

Multiple-View Real-Time Face Detection

Gayane Petrosyan and Ruslana Makovetsky



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Introduction



Motivation



- ❧ Detect human user presence
- ❧ Track user's attention
- ❧ Possible applications:
 - ❧ Gaming
 - ❧ Commercials
 - ❧ Human-robot interactions

Requirements

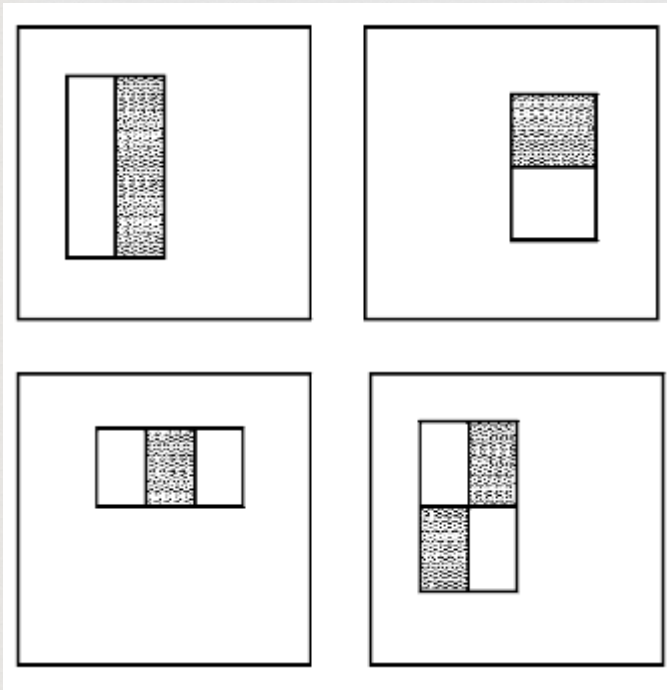


- ∞ Ability to detect and track human faces
- ∞ Real-time performance
- ∞ Different scales
- ∞ In-plane rotations
- ∞ Partial occlusions
- ∞ Ability to detect profile faces

Algorithm



Features



Three kinds of features:

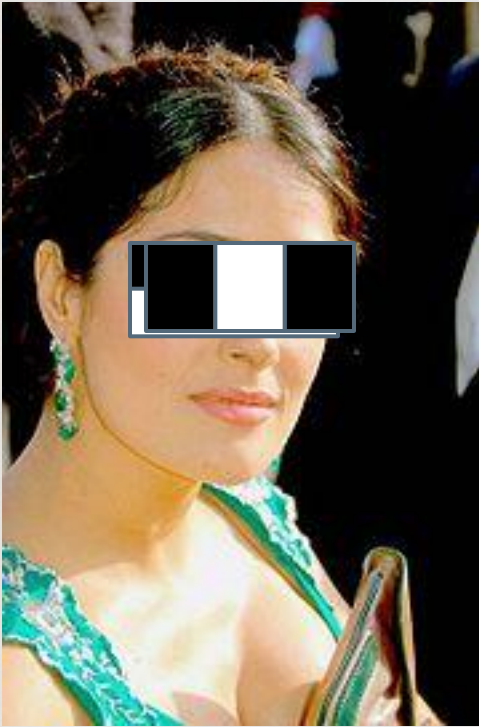
Two-rectangle

Three-rectangle

Four-rectangle

The sum of the pixels within the white rectangles is subtracted from the sum of pixels in the grey rectangles.

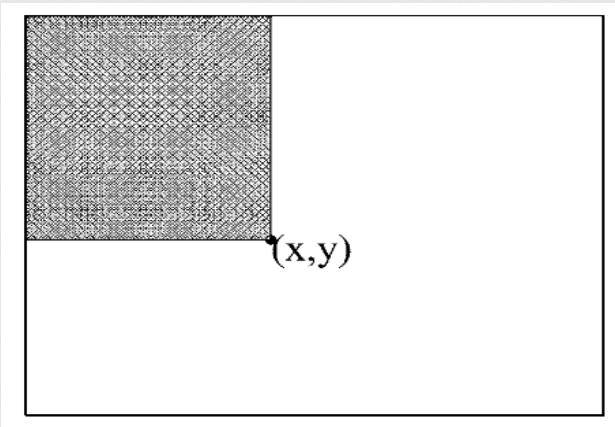
Why these are good?



