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RESEARCH ARTICLE

Improved Approach for Eigenface Recognition

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ABSTRACT

Face recognition has become an important issue in many applications such as security systems, credit card verification, and criminal identification. It is more secure among other security systems because facial image helps to avoid any duplicated identification and recognition, especially to identify certain criminals. The process of identifying and comparing the faces in a huge image database is a very complex task. The common method used in face recognition approach is eigenface method. The objective of this paper is to design and develop an improved face recognition algorithm using MATLAB. The face space is defined by the "eigenface," which is the eigenvectors of the set of faces, and they do not necessarily correspond to isolated features such as eyes, ears, and noses. Improved eigenface approach seems to be an adequate method to be used in face recognition due to its simplicity, speed, and learning capability. Experimental results show the improvement over existing method and the proposed face recognition gives better perception.

Key words: Face recognition, eigenface, MATLAB

INTRODUCTION

Face recognition is typically used in security systems. Besides that, it is also used in human-computer interaction. To develop this paper, improved eigenfaces method is used for training and testing faces.[1] It has received significant attention and a general statement of the problem can be formulated as, for example, if it is still or video images of a scene, then one or more persons in the scene can be identified using a stored database of faces. The solution of the problem involves face detection, feature extraction from the face region, and recognition. Improved eigenfaces are a set of eigenvectors used in the computer vision human face recognition.[2] A set of improved eigenfaces can be generated by performing a mathematical process using principal component analysis (PCA) approach on a large set of images depicting different human faces. The key procedure used in PCA is based on Karhunen–Loeve transformation. If the image elements are considered to be random variables, then the image may be seen as a sample of a stochastic process. The focus of the research paper is to achieve the accuracy over the existing approaches which are used in face recognition.

It is focused toward developing a sort of unsupervised pattern recognition scheme that does not depend on excessive geometry and computations like deformable templates. Improved eigenfaces approach seemed to be an adequate method to be used in face recognition due to its simplicity, speed and learning capability, etc. This scheme is based on an information theory approach that decomposes face images into a small set of characteristic feature images called improved eigenfaces, which may be thought of as the principal components of the initial training set of face images.

In the security system, many types of password are used to access the private and confidential data. Such passwords could be inserted as characters such as key or pin and touch smart card using radio-frequency identification technology. The other options such as first passwords and pins are hard to remember and can be stolen or guessed. Second, cards, tokens, keys, and the like can be misplaced, forgotten, purloined, or duplicated, and third, magnetic cards can become

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corrupted and unreadable. Hence, the developed face recognition approach seems to be more secure because facial image ID helps to avoid any duplicated identification. Moreover, identifying certain criminals are easy since face recognition helps to recognize the facial image in a more efficient and accurate manner, by matching the face with the data stored in the database.[2]

METHODOLOGY

Development of eigenface process is to first load all training images and the corresponding intensity values are stored. Second, construct the image to get mean image, normalized image, covariance matrix, and determine the eigenvector. The third stage is classified the new image where it needs to insert the new name image to continue the process. The functionality of this process is analyzed using a given test image. If it is a face image, then it is compared with the existing face classes. If it matches, the result will appear. The flowchart of eigenface is given in Figure 1.

EXISTING METHOD

Face recognition presents a challenging problem in the field of image analysis and computer vision, due to its many applications in various domains. Face recognition techniques[3] can be broadly divided into three categories based on the face data acquisition methodology: Methods that operate on intensity images; those that deal with video sequences; and those that require other sensory data such as three-dimensional information or infrared imagery. In case of information theory, the objective is to extract the relevant information in a face image, encode it as efficiently as possible, and compare one face encoding with a database of models encoded in the same way.

In mathematical terms, the objective is to find the principal components of the distribution of faces or the eigenvectors of the covariance matrix of the set of face images. These eigenvectors can be thought of as a set of features which together characterize the variation between face images. Each image location contributes more or less to each eigenvector so that it will display the eigenvector as a sort of ghostly face called an eigenface. Figures 2 and 3 show typical face recognition system and algorithm, respectively.[4]

PROPOSED METHOD

The proposed face recognition system passes through three main phases during a face recognition process. Three major functional units are involved in these phases and they are depicted in Figure 4. Acquisition and pre-processing of the face images are going to be added and stored in the face library. This face database is called as "face library" because it does not have the properties of a relational database. Every action such as training set or eigenface formation is performed on this face library and it is initially empty. To start the face recognition process, this initially empty face library has to be filled with face images.

