SVM based gender classification

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Abstract— **Gender classification is an important and challenging task for computer vision because it is recommended for a lot of fields. In this paper, we propose an approach for gender classification from faces images that is based on support vector machine (SVM). In this approach a majority voting combining technique is applied for the output of three SVMs that have been trained for three thumbnails features. In the experimentation step we have used the FERET with a WWW datasets and an accuracy of 92% was obtained.**

Keywords— **Gender classification, Face detection, Support vector machine, Face identification, Biometrics systems, Majority voting**

I. INTRODUCTION

Gender classification is a biometric task that consists to predict the gender of a person from a biometric modality. Formally, gender classification is a binary classification problem in the role is to affect an example data to one of two complementary classes: man or woman [01].

Recently, gender classification has attracted several searchers and various systems have been proposed. Indeed, gender classification is greatly recommended for a lot of domains in which it allows a considerable advantage. Among these domains we can mention the computer-human interaction, the biometrics systems, the security, the target commerce and many others [04].

In the practice, divers biometrics modalities have been used for performing gender classification systems as iris images [09], hand shape [10], body analyse [11], etc. However, the face modality is the most exploited because it's the most powerful and vigorous.

Classically, a gender classification system is organized in three modules: pre-processing, features extraction and classification [02]. In the pre-processing step, preliminary filters are applied to the input image for improving details and face is extracted. In the literature, the size normalization, histogram equalization and Viola-Jones algorithm [5] for face detection are useful techniques for pre-processing. In the features extraction step, a determinist vector is calculated from the pre-processed image. Features extraction based, a gender classification approach is categorized as global if a same operator is applied for the whole image to compute the feature and as local if the image is decomposed into subcomponents [03]. The Principal Components Analyse, Local Binary Pattern and Gabor filters are useful techniques for feature extraction. In the classification phase, a binary classifier is used to predict the gender of the input image. For this step, the Neural networks, Support Vector Machines and the Adaboost algorithms are powerful and robust techniques [04].

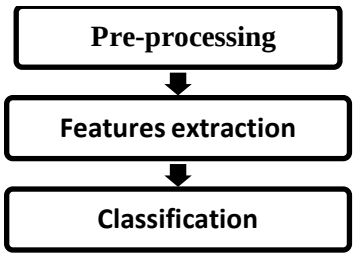


Fig. 1: Steps for gender classification

In this paper, we propose a gender classification approach from face images based on the support vectors machines classifiers with the vote majority combination technique. For each classifier a thumbnail feature is extracted from different masked face images which differ in the contended face regions.

The rest of this paper is organized as follows: (2) The proposed system overview, (3) Pre-processing and face detection algorithm presentation, (4) Features extraction (5) Classifiers and majority voting presentation (6) Experimentations and results discussion.

II. SYSTEM OVERVIEW

It was observed that the classifiers performances are affected by the included information's exploited for features extraction and the use of some parts of face can decrease the robustness. In the same, a single classifier can be judged as

insufficient and the combination of classifiers ensemble can be utile to increase the global performance [04].

So, knowing that a well accuracy can be obtained for gender classification from face image with an intensity deduced feature the overview of our approach is illustrated by the following figure.

