Face detection without bells and whistles

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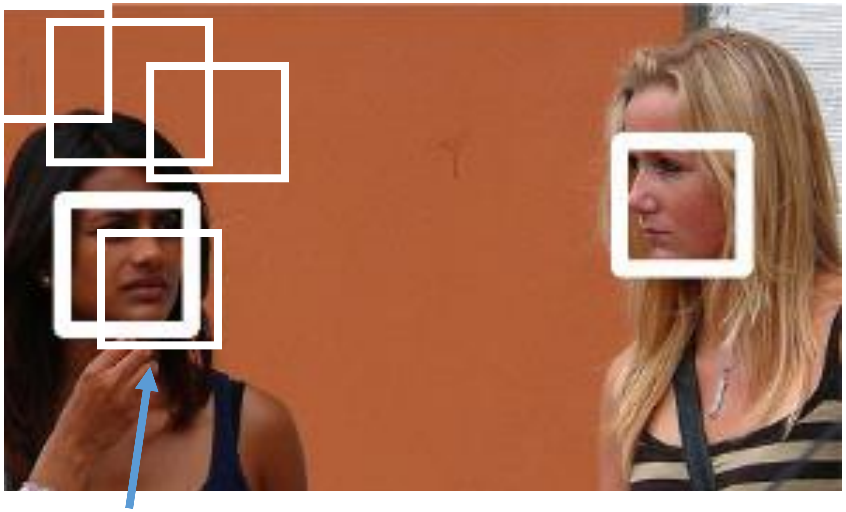
Oral at ECCV 2014, 2.8% acceptance rate

homepage：http://markusmathias.bitbucket.org/2014_eccv_face_detection/

By Wei

detection

~~0. **preprocess**, like histogram equalization and other method to normalization.~~

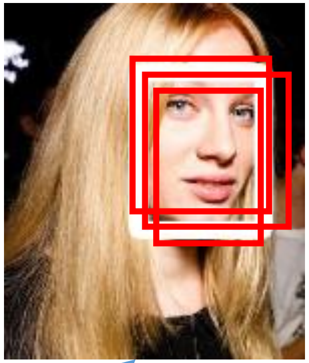


1. Sliding window

   Traversal all the window that have the possibility to be a face.

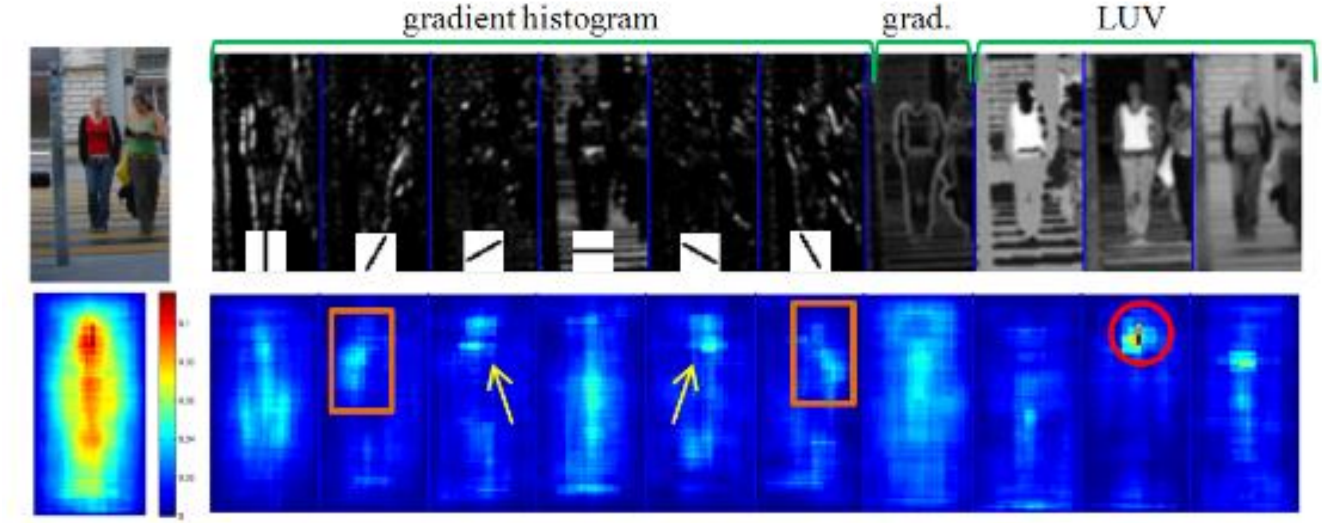
   - Each scale
   - Each position
   - Each ratio
2. feature extraction
3. According to the model to judge if the window is a face.
4. After the possessing we got a series of candidate results, using non-maximal suppression(NMS) to find local minimum as the result. (the so-called local is controlled by the overlap.) For example In the figure, three red rectangles is the candidate results match the model in one face, after NMS only the best reserved.

