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Gender recognition using Self Organizing Map (SOM) - an unsupervised ANN approach

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Abstract-

With the help of computer vision techniques we can solve many real life problems, gender recognition is one of them. Gender recognition is very much useful in many applications like security system, medical imaging system, forensic identification system, biometric identification system, human computer interaction system (HCI), demographic data collection, video surveillance, online audience measurement etc. In this paper we will describe how an unsupervised artificial neural network can be used to classify gender patterns. An unsupervised training network is very useful to classify the input pattern without any external interference. In this type of network we need to define a classification function by populating a large number of input patterns. Patterns sharing some common features can be classified as one pattern, hence the network must be able to identify those features in the input pattern and classify them accordingly. Here we use SOM, which is a type of artificial neural network (ANN) trained using unsupervised learning rules.

Keywords- SOM, Unsupervised ANN, Gender recognition, classification function.

I. INTRODUCTION

An important aspect of an ANN is the learning process. Hence based on the learning rules they have used, all the artificial neural networks can be classified into two categories – supervised and unsupervised [2]. In supervised learning, a desired output result for each input vector is required when the network is trained. While in unsupervised learning, the training of the network is entirely data driven and no desired output results for each input vectors are provided.

Self Organizing Map (SOM)

An ANN of the unsupervised learning type, such as the SOM [11]-[13] can be used for clustering the input data and find features inherent to the problem. In this type of unsupervised networks, all the output neurons compete among themselves to be activated. This activated neuron is called a winner-takes-all neuron or simply the winning neuron. Such competition can be implemented using negative feedback paths between the neurons. Depending on the result, these neurons will reorganize themselves to get better results. For these reasons, such network is called a Self Organizing Map (SOM) was first developed by professor Kohonen.

Self Organizing Maps are different from other artificial neural networks in the sense that they may use a neighborhood function to preserve the topological properties of the input space. SOM operates in two modes: training and mapping. "training" builds the map using input examples, while "mapping" automatically classifies a new input vector. SOM is also useful in clustering data without knowing the class membership of the input data.

Gender recognition

Gender is a demographic attribute of human being; apart from gender there are various other demographic attributes like age, ethnicity, which can be identified by computer vision and can be applied to many applications such as human computer interaction, surveillance, biometrics and demographic studies [1].

In recent years, identification of demographic attribute using computer vision is becoming a great challenge. Gender recognition can be done using different approaches like using face features, audio signal frequency etc [10]. In this paper we will consider face features instead of voice signal because we are mainly interested in computer vision techniques. Gender recognition is a type of pattern recognition, which can be solved by ANN. In this paper, we use an unsupervised ANN called Self Organizing Map (SOM) [12].

Gender recognition using SOM

The advanced image processing techniques [9] with the help of pattern recognition and artificial intelligence can be effectively used in automatic detection and classification of various facial attributes. Some previous research works show that how SOM [3]–[6] can be used to recognize face, facial expression and now we are considering gender. The main concept behind all these recognition process is same like, in case of face recognition system we consider two classes or patterns like 'known' and 'unknown', in facial expression recognition system we consider classes each of them representing a facial expression like 'neutral', 'happy', 'sad', 'angry', 'disgust' etc. We can use the same concept for gender recognition, where we need to consider two classes 'male' and 'female'. In Figure.1 we have shown the block diagram of a gender recognition system using SOM [3].

The overall process of gender recognition can be done in four steps:

A. Image Acquisition
B. Extract The Facial Feature
C. Image Compression
D. SOM Classifier

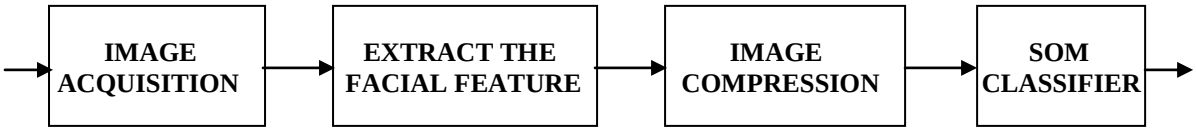


Figure 1: Block diagram of a typical gender recognition system.

A. Image Acquisition

Image acquisition can be made using any kind of imaging system or they can be collected from an image database. There are many image databases available on the Internet and hence acquiring image data from database is the most fast and inexpensive way. But in case of a real-time system, we should install the proper imaging system to capture the face image of a person.

B. Extract The Facial Feature

Once we acquire the face image, we need to extract the facial features from the background of the image. In this paper we use skin color based face detection technique, which uses RGB and HSV color model [7]. There is another color model (YCbCr) that can also be used to detect skin color region.

C. Image Compression

In this stage, we use 2D-DCT [8] to compress the extracted facial feature, which can make our processing faster. As our algorithm uses an image database, we have to apply the compression technique in all the images in the database.

