Face recognition with Raspberry Pi

Jayasimha Rao

Outline

- Introduction
- Face detection
  - Viola-Jones method for object detection
- Face recognition
  - Linear discriminants
  - Fisher faces
- Conclusion.
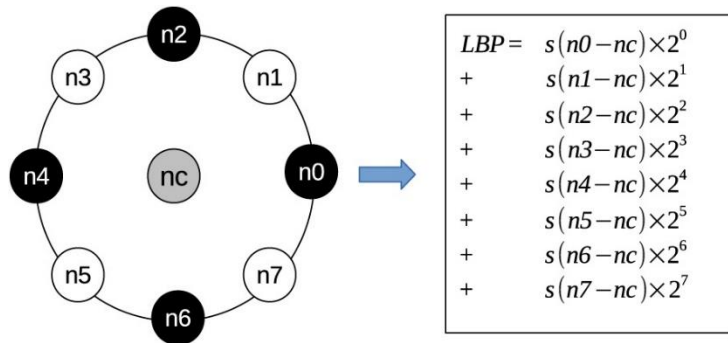
Viola-Jones Object Detection

- Viola, Paul, and Michael Jones. "Rapid object detection using a boosted cascade of simple features." *Computer Vision and Pattern Recognition, 2001. CVPR 2001. Proceedings of the 2001 IEEE Computer Society Conference on*. Vol. 1. IEEE, 2001.

- Haar like features

- AdaBoost based cascade classification

Haar-like feature extraction

(a) Edge Features

(b) Line Features

(c) Four-rectangle features
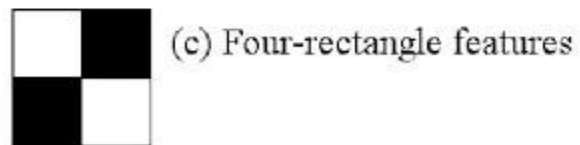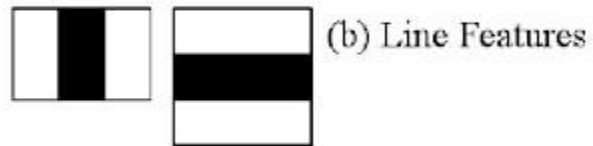
- Subtract sum of pixels under white rectangle from sum of pixels under black rectangle
- For each feature, find the best threshold which will classify the faces to positive and negative.
- AdaBoost combination of the above weak classifiers into one final classifier.

LBP feature extraction

$$
\begin{aligned}
LBP = \ & s(n0-nc) \times 2^0 \\
+ \ & s(n1-nc) \times 2^1 \\
+ \ & s(n2-nc) \times 2^2 \\
+ \ & s(n3-nc) \times 2^3 \\
+ \ & s(n4-nc) \times 2^4 \\
+ \ & s(n5-nc) \times 2^5 \\
+ \ & s(n6-nc) \times 2^6 \\
+ \ & s(n7-nc) \times 2^7
\end{aligned}
$$

- Very fast since it involves only binary operations.
- Good discriminating quality.
- T. Ojala et al., "Multiresolution gray-scale and rotation invariant texture classification with local binary patterns," IEEE Trans. Pattern Anal. Mach.Intell., vol. 24, no. 7, pp. 971–987, Jul. 2002.

Multiscale Detection

- Detection run on multiple scales.

- Scale down the image based on the given scale factor, and perform detection.

- Stop when the minimum image size is reached.

- Lower scale factor means more scaling steps, hence slower processing.

- Higher scale factor would mean, less detection rate, but faster processing. On an RPi, scale factor of 1.2 is recommended.

Cascade multi-scale detection on OpenCV

- Cascade file – A pre-trained classifier model.
  - XML file.
  - On Linux you can find it in usr/local/share/OpenCV.
- detectMultiScale:
  - cascade file
  - image – Matrix of the type CV_8U containing an image where objects are detected.
  - objects – Vector of rectangles where each rectangle contains the detected object.
  - scaleFactor – Parameter specifying how much the image size is reduced at each image scale.
  - minNeighbors – Parameter specifying how many neighbors each candidate rectangle should have to retain it.
  - minSize – Minimum possible object size. Objects smaller than that are ignored.
  - maxSize – Maximum possible object size. Objects larger than that are ignored.

Face recognition

- Fisher faces for frontal face recognition.
- User Fisher linear discriminant to recognize faces.
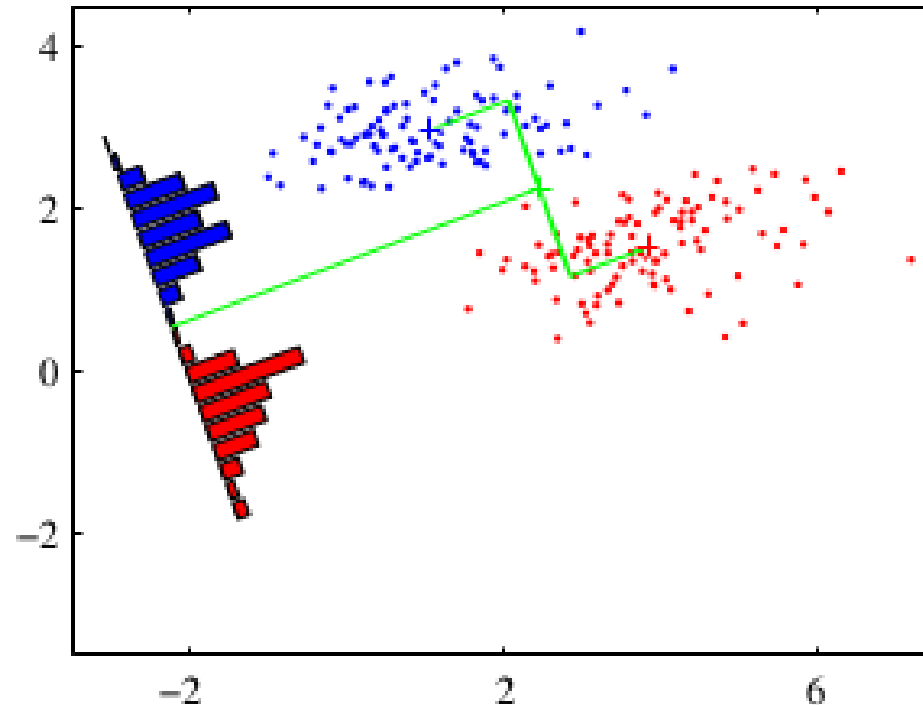
Fisher faces on OpenCV

- Use `createFisherFaceRecognizer()` to create the classifier.
- Train with a vector of images and vector of labels.
- Load the model from a XML or YAML file.