Fusion of Region-Based Representations for Gender Identification

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CONFIDENCE FOR A NETWORKED WORLD

Goals & Motivations

- Create a classification framework robust to uncontrolled, real world images while avoiding over fitting
- Explore localized classification on facial discriminative regions to increase accuracy rate that can overcome:
  - Pose
  - Alignment
  - Facial expressions
  - Occlusions

Dataset

- Database comprises 26,766 (13383 male/female) unique faces collected from Flickr by the CMU Biometrics Center
- Workers on Amazon Mechanical Turk landmarked key points on the face and provided gender ground truth
- High variation in pose, illumination, expression, resolution
- Preprocessing performed to normalize rotation and scale variation

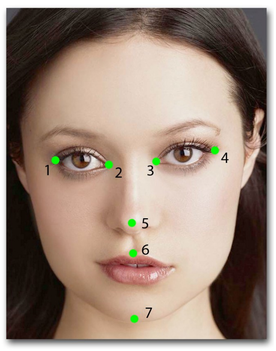

Fig: Seven facial landmark points

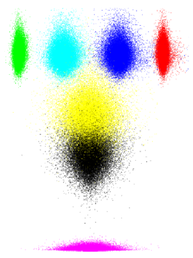

Fig: Point cloud distribution

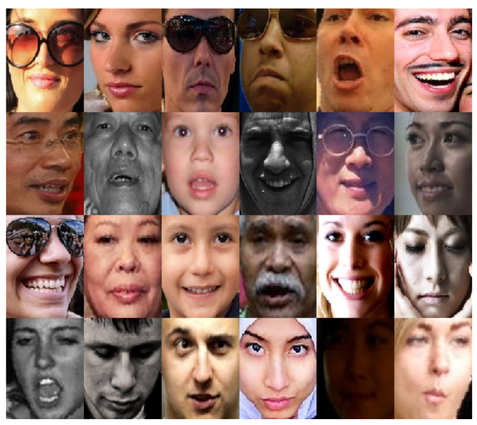

Fig: Sample images from database

Region Selection & Localization

- Local regions improves alignment in each region
- These regions are non-overlapping, so they can be manipulated individually and treated as orthogonal
- Regions selected based on:
  - Discriminant ability of SVM weight vector
  - Fisher Discriminant Analysis (LDA)
  - Perceptual and psychological studies by Brown et al.
- Bounding boxes are heuristically determined facial ratios

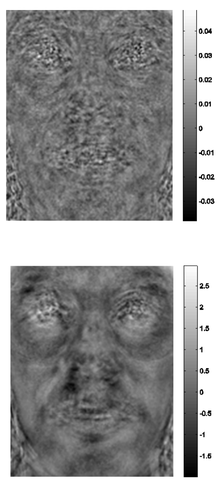

Fig: Fisher , SVM, weight vector (Top to bottom)

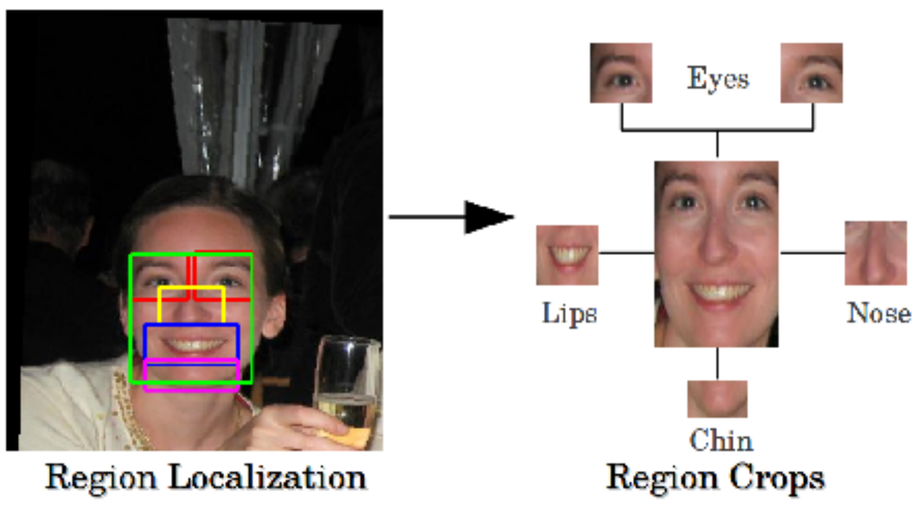

Fig: Regions of Interest

Implementation

- Gender features are well represented through texture
  - MR8 filter bank robust to rotation and scaling
- A separate linear SVM is trained on each of the regions
- The SVM classifications are fused with
  - Majority voting scheme
  - Confidence of SVM margin fit to a logistic function
  - Naïve Bayes classifier trained on margin distance
  - Logistic regression trained on margin distance
  - Taking the raw sum of distances to the margin

