GUI FOR COMPLEX SEGMENTATION OF MEDICAL IMAGES

Veska M. Georgieva

Faculty of Telecommunications, Technical University of Sofia, Bulgaria
1000 Sofia, "Kl. Ohridsky" str.8
T. (+359 2) 965-3293; E-mail: vesg@tu-sofia.bg

Antonia D. Nankova

Faculty of German Engineering Education and Industrial Management, Technical University of Sofia, Bulgaria
1000 Sofia, "Kl. Ohridsky" str.8
E-mail: antonianankova@gmail.com

Abstract

In the paper is presented software for complex segmentation and preprocessing of medical images and its graphic user interface (GUI). It works in the MATLAB environment and uses IMAGE TOOLBOXES defined functions. Three basic methods for image segmentation such as region- growing, split & merge and color based K-mean clustering algorithms are used, regarding to process different medical modalities of the images. The GUI proposes also an interactive option to make some preprocessing such as choosing a region of interest (ROI) in the processed image, grayscale conversion and filtration.

The proposed GUI can be applied to real medical images attempt to make diagnostic more precise. The presented GUI is suitable also to engineering education for studying of this processing.

1. INTRODUCTION

The medical images provide important anatomical information to physicians and specialist upon which can be made diagnoses [1]. Segmentation is a classical problem in image processing; it can be described as the process of partitioning an image into a set of non-overlapping homogeneous regions. The goal of segmentation is to simplify and to change the representation of an image into something that is easier to analyze. Image segmentation is typically used to locate objects as organs and tumors and their boundaries (lines, curves, etc.) in medical images. This is a process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.Region growing is one of the simplest approaches to image segmentation; neigh boring pixels of similar amplitude are grouped together to form a segmented region. However, in practice, constraints, some of which are reasonably complex, must be placed on the growth pattern to achieve acceptable results [2].Split and merge segmentation techniques are based on a quad tree data representation whereby a square image segment is broken (split) into four quadrants if the original image segment is no uniform in attribute. If four neighboring squares are found to be uniform, they are re-

placed (merge) by a single square composed of the four adjacent squares [3]. This approach tends to be computationally intensive. Color-Based Segmentation using K-mean clustering segments colors in an automated fashion using the L*a*b* color space and K-means clustering method. The L*a*b* color space (also known as CIELAB or CIE L*a*b*) enables quantifying of visual differences in colors and clustering is a way to separate groups of objects. K-means clustering treats each object as having a location in space. It finds partitions such that objects within each cluster are as close to each other as possible, and as far from objects in other clusters as possible [4].

The proposed program is created in MATLAB 7.14 environment by using IMAGE PROCESSING TOOLBOX.

The graphic user interface consists of checkboxes, buttons, edit boxes, pop-up controls, which make it easy to use. Users enter or choose input data in a single form, because input information changes and visualizations are easier and faster in this way. The processed images can be saved on the disk and so can be used to another processing or its visualization.

The paper is arranged as follows: In Section 2 is described the GUI; in Section 3 are presented the tasks carried out from the main program some ex-

perimental results, obtained by computer simulation and their interpretation; in Section 4 - the Conclusion.

2. THE GUI FOR COMPLEX SEGMENTATION OF MEDICAL IMAGES

The GUI for region segmentation of medical images is shown on Fig.1. It is divided in several areas, where the user applies different settings, concerning image preprocessing, segmentation techniques and theirs parameters and areas for universal application.

The area "Input Image Path" is for entering an image file name with an image file extension. The user can navigate among the folders in the work folder and choose image by using "Browse" button and view the image by using "View Image" button. There is a separate area for "Image preprocessing", shown in Fig. 2. The segmentation technique can be selected in area "Image segmentation", shown in Fig. 3.
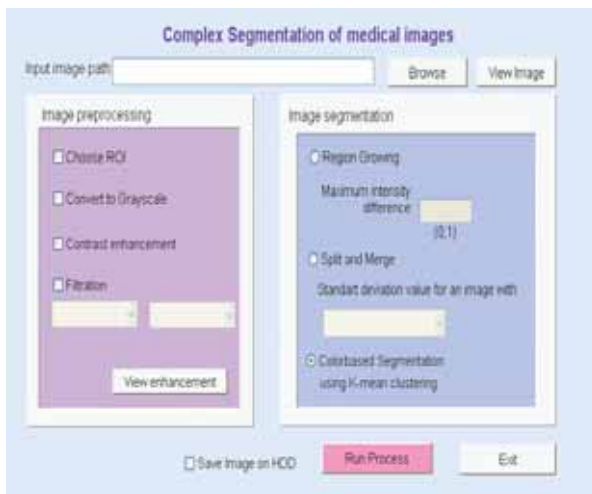