Before it, we need to read the model from the google proto model file.

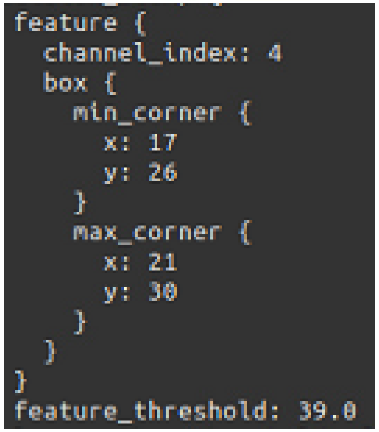


feature

Dollár, Piotr, et al. "Integral Channel Features." *BMVC*. Vol. 2. No. 3. 2009.
http://vision.ucsd.edu/sites/default/files/dollarBMVC09ChnFtrs_0.pdf



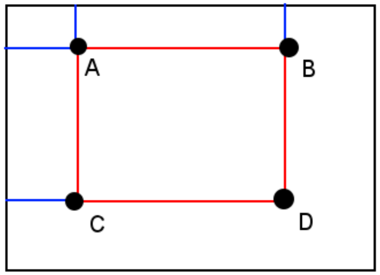
10 channels =
6 hog features
1 gradient
3 LUV (color)



```
feature {
  channel_index: 4
  box {
    min_corner {
      x: 17
      y: 26
    }
    max_corner {
      x: 21
      y: 30
    }
  }
}
feature_threshold: 39.0
```

Score = sum of the value
in channel n
within the box.

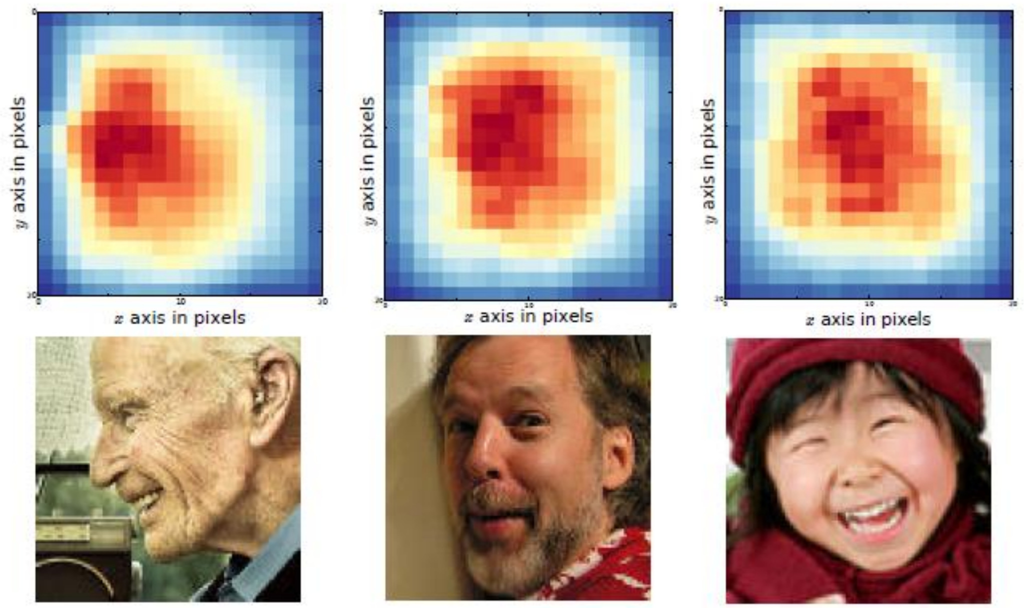
1. For one input picture，calculate integral image on each channels. Which can be reused when calculate the feature.
2. Calculate score in one feature box.
3. Compare to the threshold, output true of false.



