

REAL TIME PCA BASED FACE RECOGNITION FOR FOLLOWING STAFF

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Abstract

With the development of technology, security has entered our lives as an indispensable element. Nowadays, people are now using some methods that increase safety in every system. Biometrics technologies used in the identification of the physical properties of the body (facial, fingerprint and fingerprint) have become a common security detection approach today. Different methods are used for biometric applications. In this study, an application was developed by using PCA (Principal Component Analysis) method in the literature using face recognition algorithm. In this application, a workplace with hundreds of employees is followed by face recognition of the arrival and departure of the staff. After the follow-up, the persons who are late to the job or who are early to the desired time are reported to the management mail.

Keywords: Biometry, Image processing, Facial identification, PCA, Personnel tracking.

PERSONEL TAKİBİ İÇİN GERÇEK ZAMANLI PCA TABANLI YÜZ TANIMA

Özet

Teknolojinin gelişmesiyle birlikte güvenlik vazgeçilmez bir unsur olarak hayatımıza girmiştir. Günümüzde insanlar artık her türlü sistemde güvenliği artıran bazı yöntemler kullanılmaktadır. Kişinin fiziksel özelliklerinin (yüz, parmak izi vs.) kimlik tespitinde kullanılan biyometri teknolojileri, günümüzde oldukça sık karşılaşılan güvenlik tespit yaklaşımı olmuştur. Biyometrik uygulamalar için değişik yöntemler kullanılmaktadır. Bu çalışmada literatürde bulunan PCA(Principal Component Analysis) yöntemi ile yüz tanıma algoritması kullanılarak bir uygulama geliştirilmiştir.

Bu uygulamada yüzlerce personeli olan bir işyerinde personelin işe geliş ve gidişinin yüz tanıma ile takibi yapılmaktadır. Takip sonrasında işe istenilen zamandan geç gelen veya istenilen zamandan erken çıkan kişiler yönetime mail olarak bildirilmektedir.

Anahtar Kelimeler: Biyometri, Görüntü işleme, Yüz tanımlama, PCA, Personel takip.

1. Introduction

Biometrics is a term developed to provide identification by measuring the physical and behavioral characteristics of people. Recognition is computer controlled and can be applied to automated systems. Biometric systems work like human brains. To recognize a person, he or she keeps that person in his memory with his or her own characteristics. The person to be remembered is first added to the memory of the person. Adding is done with a number of physical properties that are unique to that person and can not be changed. Recognition occurs by measurement and analysis of the biological data in the person. Then he or she is remembered by interpreting the encounter with that person at any point in the encounter. Biometric recognition systems also work with this scheme. In this way, many jobs and transactions that are done by human beings are made by computers in a shorter time.

It is known that various biometric systems are used today. These applications are widely used in simultaneous recognition applications. These include; Iris recognition, fingerprint recognition, retina scanning and recognition, voice and speech recognition, facial recognition, etc. has. Physical identification features used in biometric methods are like individual identity information. Among the biometric recognition methods, fingerprint and face recognition are the most common. Currently, two methods are commonly used for face recognition and fingerprint recognition and these filtering and feature based recognition can be said. Filtering-based recognition is also performed by filtering the face images of the person and the fingerprint gauge filter to form the feature vector. The matching operation is performed by comparing the feature vector with the data in the database. In the attribute-based definition, the feature points in the images are scanned. After this scan, an attribute point set is created in which the physical information of feature points is found. Recognition is performed using a set of point-based matching algorithms between this set of points and the set of points stored in the database.

In security applications, biometric systems are basically used in two ways. Personification verification identifies the identity of the person in the system and the biometric feature is used to verify this identity later. The physical biometric feature of the person being authenticated is stored in the system in advance and a concurrence is obtained, especially when compared to the external ones. If the values are close to each other, the identity of the person is verified. In perception, the person is trying to be recognized without specifying the identity. A search is made in the database and the biometric feature is compared against all the people. If the difference with the characteristics of the nearest person is less than a determined threshold, then recognition is performed. In both methods used, the basic process feature points are determined and processed.

We can distinguish two methods of facial recognition that we often encounter in the literature [1]. The first set of methods work to define the target face using global approach or view-based, holistic texture attributes. As an example of this group, the main component analysis [2,3] or [4,5] the linear component analysis [6,7], the Gabor wavelet transform [8,9], discrete cosine transformations [10] based methods. The second type of method is feature based or component based. These methods use geometric relationships between different facial features such as mouth, nose and eyes. In [11], they have developed a feature-based face recognition system by extracting the face geometric model using elastic graphs. In [12], a system is proposed, which uses a template to look at mouth, eye, and nose positions and use it in recognition. They have done about face recognition similar studies [13-16].