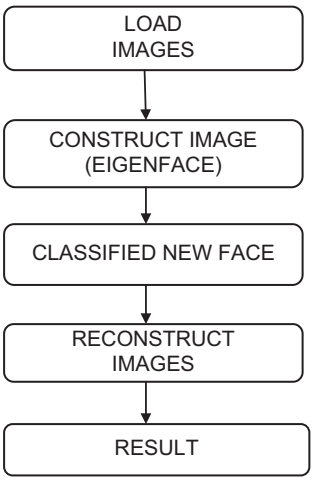

Figure 1: Flowchart of eigenface

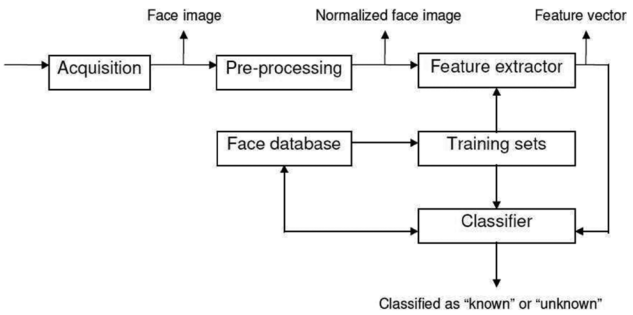

Figure 2: Typical face recognition system

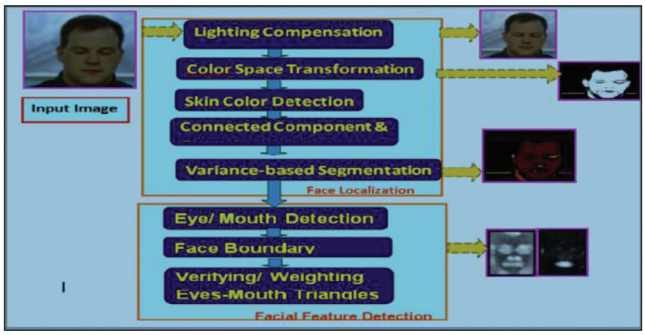

Figure 3: Face recognition algorithm

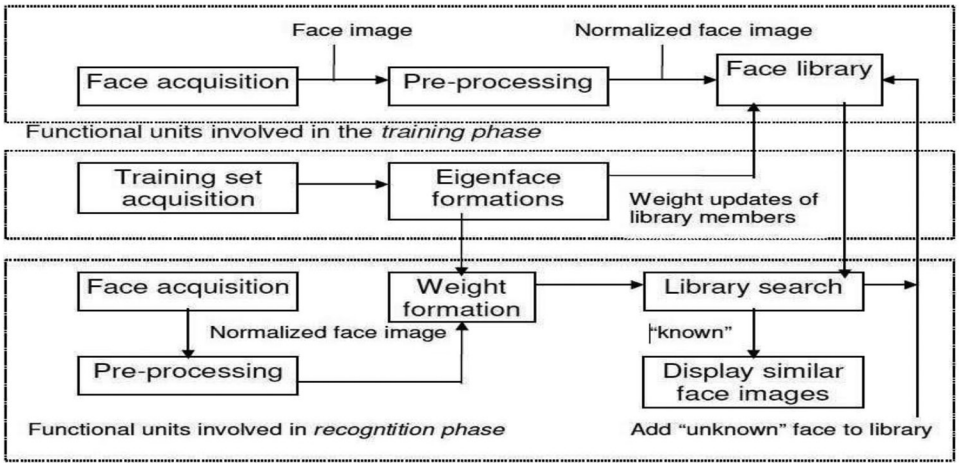

Figure 4: Proposed face recognition system

The proposed face recognition system operates on 128 × 128 × 8, Human Information Processing software formatted image files. At the moment, scanner or camera support is unavailable. To perform image size conversions and enhancements on face images, there exists the "pre-processing" module. This module automatically converts every face image to 128 × 128 size if it is necessary and based on user request, it can modify the dynamic range of face images (histogram equalization) to improve face recognition performance. Furthermore, it considers the implementation of background removal algorithm in the pre-processing module.

After acquisition and pre-processing, face image under consideration is added to the face library. Each face is represented by two entries in the face library: One entry corresponds to the face image itself (for the sake of speed, no data compression is performed on the face image that is stored in the face library) and the other corresponds to the weight vector associated for that face image. Weight vectors of the face library members are empty until a training set is chosen and improved eigenfaces are formed.

Initially, after adding face images to the empty face library, the system is ready to perform training set and eigenface formations. Those face images that are going to be in the training set are chosen from the entire face library. Because the face library entries are normalized, no further pre-processing is necessary at this step. After choosing the training set, improved eigenfaces are formed and stored for later use. Improved eigenfaces are calculated from the training set, keeping only the M images that correspond to the highest eigenvalues. These M improved eigenfaces define the M-dimensional "face space."