D. SOM Classifier

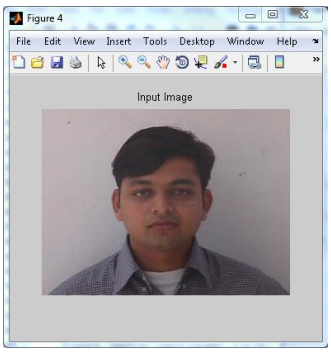
Gender recognition is a within-object classification problem. As we are using an unsupervised ANN, we need to populate the network with a larger number of training inputs. Here the subject is to be classified as either 'male' or 'female'; hence we need a binary classifier.

Self Organizing Map (SOM) is a well-known artificial neural network, which uses unsupervised learning process. Here the learning process is dependent on the input data, which is known as unlabeled data and is independent of the desired output data. The success rate of SOM network is dependent on the number of training data we are using, higher training data means higher success rate. SOM can also be termed as topology preserving map. There is a competition among the neurons to be activated and only one neuron that wins the competition is fired and is called the "winner". Kohonen rule is used to learn the winner neuron and neurons within a certain neighborhood of the winning neuron. This rule allows the weight of neuron to learn an input vector so this makes it perfect for recognition. Hence in this system SOM is used as classifier.

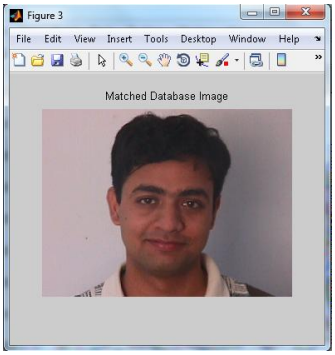
In our proposed approach we populate the training data set with 40 training images. As we are doing gender recognition, we need to store images for every gender. In our proposed approach we have used twenty different types of images for each gender. Hence our database has 40 train images. If we populate the database with more training images, we will get better results.

II. EXPERIMENTAL RESULTS

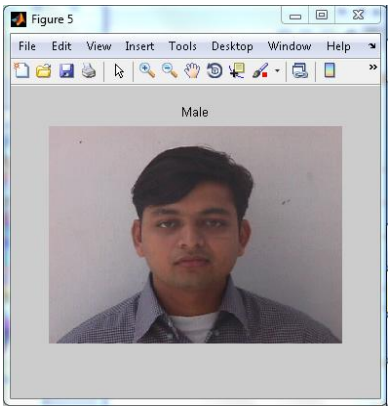
The following diagrams will show how the concept of SOM is applied in gender recognition. Here we use two patterns 'Male' and 'Female'. In our system we have used 15 male training face images for male pattern and 15 female training face images for female pattern. When an input face image is given, we will look for a face image that will best match the input image. In the following diagram, the left-hand side image is the input face image, and the right-hand side image is the training database image, which best matches the input image. As the gender tag associated with the training face image is 'Male' we can say that the gender pattern of the input image is 'Male' (Fig. 2c). Figure 3 will reflect the same concept for female gender.



(a)



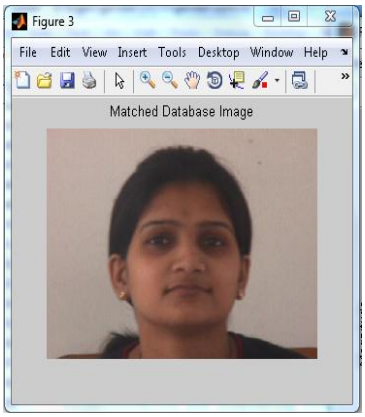
(b)



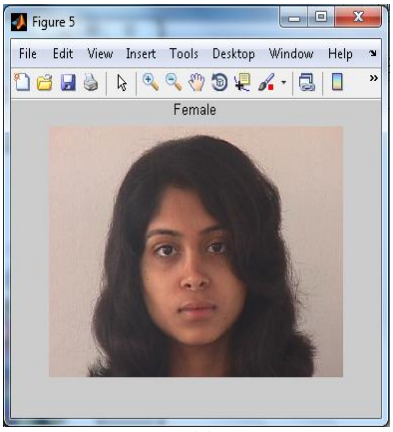
(c)

Figure 2: (a) Input image, (b) Matched database image, (c) Input image with gender details in the top.

(a)



(b)



(c)

Figure 3: (a) Input image, (b) Matched database image, (c) Input image with gender details in the top.

III. CONCLUSION

This paper shows how the concept of an unsupervised ANN can be applied in gender classification. Self Organizing Map has been proven as a great approach in face recognition, facial expression recognition. Now SOM can also be used efficiently in gender classification. Not only gender classification, SOM can be used in any type of pattern classification problem [13].

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