Fig. 1. GUI for complex segmentation of medical images
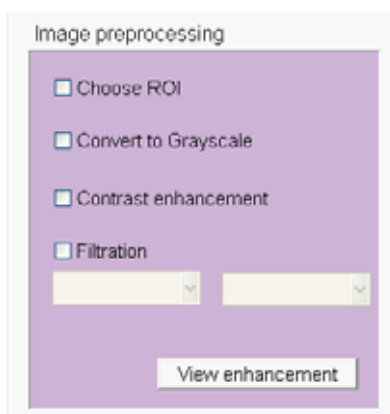

Fig. 2. Area "Image preprocessing"

In the first area the user can choose between four possibilities: Choose ROI(Region of interest); Convert to grayscale; Contrast enhancement; Filtration.There are different methods of filtration that can be used. On the left pop-up menu are listed filtration-methods for both truecolor and grayscale images: average; Gaussian; motion; unsharp; homomorph. On the right pop-up menu there are methods for filtration only of grayscale images. After choosing the preferred preprocessing variations the user can see the results by pressing the button "View enhancement".
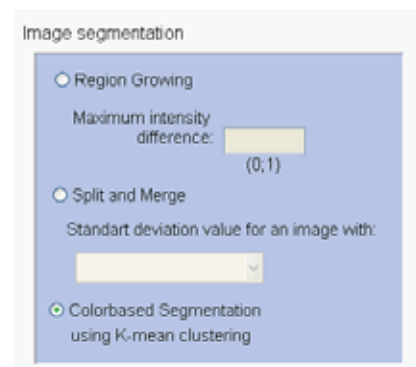

Fig. 3. Area "Image segmentation"

In the second area the user can select between three different segmentation techniques: region-growing, split and merge and color-based algorithms. The important parameters of these methods are maximum intensity difference (threshold) with values between 0 and 1. It can be input manually. Another parameter is a standard deviation. It is specific for the split and merge algorithm.

"Save Image on HDD" is checked to save results in image files in 'jpg' format. After choosing all input information the procedure of processing begins, when the user clicks on button "Run Process". Then the final result is shown – original image, and processed images. When button "Exit" is pressed the program can be closed.

3. TASKS CARRIED OUT FROM THE MAIN PROGRAM

The basic algorithm that works behind is shown in Fig. 4.

By acting of component from GUI can be implemented a callback-function from the main program. Every graphic component can be treated to object. Every object can be referred to handle. The objects referred a complex of attributes, which can be ma-

nipulated from the software. The multifarious attributes can be leaved for using in MATLAB environment, such as "Enabled", "Value", "Visible", "On", "Off" etc. [5]. Every attribute can be enabling in the presence of corresponding handle or reference to the object. Every graphic component can be reiterated to a cycle of events for the MATLAB environment by initialization of the graphic application. It submits addresses of the callback-functions, associated to a given event, which are important. By its identification can be called out a corresponding callback-function. One of the important tasks that the main program has is input data validation. The execution is canceled if an error concerned with wrong information occurs. Another essential purpose of the main program is presenting the input information in appropriate data structures. It is necessary for the next steps in the processing strategy, in this step the processing is made with appropriate input data. Wrong information prevents segmentation from carrying out or may lead to wrong output.
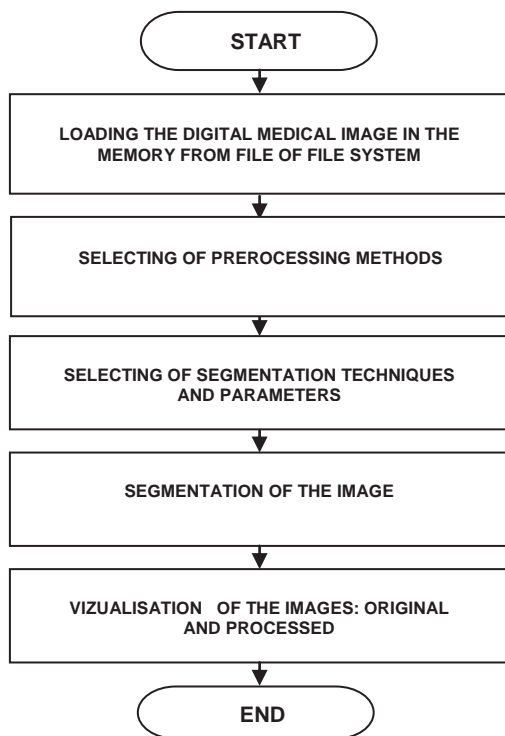

Fig. 4. Block diagram of the algorithm

Some results from simulation, which illustrate the working of the program, are presented in the next figures below. In Fig. 5 is shown the original colorful CT oncology image of size 600x390 pixels from left kidney cancer.

In Fig. 6 is presented the original image after speckle noise reduction, made on the base of homomorph filtration.