DETECTION AND RECOGNITION OF FACE IMAGES

Real-time face detection involves detection of a face from a series of frames of a video capturing device.[5] While the hardware requirements for such a system are far more stringent, from a computer vision standpoint, real-time face detection is actually a far simpler process than detecting a face in a static image. This is because unlike most of our surrounding environment, people are continually moving such as walk around, blink, fidget, and wave the hands.[6]

When new faces are involved, the improved eigenfaces can be updated or recalculated. The corresponding distribution in the M-dimensional weight space is calculated for each face library member, by sending its face image onto the "face space" spanned by the improved eigenfaces. Now, the corresponding weight vector of each face library member has been updated which was initially empty. The system is now ready for the recognition process. Once a training set has been chosen, it is not possible to add new members to the face library with the conventional method that is presented in "phase 1" because the system does not know whether this item already exists in the face library or not. A library search must be performed.

After choosing a training set and constructing the weight vectors of face library members, now the system is ready to perform the recognition process. User initiates the recognition process by

choosing a face image. Based on the user request and the acquired image size, pre-processing steps are applied to normalize this acquired image to face library specifications (if necessary). Once the image is normalized, its weight vector is constructed with the help of the improved eigenfaces that were already stored during the training phase.

After obtaining the weight vector, it is compared with the weight vector of every face library member within a user-defined "threshold." If there exists at least one face library member that is similar to the acquired image within that threshold; then, the face image is classified as "known." Otherwise, a miss has occurred and the face image is classified as "unknown." After being classified as unknown, this new face image can be added to the face library with its corresponding weight vector for later use.

RESULTS AND DISCUSSION

This section deals with the inference of the results acquired. The mat lab software is used to detect the face as segments; the segments are face, nose, mouth, and eye. Those segments are the major parts of the detection process. The database of the segments is stored as the referral. These referral images are converted into threshold images. The referral images are then used to compare with the input or the provided image. When the input image is provided, the provided image is also