Integral Image



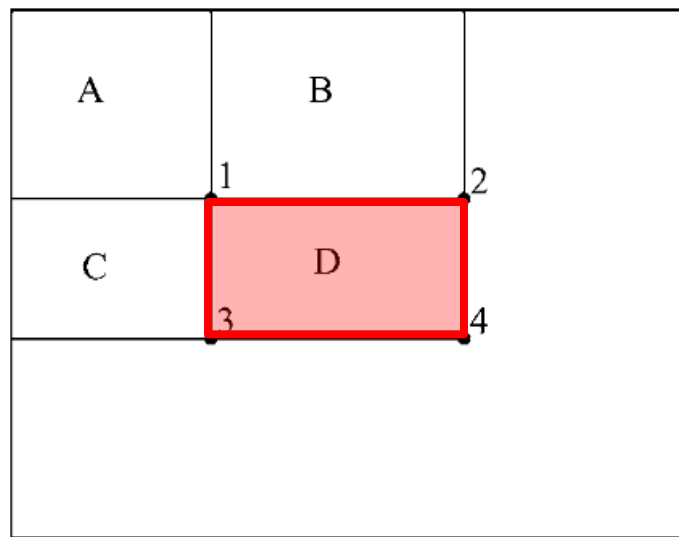
Integral image at location x, y contains the sum of the pixels above and to the left of x, y , inclusive:



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

**Integral image can be computed
in a single pass over the original image**

Features calculation



∞ The sum within rectangle can be computer in 4 array references:

$$D = 4+1-(2+3)$$

- ∞ Two-rectangle features can be computer in 6 array references
- ∞ Three-rectangle features can be computer in 8 array references
- ∞ Four-rectangle features can be computer in 9 array references

We have features
(and a lot!!!)



What next???

AdaBoost



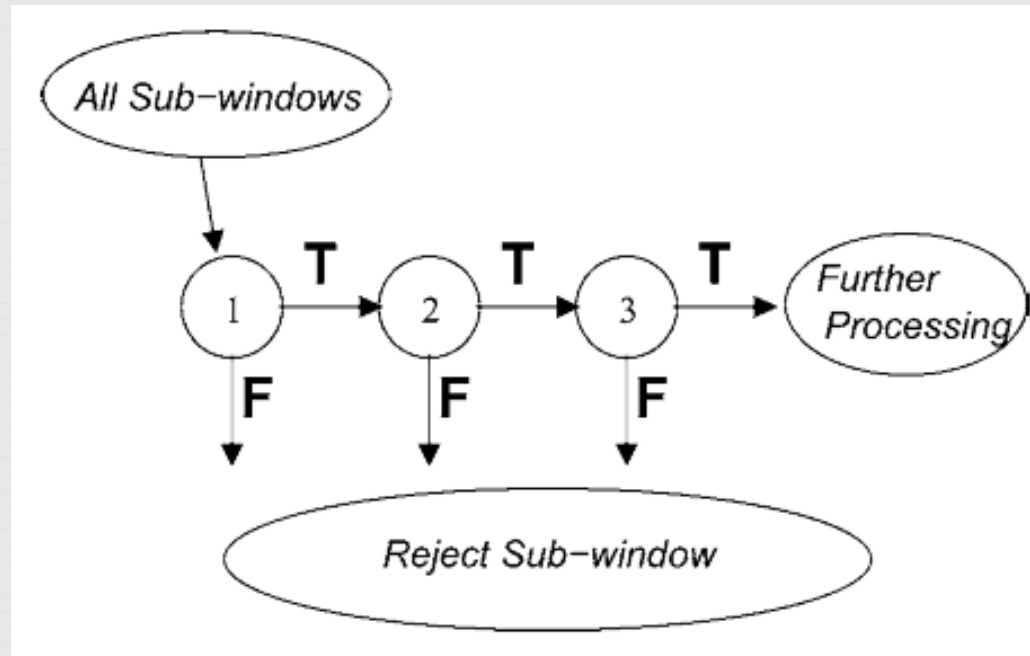
- Combine a collection of weak classifiers to form a stronger classifier

How can we use this idea?



- ❧ Associate weak classifier with a single rectangle feature
- ❧ Train weak classifiers to select strong features.

Cascade



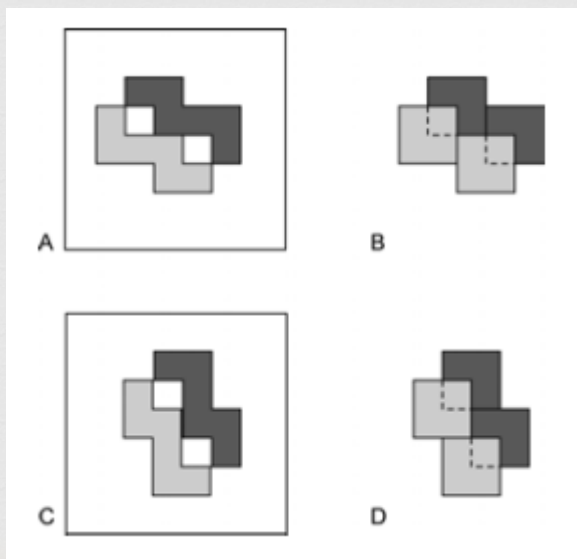
Multi-View Extension



Multiple-View Detection



- ⌘ Divide the space of head poses into various classes and train different detectors for each pose class.
- ⌘ New features type



Summary



∞ Pros

Reliable face detector that runs in real-time

∞ Cons

- Requires thousands of training samples to learn a robust classifier
- Training may take weeks!

