

Face Detection

25th October 2016

Abstract

This laboratory is devoted to work with face detection using Viola & Jones method.

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1 Introduction

In this session, we work with the concepts involved in the face detection method from Viola & Jones: Integral Images and Haar-like features. You can download from the Campus Virtual all the material you need for this practicum. The folder "CV_Laboratory_Face_Detection" contains two matlab functions to be completed and images to work with.

2 Integral Images and Haar-like features

2.1 Exercise 1: Haar-like features and Classification

Open the file FD_ex1.m and follow the comments to complete the code and solve the exercise which is explained next.

2.1.1 Compute and visualize Haar-like features

The code is devoted to compute the two firsts Haar-like features following the following steps. We have chosen three windows containing faces and three windows without faces from the image "NASA1.bmp". These Windows are defined by the coordinates (X, Y) of the top-left corner, are squared and the length of the sides is "L" pixels.

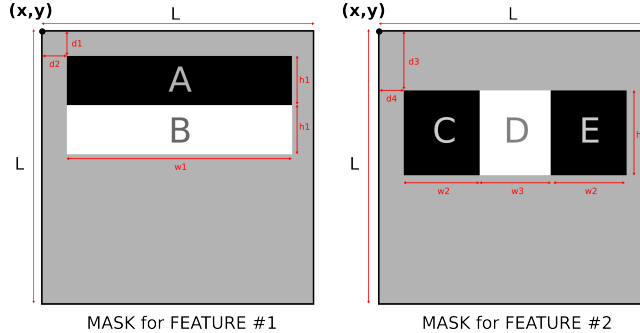


Figure 1: Two masks of Haar-like features.

The two Haar-like features to compute correspond to the rectangles described in the Figure 1. These rectangle features can be computed by means of the integral image S, computed from the original image. You have to compute features #1 and #2 over the six given windows (with and without faces). The values of the features are stored in two matrices and then visualized in a figure representing the feature space. The points are displayed in two different colors to remark the differences, in the feature space, between windows with and without faces. Finally, you can also display the windows on the original image in two different colors for windows with and without faces.

Question 1:

- *Explain the obtained 2-dimensional plot on the feature space.*
- *Given this 2-dimensional plot, can we infer the defined Haar-like features are appropriate for face/non-face discrimination?*

2.1.2 Classification in the feature space

The objective of this part of the exercise 1 is to train a k-Nearest Neighbor (NN) classifier using a set of features extracted from the image "NASA1.bmp" and evaluate the classifier in a new image "NASA2.bmp".

Consider the windows from image "NASA1" as training set. Define the test set by manually selecting a set of windows in the image "NASA2.bmp". You can use "ginput" matlab comand to manually capture the positions of these windows. In particular, you have to use the mouse to click on the top-left corner of the windows you want to define as a test sets. Then, compute the rectangular features for all the windows. Consider the 2 Haar-like features corresponding to the rectangles described in the Figure 1.

In the feature space, 2-dimensional space, use k-NN classifier to classify the test set of windows. For this purpose, the Matlab function "knnclassify" can be used. Display the results of the classification over the test image using two different colors of the rectangles for face / non-face.

Question 2:

- *Is the result good enough? Explain your response.*

You can also visualize the train set and test set in a figure representing the feature space. For that you should use four different colors.

Question 3:

- *What do you infer from the figure? Explain your response.*

2.2 Exercise 2: Apply and evaluate Viola & Jones method on a video

The objective of this exercise is to apply Viola & Jones face detection method on the video "Black_or_White_face_Morphing.mp4". Use the matlab function CascadeObjectDetector from package vision to detect the face in the image. You can find support on: <https://es.mathworks.com/help/vision/ref/vision.cascadeobjectdetector-class.html> Write your code in the file FD_ex3.m to solve the exercise.

Question 4:

- *Is the Viola & Jones method detecting faces in the video frames?*
- *When is the Viola & Jones method not able to detect the faces? Explain your response.*

3 Practicum submission

You are requested to submit a file "StudentName1+StudentName2_Lab5-6.zip" containing:

- A report entitled "Face Detection and Recognition" including the results of the problems posed in this lab 5 and next lab 6 properly commented and all necessary images to fully understand your discussion. The report must provide answers for all questions.
- The matlab files of each exercise of this lab FD_ex1.m, FD_ex2.m and FD_ex3.m, where code should be completed.

Deadline: 14th November, 23:55h by Campus Virtual.