NYUAD Computer System Programming BONUS PROJECT #2

Project Deadline: One Day Prior to Final Exam

Face Detection Using Skin Segmentation

Your goal for this project is to write a simple face detection algorithm. There are many different approaches to the problem of face detection. You are going to implement one of the basic and most straightforward algorithms based on skin segmentation. The key idea is rather simple: first of all, one finds all the objects on the photo that are skin color, then some criteria is used to distinguish the face from other objects.

To make the task simpler the following assumptions are made:

1) It's a color photo
2) There is only one face on the photo
3) The person is directly facing the camera

The algorithm is given below:

1) Load the image
2) Convert RGB to skin map
3) Find all connected objects on the skin map
4) Find number of holes in each object
5) Detect the face using number of holes > 2
6) Find the center of the face
7) Draw a red rectangle around the face in the original image
8) Output the image

The detailed algorithm:

1) Load the image
2) Convert RGB to skin map
   Skin map is a binary image, where all pixels with skin color are marked with 1 and the rest are 0.
   You can use the following criteria to create it:
   Pixel is skin if:

$$R > 95; G > 40; B > 20;$$
$$|R - G| > 15; R > G; R > B$$

3) Find all connected objects on the skin map
   Locating connected objects algorithm: Two passes over the image
   Pass 1:
   Scan the image pixels from left to right and from top to bottom.
   For every pixel P of value 1 (an object pixel), test top and left neighbors (4-neighbor metric).
   • If 2 of the neighbors equals 0: assign a new mark to P.
   • If 1 of the neighbors equals 1: assign the neighbor's mark to P.
   • If 2 of the neighbors equals 1: assign the left neighbor's mark to P and note equivalence between 2 neighbor's marks.
   Pass 2:
   Divide all marks in to equivalence classes (marks of neighboring pixels are considered equivalent).
   Replace each mark with the number of its equivalence class.
4) Find number of holes in each object
   Logically negate the image and find the number of objects again
5) Detect the face using number of holes > 2
6) Find the center of the face
7) Draw a red rectangle around the face in the original image
8) Output the image