2. Material Method

2.1. Principal Component Analysis

The Principal Component Analysis is a transformation for an existing data, and the samples to be obtained at the end of this transformation should be separated as far as possible from each other [17]. Principal component analysis method is used for the purpose of size reduction. It is a very variable statistical method. It provides classification, recognition, size reduction and interpretation. With this method, the closest pattern on the verse is tried to be found. For this reason, some applications can be used as a pattern finding-recognition technique. More diversity on the vertebrae can

be done with a small set of dimensions selected from the whole size group. The noises in the data are less powerful than the pattern and can be removed from this noisy picture as a result of size reduction.

As a result, it is possible to define PCA as a statistical method. It can be used to describe the pattern in a data set, to describe the data set, and to identify similar and different patterns in the data.

2.1.1. Data Set Preparation

At this stage, it is first determined which data is processed. An exemplary data set is shown in Table 1 below and in Figure 1.

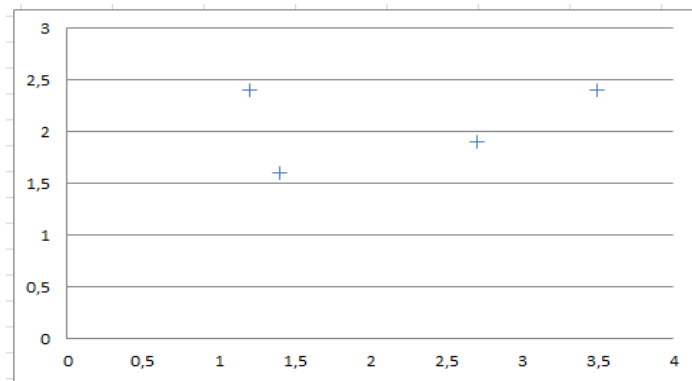


Figure 1. Sample data set

Table 1. Sample data set

x	y
1,2	2,4
1,4	1,6
2,7	1,9
3,5	2,4

2.1.2. Exclusion than average

In order to be able to process with the PCA, it is necessary to subtract each size of the data set from its own average. In this view, $(x - \bar{x})$ and $(y - \bar{y})$ for x and y values in the data set will be reached.

2.1.3. Covariance Matrix

The covariance matrix is used to obtain eigenvalues and eigenvectors from the data set. Since the data is two-dimensional, the covariance matrix will be calculated as

2x2 as a result. Once the covariance matrix is calculated, eigenvectors and eigenvalues can be obtained by performing operations on this matrix.

2.1.4. Eigenvalues and Eigenvectors

Since the covariance matrix is a quadratic matrix, eigenvectors and eigenvalues can be obtained from this matrix.

2.1.5. Selection of Components and Creation of Feature Vectors

By using eigenvectors and eigenvalues obtained from the covariance matrix, axes and feature vectors are obtained. Then the axes obtained from the normalized data and eigenvectors are reached.

The PCA represents the data set with the help of components. Generally, the eigenvectors are first obtained from the covariance matrix and then sorted from the high value to the low value. The purpose is to rank the components according to the rate of representation of the data. In this way, the most important component is the least important component is the right sorting. If some components are removed, the resulting data set may have a smaller size than the original data set. For example, if the eigenvector and the eigenvalue are obtained from an n-dimensional data set and then the eigenvector is selected up to p, the resulting data set will be only p-dimensional [18].

2.1.6. Derivation of new data set

New data set is derived from the last part of the principal component analysis. First, a new dataset can be derived that best represents the dataset, the components with the highest significance level, and the result of multiplying the normalized dataset after the transposition.

After this step the variance values in the data set can be calculated and the data can be projected onto the new axis after the components have been selected. As a result, PCA is applied to a two-dimensional data set. Figure 2 below shows the mapping of the image from the outside to the image in the database.

3. Application

In this study, staff follow-up was done automatically. Face recognition method with PCA was used in practice. The images coming from the cameras are followed by the staff entering and leaving the place of work. These operations take place in a series

of passes. The visual representation of the developed application is as shown in Figure 3 below.