Implementation



Platform



❧ OpenCV

❧ JavaCV

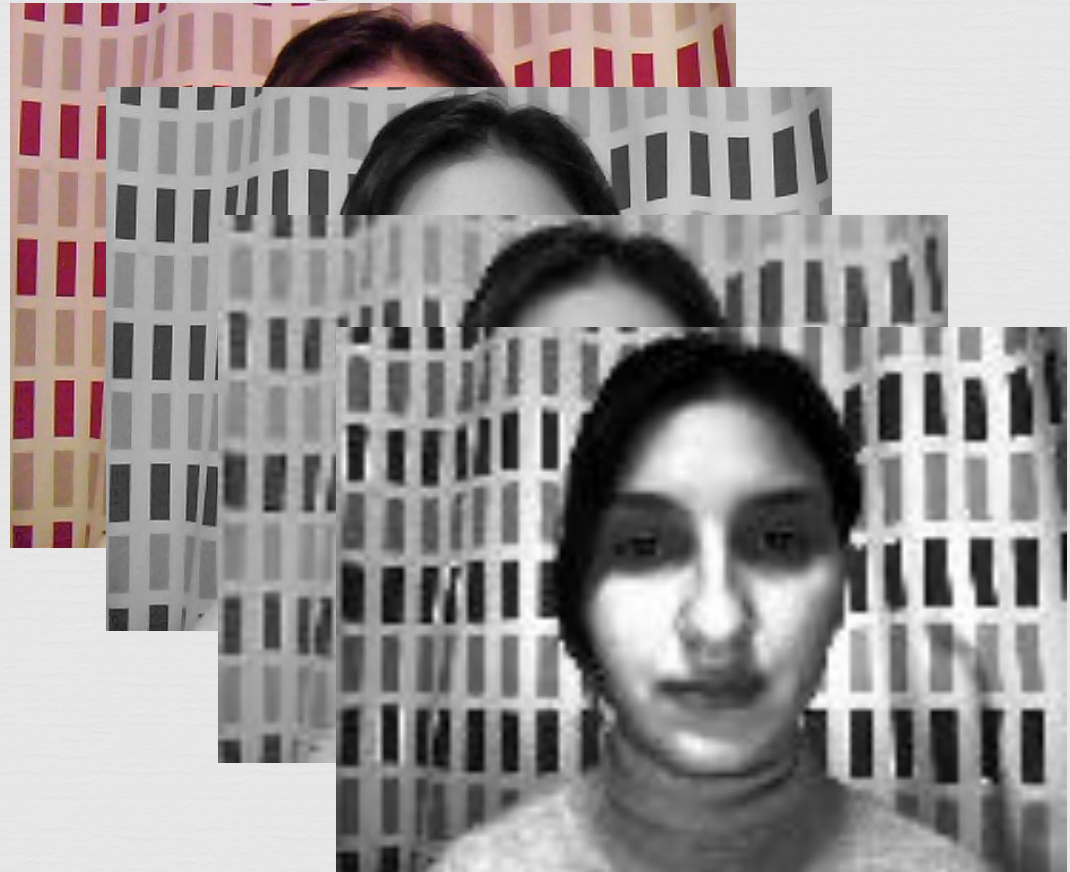
❧ Two trained classifiers

- Frontal faces
- Right Profile

Some Tricks



- Grayscale
- Sampling
- Histogram Equalization
- Mirror flip
- Rotation





Demo



References



- ❧ [1] Paul Viola and Michael J. Jones. “Robust Real-Time face detection”. *International Journal of Computer Vision*, 57(2):137-154, May 2004.
- ❧ [2] Michael J. Jones and Paul Viola. “Fast Multi-view Face Detection.” *Mitsubishi Electric Research Lab TR2000396* July (2003)
- ❧ [3] T. Ephraim, T. Himmelman and K. Siddiqi, “Real-Time Viola-Jones Face Detection in a Web Browser,” *IEEE Canadian Conference on Computer and Robot Vision*, 2009, pp. 321-328.

Thank you
for attention



Questions?

