FPGA and Optimization Technique Based Human Gender Classification

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Abstract
Gender identification from face features plays an important role in security, surveillance systems. The research is carried out with different methods in feature detection , feature extraction, and different classification algorithms. And also different processing platforms are used. In this paper the identification of gender from face has been proposed using MATLAB simulation platform and FPGA as processing platform. Firstly, the image to be examined is taken from pre-recorded video. Then the control points are detected in MATLAB and the data is transferred to FPGA platform for feature extraction. To make the system optimized, here optimization algorithm that is Ant Colony Optimization (ACO) is used. With the help of ACO, optimized features are extracted from the detected control points. Again the extracted data is send to MATLAB. Finally, with the help of Artificial Neural Network, the extracted data is tested and gender is identified
Keywords- Facial features , FPGA, Gender classification, Optimization

1. Introduction

The broad meaning of gender recognition is the genetic development that can be used to identify an individual characteristic physically. The development of the gender detection came into concentration at the time of growing the security on the airports.. With improvement in technology, gender identification at security, surveillance, biometric authentication and intelligent human-computer interface has become more noticeable these days. Even though we have technology to detect the gender of the person, detecting the gender of person with only facial features is still a difficult task for computerized systems.Automatic human detection and identification based on pattern recognition and artificial intelligence (AI) use different body parts, such as face, fingerprint, gait, iris, and voice as biometric trait. Out of all these body parts, the face is the most popular attribute because it has unique features. [20]. Identity authentication from face recognition can be executed without cooperation and knowledge of the person being acknowledged. However, recognizing a person becomes hard due to the differences in pose, illumination, expression etc.[20]. Human identification using the face is critical as it undergoes several parts of the facial structures.

Many techniques have been used for classification purpose. Some of them deal with pixel and some of them deal with features. One small image contains thousands of pixels. So that techniques based on pixels are slow. While feature based processing is faster.

2. Previous Studies

In any pattern classification solution two key points are feature extraction and pattern recognition.

In case of feature extraction, the most simple method is to use gray-scale or color pixel vectors as features [1]. Another kind of methods are PCA, ICA and LDA, which project faces into a low-dimensional space and then recognize them. This kind of method has been shown not very robust to variations of face orientation. The third kind of methods is using texture information like complexion [13]. The last kind of methods is combining the facial feature detection with wavelet transform to extract the local facial feature for classification [14,15], such as the analysis of facial wrinkles and shapes.

Traditional pattern classifiers such as k-nearest-neighbor, Fisher linear discriminant, neural network and SVMs are often employed to gender classification.[decision tree] SVMs seem to be superior to all other classifiers [3].Neural Network (NN) is a massively parallel distributed processor, which is able to store the knowledge obtained by experience and can further use this knowledge. NN is similar to brain, since knowledge is obtained by a learning process and knowledge is stored in interneuron connections[17] Support vector machine is a learning algorithm for pattern classification. a linear SVM uses a systematic approach to find a linear function with the lowest capacity. For linearly non separable data, SVMs can nonlinearly map the input to a high-dimensional feature space where a linear hyper plane can be found. It has been observed that accuracy of SVM is better than all other classifiers for low resolution images[18] here is a comparison overview of previously used different methods.[16]

METHOD	CLASSIFICATION RATE %
LBP+SVM	79.35
Neural Network	84.33
SVM	84.39
Threshold Adaboost	83.34
Average	82.85

Table no. : 1 previous method comparison

We can observe that the various methods discussed earlier in section II tend to different success rate.We want a optimized method which will give best results in less time and higher accuracy.

3. Proposed System

The gender classification system undergoes three stages. Firstly face detection from video input, then feature extraction and lastly the classification. The face detection acts as a pre-processing operation to the gender classifier that determines the gender. Given below in fig. is the block diagram of proposed system.
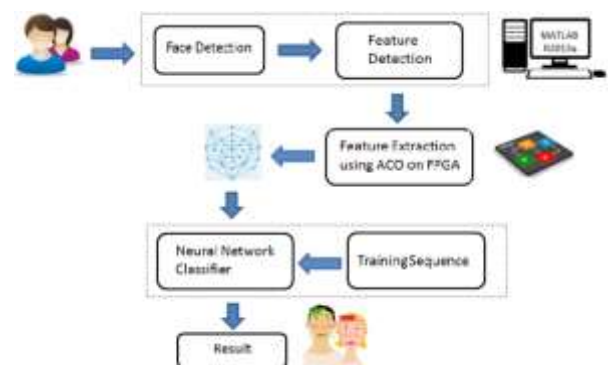

Fig.1: block diagram of proposed system

Gender classification system would go through further steps:

