TP7 : Face detection

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The aim of this lab session is to implement an image segmentation algorithm based on color statistics. The goal here is to segment faces in images. The segmentation procedure will use color probabilities calculated from color histograms.

1. Dowload the file `.zip` and unarchive it

2. You should obtain

   - a directory named `data` containing ppm image files
   - a directory named `src` containing a skeleton of the C code as well as the Makefile. File face.c is the one to be completed. File Newpixmap.c contains the read/write functions.

Algorithm outline

The proposed algorithm takes as input two images: one image where faces have to be segmented (refered in the following as image_face), and one image of skin sample (refered in the following as image_skin). The algorithm produces as output two images: a probability image and the original image_face with a cross accounting for the face center. Those input/output images are .ppm files. Exemples are given in figure 1.

The algorithm outline is the following :

1. Normalize the two input images by their luminance: for each pixel (i,j), divide the red, green and blue values $R_{(i,j)}, G_{(i,j)}, B_{(i,j)}$ by the luminance of the pixel $lum_{(i,j)} = R_{(i,j)} + G_{(i,j)} + B_{(i,j)}$.

2. From the normalized image_face, calculate the color histogram in Red / Green space $htot$ (the R/G histogram of an image is a 2D matrix, see figure 2 for an explanation). Do not forget to normalize the histogram (the sum of all elements should be equal to one). If you want to visualize the histogram, we can transform its value in grey level (between 0 and 255).
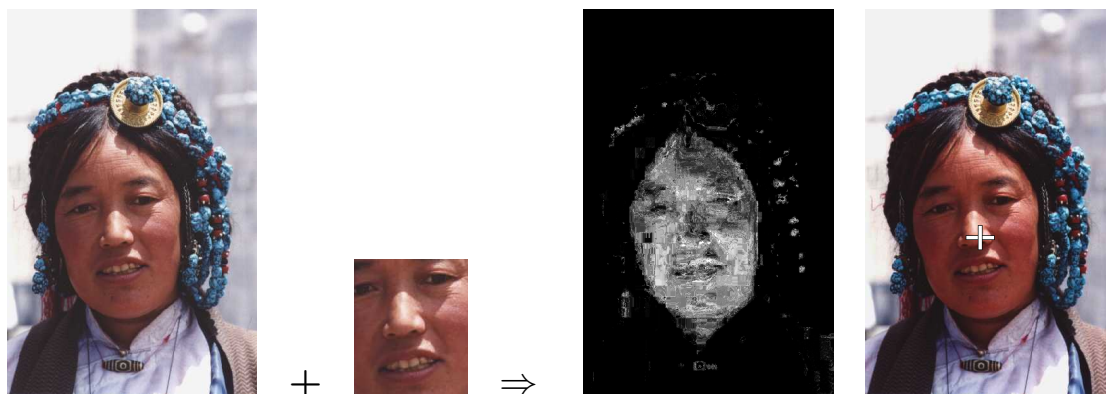
Figure 1: algorithm input / output

3. From the normalized image_skin, calculate the color histogram in Red / Green space *hskin*.

4. Calculate the probability image *proba*. *proba* has the same size as image_face. $proba_{(i,j)}$ accounts for the probability of pixel (i,j) in image_face to have a coherent color with the colors in image_skin. To do so, for each pixel in the normalized version of imageface, calculate the following expression:

$$proba_{(i,j)} = \frac{hskin[R_{(i,j)}, G_{(i,j)}]}{htot[R_{(i,j)}, G_{(i,j)}]}.$$

If you want to visualize the image, we can transform these probabitiy values in grey level (between 0 and 255).

5. Calculate the barycenter (mi, mj) of the image of probabilities and draw its position on the original image_face with a cross.

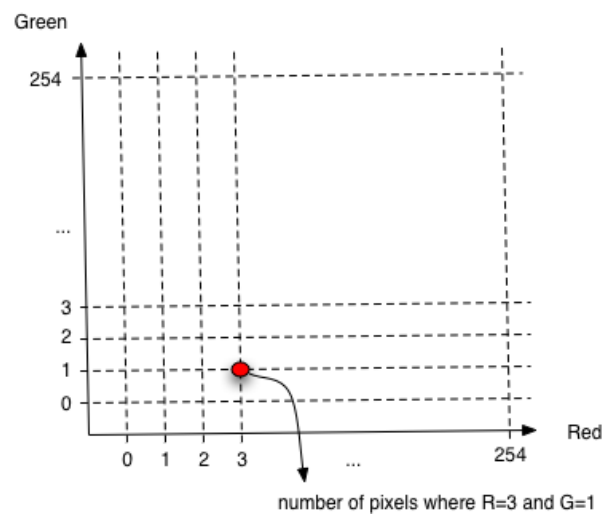6. Test your algorithm on various couple image_face image_skin. You can use Gimp to select a region in an image and thus create various skin images.

Figure 2: Red/Green histogram