

## Global and Feature Based Gender Classification of Faces: A Comparison of Human Performance and Computational Models

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Most computational models of gender classification use full face images, giving equal weight to the whole face area irrespective of the importance of internal features. Psychological research emphasises the importance of both global and featural information in the classification of face gender. In this study we compare the performance of various computational models in classifying the gender of whole faces and face features (e.g. just the eyes or mouth) with a group of human subjects undertaking exactly the same task. Specifically, we investigate whether the human subjects and the models make errors on similar items.

We use a composite representation which includes both global and featural information, where global information accounts for coarse information while featural information carries detailed information of the features. There is evidence that human visual system analyses stimuli in a similar fashion (Shapley, Caelli et al., 1990). From a 400 grey scale face images dataset (200 male, 200 female), with each image of  $128 \times 128$  resolution, we use 320 (160 male and 160 female) for training and 80 (40 male and 40 female) for testing. From each image three sub-images are extracted. A  $64 \times 32$  pixel strip pertaining to the eyes and a  $64 \times 32$  strip pertaining to the mouth region are extracted. The third sub-image is a  $32 \times 32$  reduced resolution of the original  $128 \times 128$  image. A similar type of face image representation was also used by (Luckman, Allinson et al., 1995) for a computational model of familiar face recognition.

Our computational models use different dimensionality reduction techniques: Principal Component Analysis (PCA), Self Organising Maps (SOM) and Curvilinear Component Analysis (CCA) (Demartines and Hérault, 1997). Gender classification is then done on the resultant data using a Support Vector Machine. Our experiments showed that CCAs performance, with far fewer variables, is comparable to PCA and SOM.

Using the above approach we performed classification on three sub-images of the whole face image of  $128 \times 128$  resolution: just the eyes, just the mouth, and a reduced resolution of whole face. All sub-images produced high classification rates, indicating surprisingly high amount of gender information in each of them. Experiments on the composite sub-images (all three sub-images taken together) showed significant improvement in the classification rate, when compared with the individual sub-images and the original  $128 \times 128$  resolution images.

We have also obtained the classification accuracy of human subjects on the eyes and mouth sub-images, and this is 77.53% and 75.4% respectively. It is interesting that human performance is much better than chance and only slightly lower than the computational models. It suggests that information obtained from the respective eyes and mouth components, even in the absence of any inter-relationships with other features can play a significant role in gender identification by humans.

The pattern of errors produced by human subjects showed a positive correlation with the pattern of errors produced by the classifier that uses a SOM for dimensionality reduction.

### References:

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