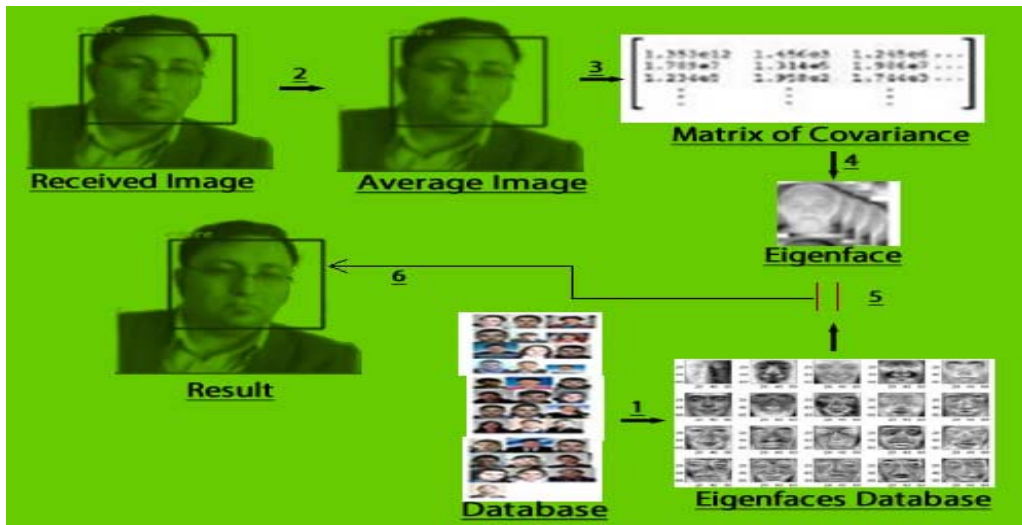


Figure 2. Image comparison

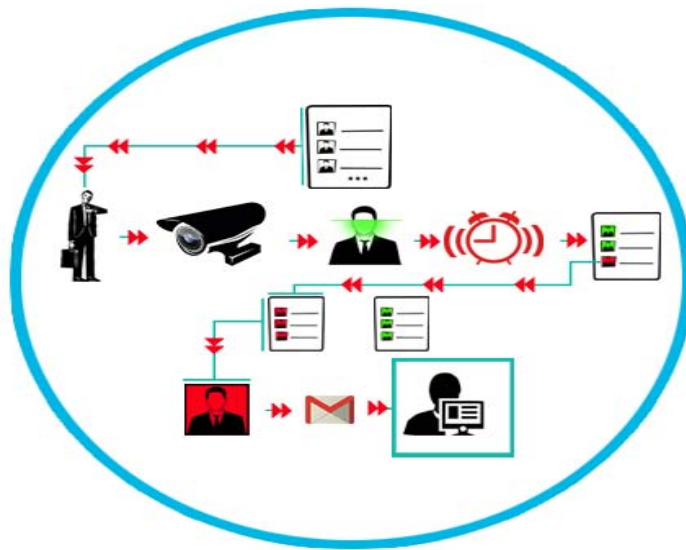


Figure 3. Working structure of the application

These steps are as follows.

3.1. Personnel introduce process

People who will work and follow in the workplace must first be added to the system. Adding is done by recording the face area of the person with the same name from several different angles. Saving facial features from different angles makes recognition easier. The information of the person added to the system is kept in the

database. This information will be used during input or output. It is determined whether or not the person at this point is a staff member.

3.2. Alarm setup process

With the alarm set up, it is determined how many hours before the workers will arrive at the workplace. After the set time, a list of people who come to the workplace is kept. Late arrivals are informed by e-mail with the time they arrive.

3.3. Incoming staff information

A list of people coming to the workplace is kept. The insertion time is based on the pre-insertion time. Those who entered before this time are listed. When the check-in time expires all the staff and the incompetent staff are listed. All staff members are displayed on another list except for the staff. Non-arriving personnel are automatically notified to the workplace by e-mail. Here, the listing process of all the staff is made possible to choose. Those who do not arrive on time but who are exposed may be excluded from the list of non-administrators.

The flow diagram of the steps that control personnel entry in the implemented application is shown in Figure 4 below.

3.4. Early departing staff

A different camera was used to check out the early departing staff. The departure alarm is set up to check for early departing personnel. A list of these people will be kept if there is a staff member leaving the workplace prior to this set alarm time. After the listing, an e-mail is sent to the business owner for information purposes. Information about the time at which the departing staff is allocated is included in the submission process.

The flow diagram of the steps controlling personnel output is shown in Figure 5 below.

The interface of the constructed application is shown in Figure 6. First, the staff is introduced to the system and then set up when the message is sent. Then the data stream is started from the camera.