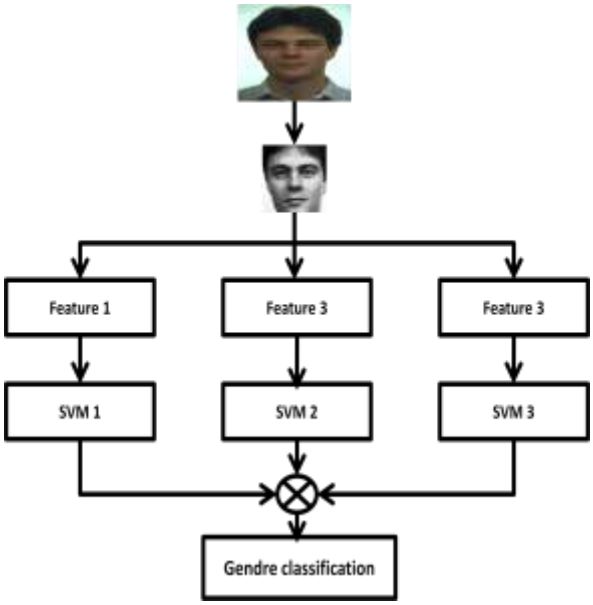


Fig. 2: Overview of the proposed approach

After preliminaries filters and face detection, three features are calculated. The first feature is corresponding to the intensity pixels values of the integral detected face, the two others features are corresponding to the intensity pixels values of the masked faces using two different masks. The first mask is exploited to eliminate the hair part and the second mask is exploited to obtain the internal face by eliminating the border and hail regions.

Thus, the idea of our proposition is to performing a profitable features gender classifications approach with taken into consideration different scenarios of prediction according to the regions contained in the face and the final decision is relative to the integrity of these divers' scenarios.

III. Pre-processing and face detection

In the proposed approach the histogram equalization is used as a pre-processing technique to make the intensity distribution more equitable in the input image. After the histogram equalization, the face is detected using the viola Jones technique that is efficacy and rapid algorithm for face extraction. In this algorithm, the face detection is performed using a supervised boosted classifier that exploit the Haar features for doing a cascades scans in a computed matrix for the input image, named integral image. The integral image allows a rapid detection of preliminary interesting rectangles for which the Haar features are used as mask to take intermediary decisions about face localisation.

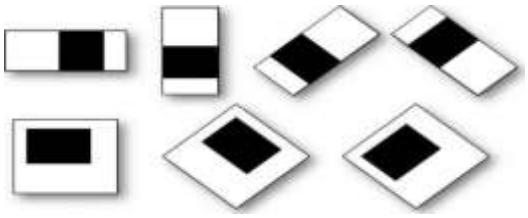
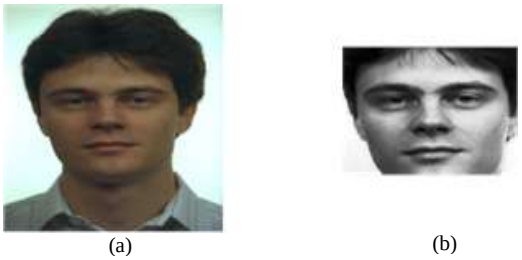


Fig. 3: Examples of Haar features

The following figure Fig. 4 shows an example for face localization using the Viola-Jones algorithm.



(a) (b)

Fig. 4: Face extraction using the Viola-Jones algorithm
(a) input image (b) detected face

The face extraction is an important pre-processing step because it allows to reducing information quantity and to eliminate the non facials input data for each an error message can be indicated.

IV. Feature extraction

For feature extraction, we have used an intensity based features. After pre-processing, the gray faces images are normalized into *24*24* and simply converted into integer's vectors, the principle of these features is showed by the following figure.

(a) (b) (c)

Fig. 5: Thumbnail feature
(a) – Detected face (b) - Thumbnail face (c) - Intensity feature vector

In the same, the figure Fig 6 illustrates the exploited thumbnails images for computing the three features which correspond respectively to the detected face and two others masked faces.

(a) (b) (c)

Fig 6: thumbnails faces

(a) – Integral detected face (b) – First mask: face without hair Face (c) – Second mask: internal face

After vectors construction and as mentioned above, the computed features for the different thumbnails will be passed to different classifiers and each classifier return an intermediary gender prediction class.

V. CLASSIFICATION

For classification, we have used the Support Vector Machines classifiers that are supervised machines learning. The SVM was firstly proposed by Vapnik [06] and it was introduced for the gender classification problem by Moghadem [07].