Sum = D - B - C + A

Summed area table
integral image

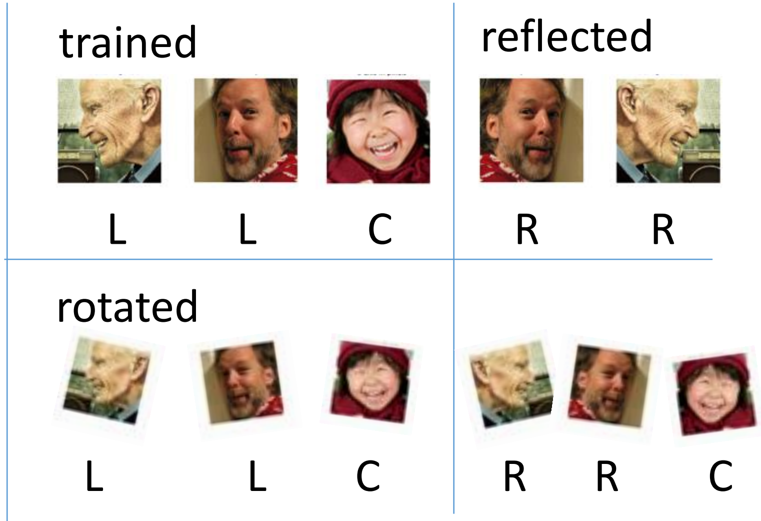
model



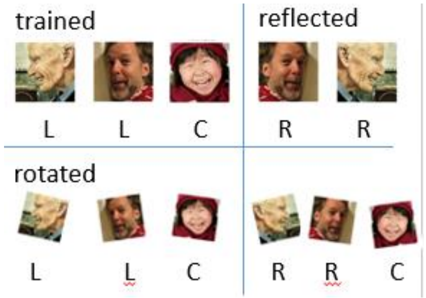
(a) 60° and above model (b) 30° to 60° model (c) Frontal model

Figure 6: Components of the learned model (and example training sample). Red indicates areas with higher influence for the score decision.

headhunter



Change scale



(5+6)*2=22 components

In the paper, the model headhunter is a combination of 22 unique Integral Channel components With 2 scales， 11 components each scale.

1. In the problem, the window should be resized to nearest scale and compute on the 11 components at that scale.
2. Compute scores on the 11 components at that scale.
3. Collect the candidate results according to the threshold.

Integral Channel model

Adaboost wiki

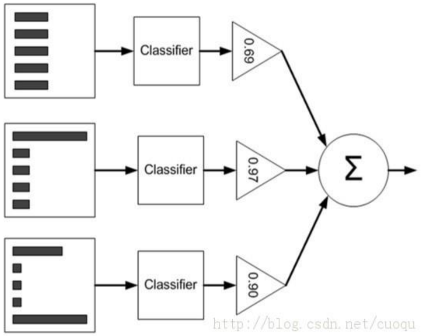
The weak classifier here is：

Level 2 decision tree.

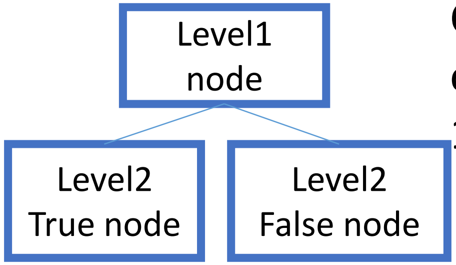
each component Headhunter

Have 2000 stage(weak classifier)

1. Compute each stage, get +1 or -1.
2. Sum up the 2000 stage with weight.



↑a lot of weak classifiers combined to make a strong classifiers



Level1 node

Level2 True node

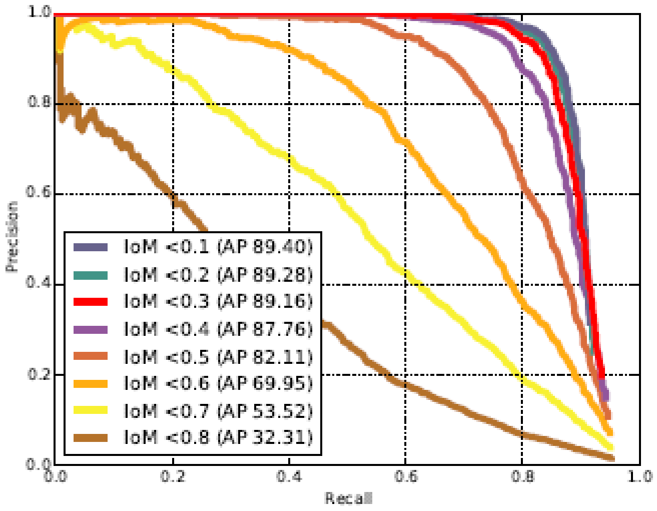
Level2 False node

Compute feature output is +1 or -1(true or false)

non-maximal suppression

- To make sure one entity is marked by only one bounding box.
- Delete redundant box with relatively lower score automatically but reserve boxes on different entities not overlap or not too large overlap.
- Use the overlap threshold to control the effects of NMS.

Here the paper use IoM intersection over min-area IoM<0.3



(a) IoU intersection over union criterion