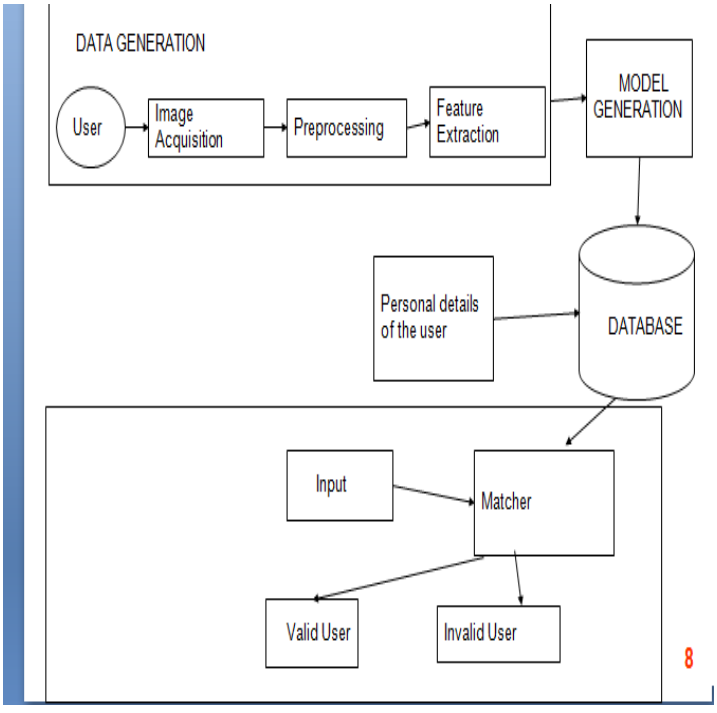
Extracting the characteristic features of the images which are used to identify the faces uniquely.These features extracted are based on the nodal points located on the face.It includes eye socket depth,nose width,jaw lines,cheek bones(around 80 points are located in human face image).The extracted nodal point data are stored as numeric codes(face print) for the set of images,for each set of images unique id will be assigned.Face prints are used for comparison of the images. For more efficiency surface deviation features are also compared ,if required.

The above mentioned three stages are common for both data generation phase and recognition phase.

4.Comparison and verification:

This stage involves comparison of input images with set of images stored in the database(images in dataset).Template matching module is used for comparing these images.Face images of the individual users are assigned with unique id.

The architecture for the proposed system is as follows:



LBPH:

LBPH(Local BinaryPattern Histogram) is a popular face recognition algorithm. It is a simple yet very efficient texture operator which labels the pixels of an image by the use of threshold values, the neighbourhood of each pixel and considers the result

as a binary number .It uses four parameters namely :radius, neighbours,grid x, grid y for performing the face recognition task.The computational part of this algorithm is to get a part of the image that describes the original image by locating the facial characteristics.The obtained image is divided into multiple and then histogram for the images are extracted.

2.SIFT:

Scale-Invariant Feature Transformation is a feature detection algorithm used to detect and describe local features in images. SIFT keypoints of objects are first extracted from a set of images and stored in a database. An object is recognized in a new image by individually comparing each feature from the new image to this database and finding candidate matching features based on Euclidean distance of their feature vectors.

3. LDA:

Linear discriminant analysis is used in pattern recognition and statistics to find the linear combination of features that characterizes or separates two or more classes of objects.The resulting combination may be used for dimensionality reduction. LDA is also quite related to principal component analysis , in that they both look for linear combinations of variables which describes the data . LDA explicitly attempts to model the difference between the classes of data. LDA works when the measurements made on independent variables for each observation are continuous quantities.

4.PCA:

Principal component analysis is used for dimensionality reduction . It transforms the original coordinates of a dataset into a set of principal components.First component in the set of principal components has the largest possible variance and each succeeding component has the highest possible variance with a condition that it is orthogonal to the components preceding to it .Considering only the first m components(m<n) from the original set of images reduces the dimensionality of the data.PCA still retains most of the information about variance of the data .And it is known that PCA doesn't provide interpretability of the dataset.

IV.Conclusion

This system offers better results in providing authenticated entry to the users of a library .It shows better recognition rates for various posing angles.And provides efficient false acceptace and false rejection rates.It automates the process of recording the time of users.However the system works under certain constraints such as lighting conditions and posing angles.

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