

Face detection and recognition Team 2

THE TEAM

	Oana -Research		Ferenz -Research -Code-breaker
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No leaders - democracy!

Problem definition

- Input: Several Group photograph
- Identification of target face
- Finding correspondence
- Remarks: Difficulty variable depending on input image

Main problems to overcome

Extremely large inner class variability:

- Pose
- Orientation
- Beards, mustache, glasses
- Lighting conditions

We need some simplification of the problem

Brainstorming

Viola-Jones Adaboost

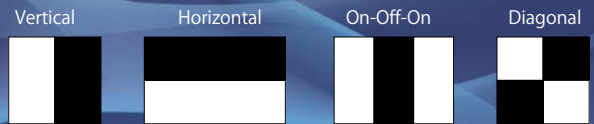
- Combines a set of simple classifiers to form a strong and effective one
- Uses Haar features
- Integral Image allows less computing time

- Sliding window traversing the image
- Search among many scales



Features

- Haar masks represent facial features: the difference in lightness between parts of the face
- Their calculation is made considerably faster with a use of Integral Image



Integral Image

- significantly reduce computation



A	1	B	2
C	3	D	4

$$ii(x, y) = \sum_{\substack{x' \leq x, \\ y' \leq y}} i(x', y')$$

$$4 = A + B + C + D$$

Simple filters

Image feature f is obtained as

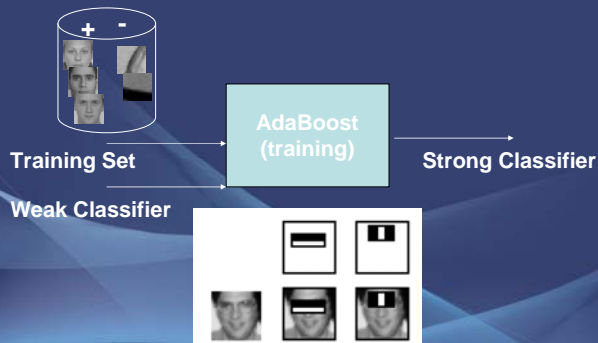
$$f(I) = \int_{R_2} I(x, y) dx dy - \int_{R_1} I(x, y) dx dy$$

and this defines a **weak classifier** for a face

$$h(x) = \begin{cases} 1 & \text{if } f(x) > \theta \\ -1 & \text{otherwise} \end{cases}$$

Need to choose threshold for a classifier and the best classifier itself!

AdaBoost



Given example images x and classifications $\{x, y\}$ where $y \in \{-1, 1\}$

Iterate:

- Evaluate each rectangular filter 'j' on each example 'i'
- Select best threshold for each filter to minimize error:

$$\epsilon_j = \sum \omega_i [h_j(x_i) \neq y_i] \quad \text{where } \omega_i \text{ are weights}$$

- Select filter threshold with min error

Choosing treshold/classifier

Given exaple images x and classifications y where $y=\{-1,1\}$ we iterate:

Start with equal weights on each data point (i)

For $t = 1 \dots T$

- Select weak classifier with minimum error

$$\epsilon_t = \sum_i \omega_i [h_t(x_i) \neq y_i] \quad \text{where } \omega_i \text{ are weights}$$

- Set $\alpha_t = \frac{1}{2} \ln \frac{1 - \epsilon_t}{\epsilon_t}$

- Reweight examples (**boosting**) to give misclassified examples more weight

$$\omega_{t+1,i} = \omega_{t,i} e^{-\alpha_t y_i h_t(x_i)}$$

- Add weak classifier with weight α_t

$$H(x) = \text{sign} \sum_{t=1}^T \alpha_t h_t(x)$$

AdaBoost pros vs cons

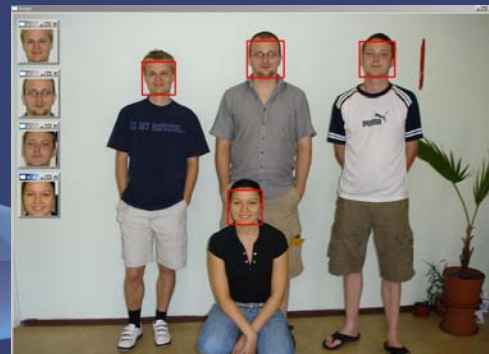
Advantages:

- No a-priori knowledge - The most representative features will automatically be selected during the learning.
- Adaptive algorithm.
- The training error theoretically converge exponentially towards 0

Drawbacks :

- The result depends on the data and weak classifiers.
- They have to be as well chosen as possible.
- Quite slow training.

Viola/Jones detection results



References

Boosting for Fast Face Recognition:

<http://www.face-rec.org/algorithms/Boosting-Ensemble/RATEFG-RTS01Guo.pdf>

Computer Vision Project by Kihwan Kim:

http://www.cc.gatech.edu/~kihwan23/imageCV/Final2005/FinalProject_KH.htm

Fast Face Detection Using AdaBoost:

http://ftp.utcluj.ro/pub/users/medvedevschi/AV/Topics/Meynet2003_923.pdf