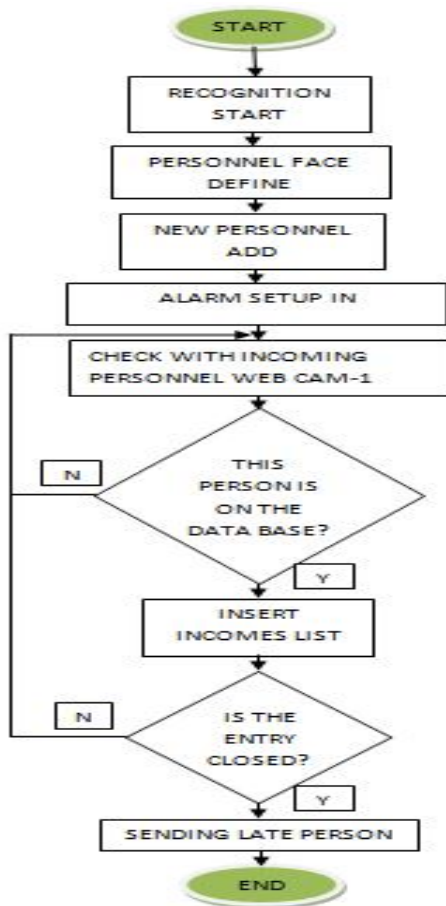


Figure 4. Flow chart of staff entry

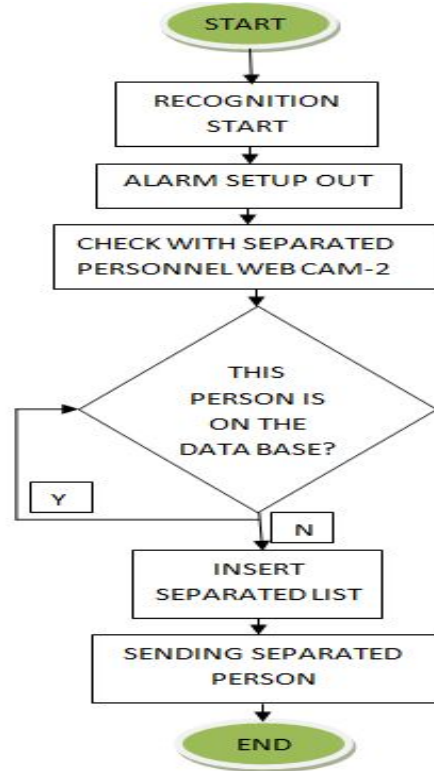


Figure 5. Personnel exit control flow diagram

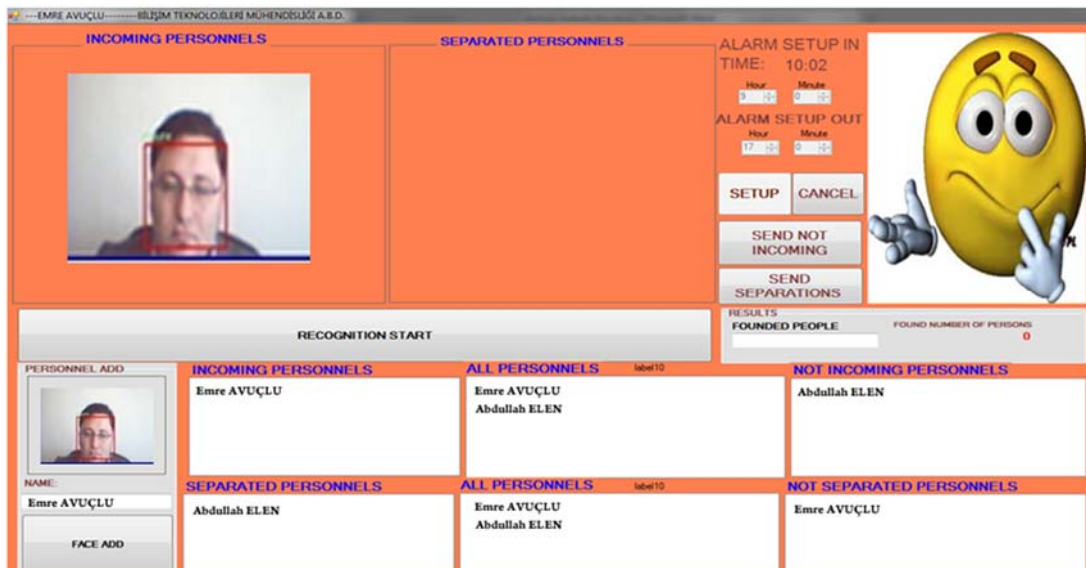


Figure 6. The interface of the application

4. Results and Discussion

Personnel may not show his / her face exactly at camera entrance. This situation leads to wrong decisions about person. Employees should not wear glasses or anything while entering the workplace. The camera is placed at a fixed distance and some experiments have been done. As the number of people increased in these experiments, the rate of correct finding increased. Some experiments have been conducted at certain distances and the results are shown in Table 2 below.

Table 2. Experiment results

Number of registered staff	Distance (cm)	Number of subjects	Number of correct finds %	False acceptance/rejection rate (%)
10	90	10	40	40/20
20	90	10	60	30/10
30	90	10	70	20/10
40	90	10	90	5/5

In this study, real time face recognition application with PCA was performed. Employees working in a workplace at any location are automatically followed up. Workers at the workplace are first recorded in the system with their information. When this is done, the cameras that control personnel input and output are used. Thanks to these cameras, it is possible to keep information about which staff entered which hour or which hour. This information is then sent to the business owner by e-mail. Alarm setup can be done at any time. There is no need to check the workplace with the application. At this point, job creation also increases significantly and reduces the workload of the workplace.

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