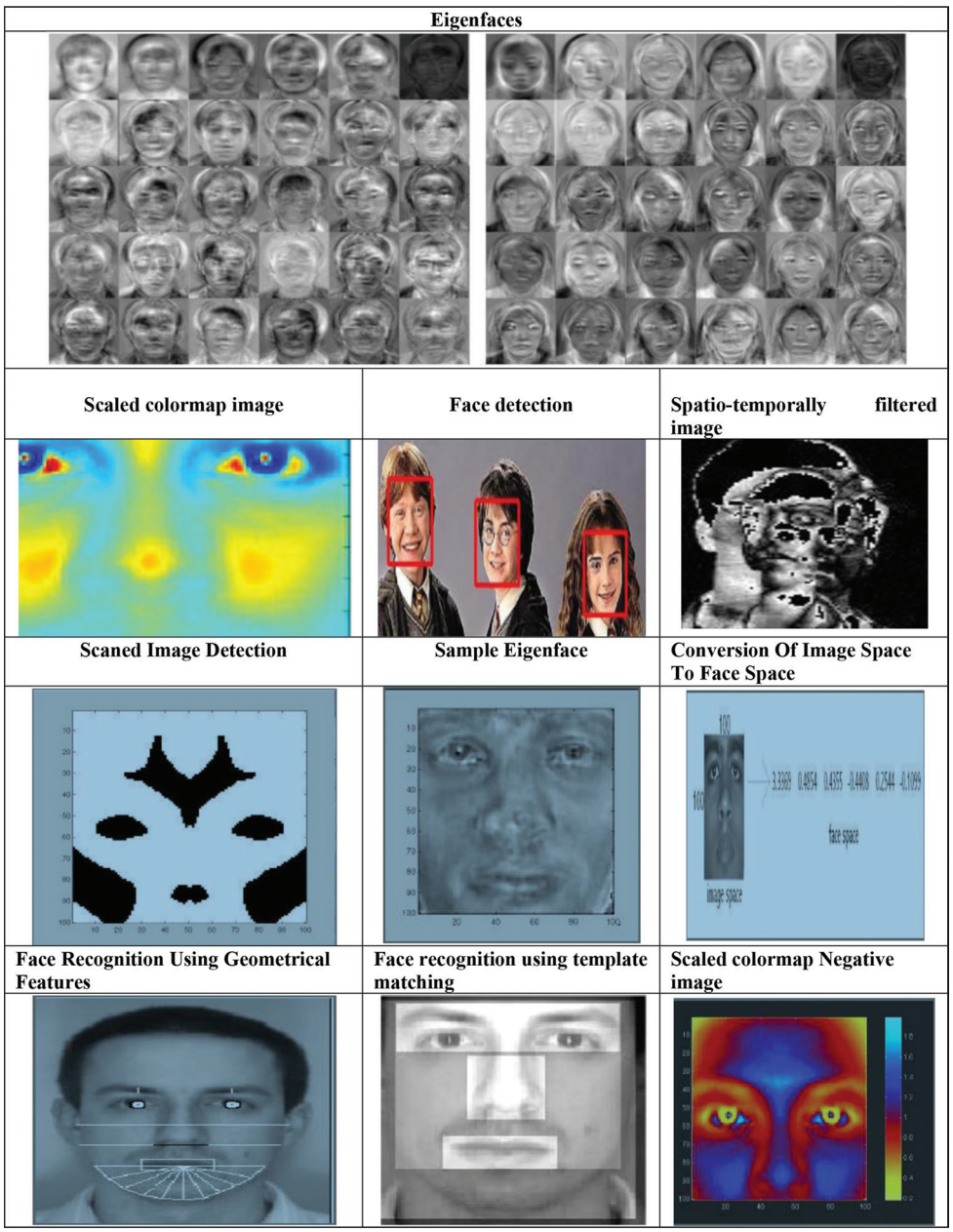

Figure 5: Qualitative results of face detection and recognition

converted into threshold images for comparison with the referral image. The mat lab then processes the input image by comparing it with the referral image. After processing the images, if the images coincide, then the application shows the output. If the images do not coincide with the referral images, the application shows error and does not provide the output.[7] This research paper has focused and analyzed the results in qualitative wise and results have been shown in Figure 5 for face detection and recognition using both gray and color face images.[8]

CONCLUSION

The computational models and the sample images, which were implemented in this paper, were chosen after extensive research, and the successful testing results confirm that the choice made by the research work is reliable. The earlier system with manual face detection and automatic face recognition did not have a recognition accuracy over 90%, due to the limited number of eigenfaces, but this system which was used by the PCA transform finds useful and beneficial. This system was tested under very robust conditions and the experimental study shows that it is better in real-world performance and also it will be far more accurate. The fully automated frontal view face detection system displayed virtually shows perfect accuracy. Moreover, the fully automated face detection and recognition system was not robust enough to achieve a high recognition accuracy. The only reason for this was the face recognition subsystem did not display even a slight degree of invariance to scale, rotation, or shift errors of the segmented face image.[9]

However, if some sort of further processing, such as an eye detection technique, was implemented to further normalize the segmented face image, performance will increase to certain level when compared to the manual face detection and recognition system. Implementing an eye detection technique would be a minor extension to the implemented system and would not require a great deal of additional research. All other implemented systems displayed commendable results and reflect well on the deformable template and PCA strategies. The most suitable real-world applications for face detection and recognition systems are for mugshot matching and surveillance. There are better techniques such as iris or retina recognition and face recognition using the thermal spectrum for user access and user verification applications since these needs a very high degree of accuracy. The real-time automated pose invariant face detection and recognition system[10] could be proposed further and that would be ideal for crowd surveillance applications. If such a system is widely implemented, then the potential of this will be useful for locating and tracking suspects.

REFERENCES

1. Gonzalez RC, Woods RE, Eddins SL. Digital Image Processing Using MATLAB Pearson Education Society. New Jersey: Prentice-Hall; 2004. 9. Turk MA, Pentland AP. Face Recognition Using Eigenfaces, Proceedings of the IEEE. Inter Conference Vision and Pattern Recognition; 1991. p. 586-91.
2. Wiskott L, Fellous M, Krger N, Malsburg C. Face recognition by elastic bunch graph matching. IEEE Trans Pattern Anal Mach Intell 1997;19:775-9.
3. Lu J, Plataniotis KN, Venetsanopoulos AN. Face recognition using LDA-based algorithms. IEEE Trans Neural Netw 2003;14:195-200.
4. Abdelwahab MM, Aly SA, Yousry I. Efficient Web-Based Facial Recognition System Employing 2D HOG. IEEE 2012;410-210.
5. Kukenys I, McCane B. Support vector machines for human face detection. In: Proceedings of the New Zealand Computer Science Research Student Conference; 2008.
6. Yang MH, Kriegman DJ, Ahuja N. Detecting faces in images: A survey. IEEE Trans Pattern Anal Mach Intell 2002;24:34-58.
7. Zhao W, Chellappa R, Phillips PJ. Face recognition: A literature survey. ACM Comput Surv (CSUR) 2003; 35:399-458.
8. Maia D, Trindade R. Face detection and recognition in color images under matlab. Int J Signal Process Image Process Pattern Recognit 2016;9:13-24.
9. Marcialis GL, Roli F. Fusion of Face Recognition Algorithms for Video-Based Surveillance Systems. Boston, MA: Springer; 2003.
10. Suman A. Automated face recognition: Applications within Law Enforcement. Market and Technology review. London: NPIA; 2006