We have opted for the SVM classifiers because it has been proven that they are robust and powerful for gender classification with face images, in comparison with others classifiers [04].

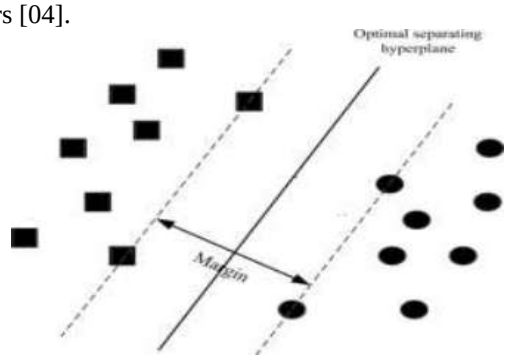


Fig 7: Support Vectors Machines principle

The principle of the SVM in the case of linearly separable class is to construct a hyper-plan that has a largest distance to the nearest data points of any class. Generally, the manipulated data are not linearly separable. In this case, the SVM use a nonlinearly kernel function named K to construct the boundary function f(x) that is defined by the following formula where b is the bias value and yi , αi covers a Lagrange optimization parameters :

$$f(x) = \sum_{i=1}^{M} y_i \alpha_i K(x, x_i) + b$$

In our case the SVM is used as binary classifier that affects an example to one of two gender class: man or woman and polynomials kernels were exploited in the experimentations, one classifier for feature and the final decision is calculated by the majority voting as showed in the table 01.

SVM1 Class	SVM1 Class	SVM1 Class	Final Class
W	W	W	W
W	W	M	W
W	M	W	W
W	M	M	M
M	W	W	W
M	W	M	M
M	M	W	M
M	M	M	M

Table 1: Majority venting principle

In the next section, the context and experimental results will be discussed for the proposed approach.

VI. EXPERIMENTATION

In the experimentation, we have used for the training phase a subset of 200 frontal images from the experimental FERET [08] dataset that contain different facials variations for ethnic, age, pose, illumination and facial expression.

Fig. 8: Example of the FERET databases Images

In the testing phase, we have exploited a second subset of frontals images from the FERET dataset with a WWW dataset that we have constructed by regrouping frontals face images from the World Wide Web.

Fig 9: Examples of WWW images

The details of the used datasets in the testing phase for the three classifiers are showed in the table 02.

	FERET	**WWW**
DataBases size	800	800

Table 2: Datasets details

The accuracy of the gender classification of each classifier was calculated by the formula:

$$\boldsymbol{Accuarcy} = \frac{\boldsymbol{NTP}}{\boldsymbol{TDZ}} * \mathbf{100}\%$$

where $NTP = Number\ of\ Trues\ Prédictions$ and $TDZ = the\ Test\ Dadabase\ Size.$

The obtained results with the FERET dataset are presented in the table 03.

SVM1	**SVM2**	**SVM3**	**Combination**
91,5%	90,75%	90,12%	92,87%

Table 3: Accuracy for gender classification with the FERT dataset

In the same, the results with the WWW dataset are presented in the following table 04.

SVM1	**SVM2**	**SVM3**	**Combination**
87,12%	85,62%	85,12%	89%

Table 4: Accuracy for gender classification with the WWW dataset

By analysing the obtained results, we are finding that the integral face detected by the Viola-Jones algorithm has returned the best accuracy for gender classification with the support vectors machines classifiers that was introduced by Mogadam [7] in comparison with the cases of elimination of hair part and the internal face. In addition, we observe that the used features provide a complementary decision and the majority voting inter SVMs classifiers has improved the global classification accuracy.

VII. CONCLUSION

In this paper, a support vectors machines classifiers based approach was proposed for the gender classification from face images. The classifiers were trained with thumbnails features corresponding to different face parts. It was observed that the better individual classification accuracy is obtained with the integral Viola-Jones detected face and the majority voting combination technique has allows a classification accuracy gain.

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