RESEARCH ARTICLE / ARAŞTIRMA MAKALESİ

PATTERN RECOGNITION USING NEURAL NETWORKS

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Abstract

Due to its various applications, such as security systems, medical systems, entertainment, etc., face recognition has also been identified as one of the main research topics. The preferred method of human identification is face recognition: natural, robust and non-intrusive. A wide range of systems require reliable personal identification schemes to either confirm or determine the identity of a requester. The purpose of these schemes is to ensure that only a legitimate user and no one else accesses the rendered services. For example, secure access to buildings, computer systems, laptops, mobile phone and ATMs is included. These systems are vulnerable to an impostor's will in the absence of robust personal recognition systems. This article has developed and shown the human face identification system using artificial neural networks, which reflects that the face recognition rate for 40 individuals shows results for 400 frames in the AT&T database at 85.5 percent.

Keywords— *Pattern recognition, Neural network, Kohonen, Self-Organized map, Classification*

SİNİR AĞLARI İLE DESEN TANIMA

Özet

Güvenlik sistemleri, tıbbi sistemler, eğlence vb. Çeşitli uygulamaları nedeniyle yüz tanıma da ana araştırma konularından biri olarak tanımlanmıştır. Tercih edilen insan tanımlama yöntemi yüz tanıma yöntemidir: doğal, sağlam ve müdahaleci olmayan. Çok çeşitli sistemler, talep edenin kimliğini onaylamak veya belirlemek için güvenilir kişisel tanımlama şemaları gerektirir. Bu programların amacı, yalnızca meşru bir kullanıcının ve başka hiç kimsenin sunulan hizmetlere erişmemesini sağlamaktır. Örneğin, binalara, bilgisayar sistemlerine, dizüstü bilgisayarlara, cep telefonuna ve ATM'lere güvenli erişim dahildir. Bu sistemler, sağlam kişisel tanıma sistemleri yokluğunda bir sahtekârın iradesine karşı savunmasızdır. Bu makale, yapay sinir ağları kullanan insan yüz tanıma sistemini geliştirdi ve gösterdi; bu, 40 birey için yüz tanıma oranının, AT&T veritabanında yüzde 85,5 ile 400 kare için sonuç gösterdiğini gösteriyor.

Anahtar kelimeler — *Desen tanıma, Sinir ağı, Kohonen, Öz-Organize harita, Sınıflandırma*

I. **Introduction**

Face recognition has the advantage of being a passive, non-intrusive identity checking system. Many supervised and unattended techniques for face recognition have been reported. Several facial recognition algorithms were used which can be widely split into two approaches: structure-based (appearance-based) and statistical (feature-based). The facial recognition has been carried out using three different technologies– PCA, ICA and SOM (Kohonen, 1990 and Germano, 1999). Karhunen-Loeve's Transformation derived the Principal Component Analysis (PCA) (Kumar et al., 2005). Given the s-dimensional representation of every facet in a photography set, PCA tends to find a t-dimensional subspace whose basis vectors are in the original photo space the maximum direction of variance. Normally, this new subspace is smaller. If image elements are regarded as random variables, the PCA basis vectors are defined as the scatter matrix's own vectors. Independent component analysis (ICA) (Kumar et al., 2005) minimizes dependence on input data both in second-order and higher-order and tries to find a basis for statistical independence (where projected).

ICA's two ICA Architectures–statistically independent base images and factorial code represented by Architecture II–were supplied by Bartlett et al. Facial analytics using SOM provide better results than those presented in this paper, PCA and ICA techniques. SOM is an uncontrolled process of learning which preserves topology.

Basically there are two types of modes (Zurada, 1992):

- **Supervised:** The desired system response is provided by the teacher during supervised learning at every point when the input is used. In many situations of natural learning, this persistent mode is used. This learning mode requires a set of inputs and putting patterns called a training set.
- **Unsupervised:** Uncontrolled study algorithms use patterns that are typically redundant raw data without labels of membership. The network needs to identify any possible patterns, regulations, separating properties, etc. in this way of learning. When this is discovered, the network undergoes parameter modifications, which are called autonomy. Sometimes unattended learning is referred to as teacher-free learning. We use the non-controlled learning algorithm based on the neural network called the self-organizing map.

II. **FACIAL ANALYTICS**

Persons are often recognized through their faces and similar recognition has now arisen automatically with the recent computer technology. Initial algorithms of face recognition used simple geometric models but process of recognition was matured into a science of sophisticated mathematical depiction and correspondence.

Algorithms for recognition can be split into two major approaches,

- Geometric that looks at characteristics,
- The Photometric approach distils an image into values and compares the values with templates in order to eliminate differences. For our facial analysis, we use photometric approach.

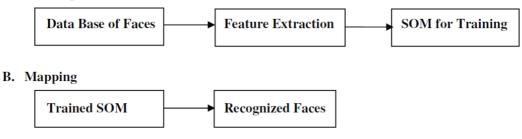Our project's basic block diagram is illustrated in Figure 1.

Figure 1. Face Recognition

1. Training

Data Base of Faces: Each of 40 distinct persons contains ten different images. For certain people, the images were taken at various times, with different lights, face expressions (open / closed eyes, smiling / not smiling) and face details (glasses / no glasses). All pictures are taken in an upright frontal position against a dark homogeneous background (with tolerance for certain side motion). The PGM files are available.

