BLG 453E Homework - 4

Due 23.12.2018 22:00

Policy: Please do your homework on your own (Do not copy paste your solutions from the internet or your friends). The code and the report you submitted must be your own work. All code must be implemented using **Python 3.5+** programming language and **OpenCV Python wrapper**. If you use other version of Python and your code give an error because of Python version you will get 0 point. Include necessary files with your homework. Do not use absolute file paths. The deadline for this assignment will not be postponed.

You do not have to use PyQt5 in this homework but if you use PyQt5, you will get 50 extra points

For your questions: albay@itu.edu.tr

1. **Harris Corner Detection**

   In this problem you will implement harris corner detector algorithm to find the corners of a given image. Load the image "blocks.jpg", name it as I. Note: You are not allowed to use built-in Harris Corner function.

   You will follow the steps to implement the harris corner algorithm as follows:

   (a) Smooth your image with a Gaussian filter using a small sigma value.

   (b) Calculate the gradients of the image in x and y directions, and name them as I_x and I_y.

   (c) Solve Harris corner detector using the following algorithm (for more details check your lecture notes):

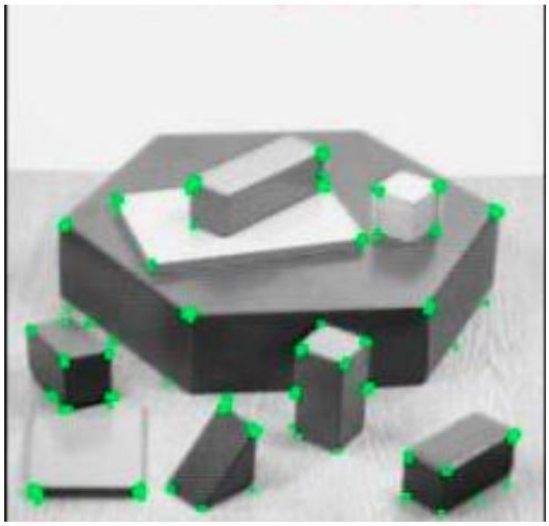
Algorithm 4.2 (Corner detector).

Given an image $I(x, y)$, follow the steps to detect whether a given pixel (x, y) is a corner feature:

- set a threshold $\tau \in \mathbb{R}$ and a window W of fixed size. and compute the image gradient (I_x, I_y) using the filters _____
- at all pixels in the window W around (x, y) compute the matrix

$$G = \begin{bmatrix} \sum I_x^2 & \sum I_x I_y \\ \sum I_x I_y & \sum I_y^2 \end{bmatrix}; \tag{4.30}$$

- if the smallest singular value $\sigma_2(G)$ is bigger than the prefixed threshold τ, then mark the pixel as a feature (or corner) point.



(d) Plot the corner points on the original image. Your result should look like following:

2. **Segmentation of tumor region from a magnetic resonance (mr) image**

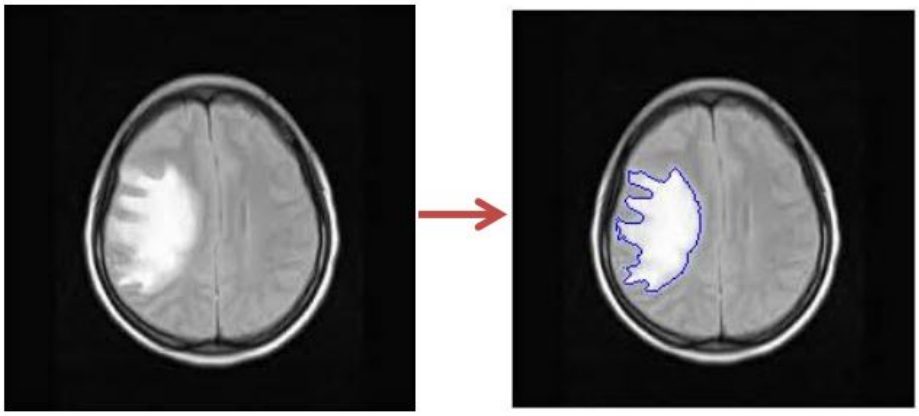


Figure 1-Input image (mr.jpg)

Figure 2-Output image (tumor region is shown by blue)

In this question, you will write a program to segment the boundaries of tumor region in an image by using k-means algorithm and some morphological operators.

(a) Load the ”mr.jpg” image, convert the image to gray

(b) Threshold the image using an appropriate value to obtain a mask similar to Figure 3.

(c) Remove the skull region from the image by selecting an appropriate morphological operator and a structuring element

Figure 3-mask

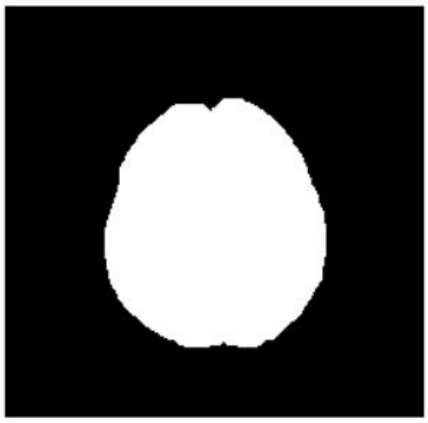


Figure 4-Brain mask

(d) Implement your own K-means and apply it only to the masked brain region by choosing an appropriate number of clusters to segment the brain in the image.

(e) Find the tumor boundary using morphological operators.

(f) Show the boundary on top of the original image. Your final visualization should look like Figure 2.

Figure 5-Result of kmeans segmentation

Figure 6-Tumor boundary