XXVI Congresso Brasileiro de Engenharia Biomédica

Armação de Búzios – RJ – Brasil

October 21st to 25th, 2018

Image Segmentation of Brain MRI Using Mathematical Morphology for Contribution in Diagnosis of Schizophrenia

E K M Nunes[1], R U Ferreira[2], M V C Costa[1,2*]

[1]Graduate Program in Biomedical Engineering, University of Brasília at Gama, Brasília, Brazil

[2]Electronic Engineering, University of Brasília at Gama, Brasília, Brazil

**chaffim@unb.br*

Background, Motivation and Objective. Schizophrenia is a mental disorder that affects the life quality of the patients and their families. Currently, the diagnosis of this disease is given through an interview with the patient, still being uncertain. The uncertainty leads patients to suffer, along with their families, the consequences of the disease that affects part of the population. Another factor of suffering is the discrimination that involves the disease. However, researchers claim the upcoming classifications of the disease should be based on biological evidence. Thus, studies point to brain abnormalities, such as enlargement of the ventricle, as those which may be linked to the disease. The images obtained by magnetic resonance have been driving the study of the disease. This research shows the results of an algorithm developed to extract the cerebral ventricle from the brain images provided by the Biomedical Informatics Research Network (BIRN). The algorithm is based on ventricle segmentation, using mathematical morphology. The segmentation is fundamental in analysis of the extracted object, because it provides visually satisfactory results, which may later be used for parameter extraction and image classification. The goal is to contribute to the diagnosis.

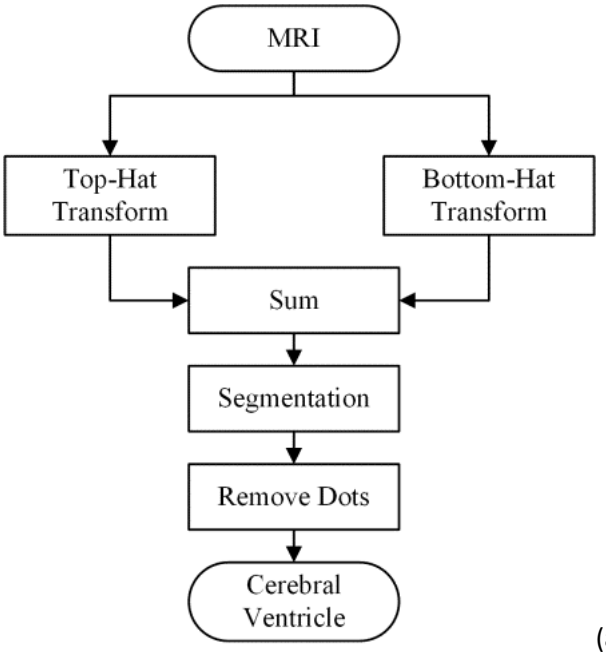
Methods. Based on researches that seek to detect brain tumour in an MRI by means of segmentation using mathematical morphology, this study presents a similar implementation, but focused in detection of the cerebral ventricle. Figure 1(a) shows the general approach. The first step is the application of the top-hat and bottom-hat transformations and, subsequently, the resulting images are summed up. Since the transformed images bring enhanced bright and dark details, respectively, their sum provides an image with more details. The structuring elements applied were disks with a radius of 10 pixels for the top-hat transform and 6 pixels for the bottom-hat transform. The resulting image is segmented using the 128 gray-level as threshold. After this step, some points that do not belong to the ventricle are automatically removed by eliminating all connected components with 100 pixels or less. The values, used in the research, were obtained from preliminary results and subjective observation. The images acquired by MRI used in the work have 256 gray levels and were obtained from the BIRN data-base. The fBIRN is a specific set of images from the BIRN database that contains brain images from patients with schizophrenia and from a control group. In this study, only the images that present the cerebral ventricle visible were used.

Results. In the current development of our work, all results are visual and subjective. Result examples of four different images with isolated ventricles are shown in Figure 1(b).

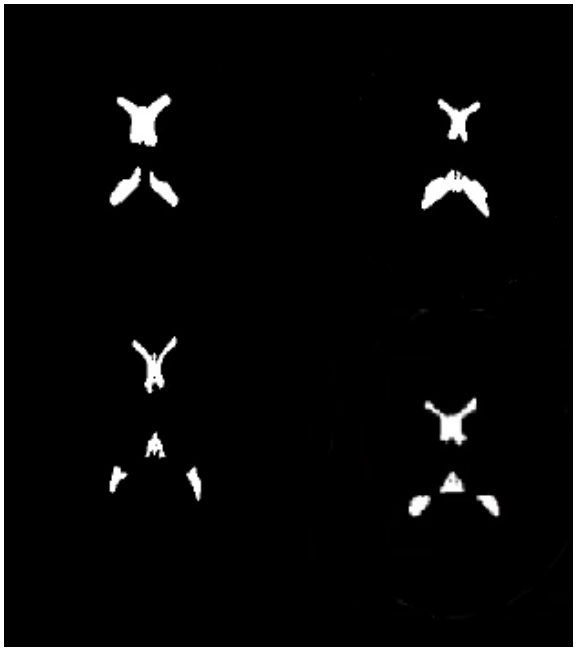
Discussion and Conclusions. In the presented scenario, where the uncertain diagnosis of schizophrenia directly affects people, digital image processing is a strong tool. In our work, we used a previously presented segmentation method to extract the brain ventricle from brain MRI images. We have shown, in preliminary results, that the use of mathematical morphology, through top-hat and bottom-hat transforms, is visually promising. The application of the top-hat and

bottom-hat transformations produces an image in which the lighter and darker pixels are highlighted, respectively. In the top-hat transformed image, the ventricle is highlighted as well as small parts at the edges. In the bottom-hat transformed image, the dark spots are highlighted, and the edges disappear. At this step, it is not possible to accurately visualize the region of interest. The segmentation is executed on the image resulting from the sum of the last two images, obtained from the two described morphological operators, using the 128 gray-level as threshold for the images, leading to the isolation of the brain ventricle. The pixels above 128 become white, while the pixels below this value are set to black. However, after segmentation, it was verified that elements which did not belong to the cerebral ventricle were present. In face of this problem, the algorithm can automatically extract dots and regions that are not part of the ventricle. This removal is crucial, because it is necessary to properly isolate the ventricle to obtain information about the segmented object to, posteriorly, perform a classification based exactly on parameters extracted from the ventricle. Finally, the ventricle is isolated, allowing further analysis to be performed. In a complete study, our goal is to be able to classify healthy and schizophrenic patients according to parameters extracted from the segmented images.

Figure 1. (a) General structure of implemented method; (b) Four examples of isolated ventricles



(a)



(b)

Keywords. MRI; Digital Image Processing; Image Segmentation; Mathematical Morphology; Schizophrenia.