Fig. 5. Original CT image

Fig. 6. CT image after filtration

In Fig. 7 are presented the selected CT ROI image of size 203x312 pixels from kidney with cancer and its modifications, obtained by region growing algorithm. The best result is obtained for the value 0.15 of the parameter threshold by region growing algorithm.
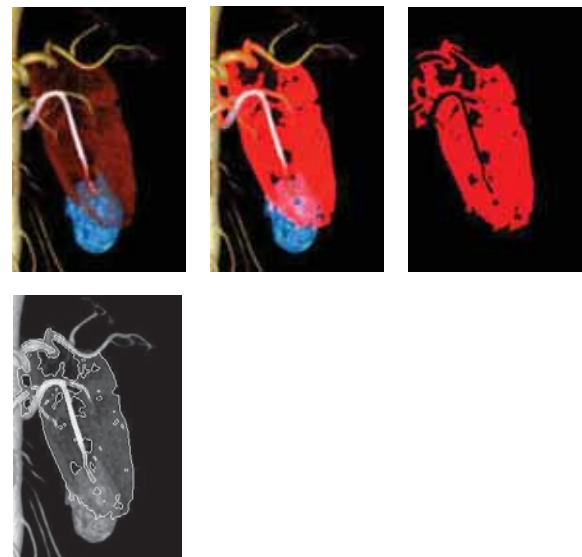

Fig. 7. CT ROI image and its modifications by region growing

In Fig. 8 are presented the same CT ROI image and its modifications, obtained by split & merge algorithm. The value of standard deviation by split and merge algorithm is defined in the case of more gray in the ROI image in grayscale.

In Fig. 9 are presented the same CT ROI image and its modifications, obtained by color-based segmentation using K-mean clustering algorithm.
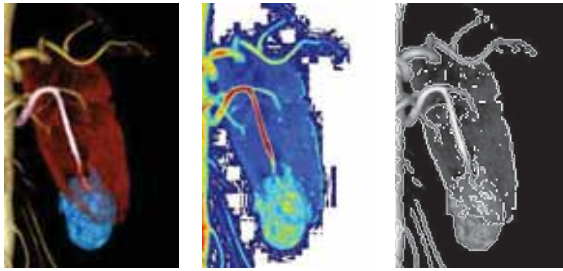
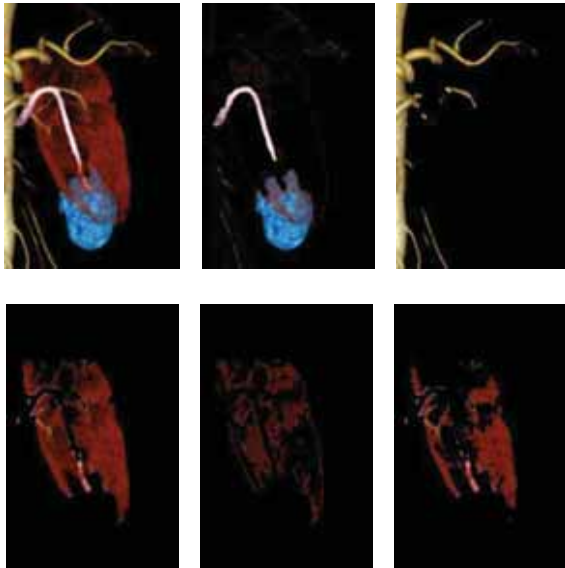Fig. 8. CT ROI image and its modifications by split & merge

Fig. 9. CT ROI image and its modifications obtained by color-based segmentation using K-mean clustering

4. CONCLUSION

In the paper is presented a GUI for preprocessing and complex segmentation of medical images. It uses MATLAB defined function and works in MAT-LAB 7.14 environment. The processing can be used to locate objects as organs and tumors and their boundaries by using of region growing, split and merge, color-based segmentation using K-mean clustering algorithms. The GUI can be used in engineering education for studying those processes. It can be used also in real time to provide important anatomical information in medical images to physicians and specialist upon which can be made diagnoses of different diseases. The results by segmentation of sequences of CT images can be used for future application in 3D visualization.

From the simulation-images can be make a comparison between the different kinds of segmentation algorithms in the GUI. By the region growing algorithm it is obvious that the kidney can be extracted in a different color or by a contour but in grayscale. The second shown segmentation (split & merge) works only with grayscale images and converts firstly the image in grayscale, than after segmenting the image paints it in different colors depending on the region. Finally the kidney can be extracted by a contour, but results in this phase are usually not as good as those after using the region growing algorithm. The third color-based segmentation using K-mean clustering can be made only for true color images. The result images are presented in more different segments of the original image by separation of the colors in three clusters and two nuances of one of the clusters. That brings more information about the kidney itself, the vascular and more important about the tumor formation.

References

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