- Obtaining image frames from video
- Detection of face and image pre-processing.
- Extraction of face features and optimization of features using Ant Colony Optimization technique on FPGA board.
- Classification of gender with help of Neural Network
- Displaying the results

4. System Implementation And Results
a. Face Detection And Feature Point Selection :

Similar to every recognition or classification method, gender classification using face features also consists of image acquisition and pre-processing at initial stage. MATLAB 2013a

supports video files to read from their given path and to operate on it. Then the respective video is converted into number of frames. Each frame is containing image data. The frame which is having 'face' is used as input image. Skin colour segmentation is applied to find the face portion .fig.2

(a) original image

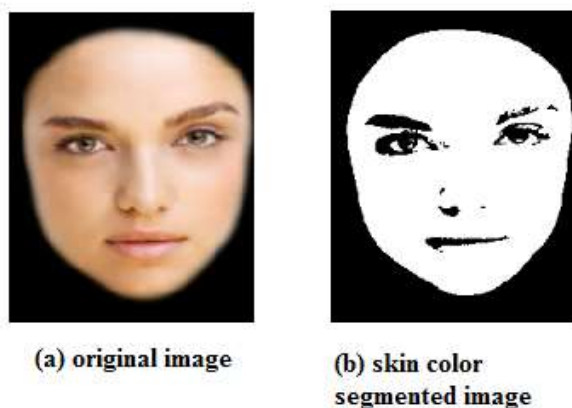(b) skin color segmented image

Fig. .2: face detection using skin color segmentation

Using cascade object detector, face and the facial features are obtained and then the other part of image except face features is removed and cropped image is used as an input to FPGA.

selected image   Dectected face parts   Cropped face

Fig.3: Detect, Locate   Face Features

b. **Feature Extraction And Optimization :**

Core part of the system is feature extraction. In pattern recognition and in image processing, feature extraction is a special form of dimensionality reduction Accuracy of any classification system depends on the accuracy of extraction of exact feature set. Features are of geometric and appearance based. Geometric features deals with shapes and distances where as appearance based features describe low-level information of pixels.

Here, a system is developed using both the geometric as   well as appearance(i.e. shape and texture features.) based feature extraction . Male and female faces vary in shape of jaw, distances between eyes, nose to lips and in beared and maustatches. So keeping in mind these differences,

system is designed and threshold for both shape as well as texture feature is set.

Number of control points are chosen as difference in male female out of them only few proves to be eligible for best difference. This set of features is selected using Ant Colony Optimization. The algorithm gives the best match results with reduced dimensions. Use of FPGA reduces the time required for computation by its parallel operation.

c. **Classification :**

Neural networks are used for classifying the gender. Any network must be trained in order to perform a particular task. In training process, training data set is presented to the network and network's weights are updated in order to minimize errors in the output of the network.

i. *Selection and Preparation of Training Data*:
Training set contains images of 100 male and 100 images of females.

ii. *Modification of connection weights:-*
The training data set consists of input signals assigned with corresponding target. The network training   is an iterative   process.   In every iteration weights   coefficients   of nodes square.measure changed victimiz ation new information from coaching in formation set.
Step 1:- Choose an input data from training set and   compute output of each node in hidden and output layer using activation function.
Step 2:- Output signal of the network is compared   with the specified output worth (the target), that is   found   in coaching knowledge set.   The distinction is calculated mistreatment Mean square Er ror and referred to as error signal of output layer nodes.
 Step 3:- When error signal for each node is computed, weights associated with   different   connections   can be modified

iii. *Repetitions:-*
Once the above procedure is completed for all examples in training set, same procedure must be repeated many times.

The gender is classified on the basis of distance between desired features.

d. **Experiments And Results:**

The system is performed for many input video frames, which gave results with 88% accuracy.

To justify the optimization and dimensionality reduction, the system is compared with different combinations such as only shape features, shape features with and without FPGA and ACO, shape + texture features etc.

Use of ACO results in dimensionality reduction by 30%. And FPGA contributed in less power requirements and less memory requirements. The result summary is given in below table no. 2.

METHOD	CLASSIFICATION RATE %	PLATFORM USED
LBP+NN	79.35	MATLAB
Neural Network	84.33	MATLAB
Shape Features	81.25	MATLAB
Proposed System	87.50	FPGA+MATLAB

Table no : 2 Result and Experiment summary

5. CONCLUSION

Here in this paper the concept of human gender classification from human face features using optimization algorithm on FPGA platform is proposed. The features are extracted with the help on Spartan 6 FPGA and classification results are obtained from neural network classifier. The video inputs consists of variation in light and make up of object.

The overall success of gender classification is 87% with 30% reduced dimensions

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