Feature Extraction: Feature removal is a special form of reduction of dimensionality. When the data entry into an algorithm is too large to process and it is notoriously redundant (many data, but not many information), the data entering the algorithm will be turned into a reduced range of features (also called vector characteristics). The input data is transformed into a feature set. Functional extraction is called. The features set are expected to extract the pertinent data from the input data in order to perform the desired task using this reduced image instead of the full size input.

Training of SOM: Input and target vectors are part of the recognition process. No target vector is needed for SOM training. A SOM can classify training data without external monitoring, which leads to the formation of various Clusters or Classes. There are different topologies of clusters like grid, hex and random. We use hex topology in our project as it covers the maximum area of the neurons being trained.

2. Mapping

Trained SOM: The input image mapping is carried out using trained database clusters. The application of the Euclidean Distance formula is the result of this match.

Recognized Faces: The result of this process is the best match determined with the Euclidean distance formula. The actual recognized facial image is the minimum distance between an image input and the classifier or cluster.

III. **PATTERN RECOGNITION**

Face recognition is one of the few biometric methods with high precision and low intrusively. The recognition of patterns is one of the key steps in image processing. The first step in the pattern recognition is to select a number of features or attributes that are used to classify the pattern from a universe of available features.

The original pattern must then be converted into a display that can be programmatically manipulated. Following the processing of data to eliminate noise, functions in the data are searched which are defined as relevant to pattern matching. Data are classified at the classification stage based on similarity measurements with other patterns. The process of pattern recognition ends when the data is given a label based on its class membership.

We have a database of images stored in the system in the face recognition system. Whenever a new image is obtained, it is compared with the already saved image database in the system. We first experimented with our students ' database.

- Training uses input examples to build the map. It is also known as vector quantization as a competitive process.
- Mapping classifies a new vector automatically.

IV. **SELF-ORGANIZED KOHENEN ALGORITHM**

Teuvo Kohonen's (1990) self-organizing map, or SOM, is an unattended learning process which learns how patterns are distributed without class information. Kohonen's Self-Organizing Maps (SOM) (Lawrence, 1997) has been used in a broad range of models as a neural unchecked learning algorithm. Using SOM in face recognition applications as a feature extraction method is a promising approach as learning is not monitored, and no pre-classified image data are needed. The final classification procedure can be fairly simple in highly compressed representations of face pictures or their parts, with a small number of labeled training samples. The SOM is different from most classification and/or grouping techniques because it offers the classes topologically (Kohonen, 1982). The process output retains similarity in input patterns. The topological preservation of the SOM process makes the classification of data, which comprises a large number of classes, particularly useful.

The algorithm used for our Facial Analytics project consists of following steps:

Step 1 – START.

Step 2 – Initialize the Map for Clustering.

Step 3 – Set $t = 0$ and Repeat the following steps until $t < e$,

where t is the iteration rate and e is the error rate,

Step 4 – Get the Best Matching Unit.

Step 5 – Scale Neighbours

Step 6 – Increase t by small amount.

Step 7 – END.

- Initializing

The weight vectors are initialized in a number of ways. The first is to give random values for its data between 0 and every weight vector as illustrated in Figure 3.

1. There are fewer iterations needed to create a good map and the analysis can be saved some time.
2. Best Matching Unit

This is a very easy step, just cross all weight vectors and calculate the distance between each weight and the selected sample vector. The winner is the weight of the shortest distance. If more than one is on the same distance, the winning weight is randomly chosen among the shortest weights. The distance is determined by a number of mathematical means.

1. Scale Neighbours

In fact, the adjoining weights can be scaled in two parts: which weights are considered neighbouring and how much each weight may more closely resemble the sample vector. The second part of the neighbour's scaling is learning. The weight of the winners is more like a sample vector rewarded. The neighbours become more like the vector of the sample. A characteristic of this learning process is that the farther the neighbour is away from the winner, the less he learns. The rate at which the weight can learn diminishes and can be determined as much as you wish. So once a weight is determined, the winner is found, and each person is found.

V. **EXPERIMENTAL DATASET AND OBSERVATIONS**

In our face recognition experiments, we have used the AT&T database (AT&T Laboratories Cambridge). With almost 400 images, we experimented here with 40 people variations. As shown in Figure 2, a preview picture of the Faces database is shown.

Figure 2. AT&T sample

Table 1 shows the experimental observations of data sets experiments as follows:

Table 1. Experimental Observations

Criteria	Values
Training images	30
Testing images	370
Learning coefficient	0.01
Iterations	50
Recognition Rate	85.5%

VI. **Conclusions**

In order to make the face matching in large databases, a novel self-organized retrieval system (SOM) is being suggested. The system offers a small subset of faces most similar to a certain query face from which users can easily check the images they correspond to. The system architecture includes two main elements. First, the system generally integrates multiple functional sets using several self-organizing maps. Secondly, a SOM is trained by the compressed feature vector to organize all face images in a database. The organized map can be used to efficiently identify similar faces to a query. SOM is a Face Recognition algorithm based on statistics.

An improved SOM method is suggested in this paper. For 40 persons' 400 AT&T database images, the highest average recognition rate of 85% is achieved, which takes place on only 30 images and is tested on other images. The proposed method is therefore an efficient process of face recognition.

Conflict of Interests/Çıkar Çatışması

Authors declare no conflict of interests/Yazarlar çıkar çatışması olmadığını belirtmişlerdir

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