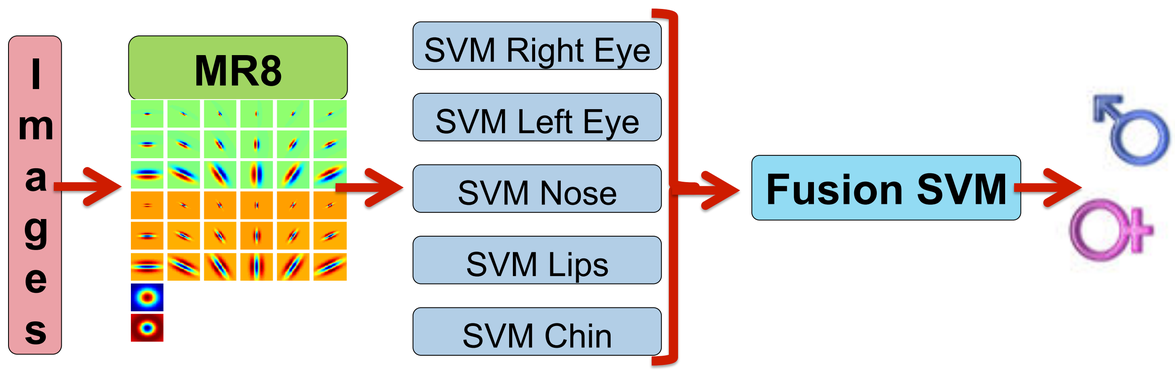

Fig: Algorithm implementation

Results & Conclusion

- Results reported on 5-fold cross validation for each dataset
- Despite the significant loss of information for each ROI, each still has significant discriminant power
- The SVM distance margins in each regions provides independent prediction of gender
  - Results in a 5 dimensional feature space
  - Likely to better separate due to region localization

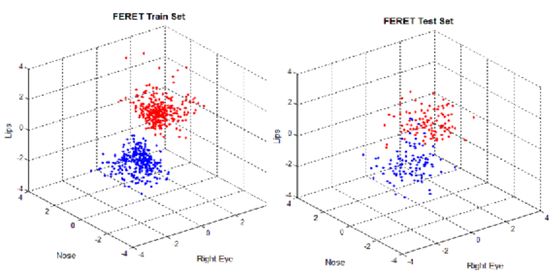

Fig: Visualization FERET score distribution

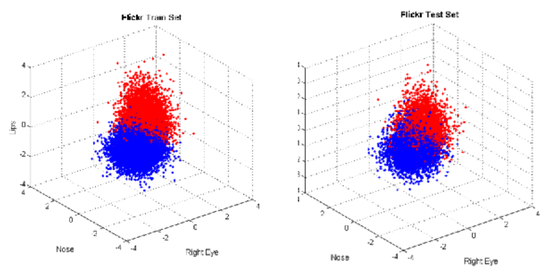

Fig: Visualization Flickr score distribution

Region	Pixel Feature FERET	Pixel Feature Flickr	MR8 Feature FERET	MR8 Feature Flickr
Full face	86.6%	78.5%	90.2%	85.4%
Right eye	85.8%	73.2%	73.8%	81.1%
Left eye	84.2%	69.0%	75.9%	81.8%
Nose	79.9%	66.1%	72.1%	67.7%
Lips	83.4%	73.2%	72.7%	78.9%
Chin	73.7%	65.7%	68.4%	76.6%

Baseline

Method	FERET	Flickr
No Regions	90.1%	85.4%
Majority Vote	90.9%	87.5%
Naive Bayes	91.6%	90.1%
Logistic Regression	92.8%	89.8%
SVM Distances	91.9%	90.1%

Fusion

Int. Joint Conference on Biometrics
IJCB 2011
IAPR
IEEE Biometrics Council