MeVisLab Lab Report

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1 Objective

The objective of the lab-work was to get familiarized with the MeVisLab softare, which is a platform specifically designed for medical imaging and visualizations. MeVisLab has advanced inbuilt functionalities for medical image analysis. He lab was divided into two phases:-

- In the first phase, we tried out different options available in MeVisLab and got accustomed to the basic blocks in MeVisLab.
- In the second phase, we had to implement segmentation algorithm on a 3D volume of ultrasound images.

2 Introduction

Since most of the new techniques, developed in biomedical field, reconstruct the anatomy of the body in a 3 dimensional space, 3D volume segmentation has become an integral part of computer based medical applications. The biomedical industry is growing rapidly, moving towards making computer based diagnostics a reality. The new tools being developed can be used to understand and diagnose the anatomical structures by virtually interacting with them. 3D segmentation can greatly facilitate extraction of different organs or features from the entire volume.

The main purpose of this lab was to implement a volume segmentation framework in MeVisLab. Since it was the first we were using MeVisLab, the first thing we did was to get used to different basic features of the software. Some of the basic blocks in MeVisLab were tried out by choosing them from the search module and placing them in the main window and seeing how they work by using "Show Example Network" option. This was followed by the implementation of the volume segmentation.

MeVisLab provides us with advanced feature pertaining to image segmentations. The segmentation algorithms provided by MeVisLab include:-

- Region Growing
- Live wire
- Fuzzy connectedness
- Threshold
- Manual contours

The ideal choice was to choose from one of these implementation in MeVisLab rather than writing separate code for another algorithm. All of the above five block were studied in order to decide which one to implement.

Initially, region growing was chosen and implemented as the entire breast in the volume is clustered together, allowing the region rowing to be the perfect option as in region growing even if two structures have the same feature values, they are not considered as one unless they are connected with each other.

The region growing algorithm was tested on all the volumes provided and it produced satisfactory results. However, it involved manual seed placement every time the code is opened and run as opposed to the requirement for the lab that specifically stated that the human interaction should be minimum. For this reason, the segmentation algorithm was replaced later with the threshold based segmentation.

3 Breast Boundary Segmentation Framework

The main task of the lab work was to devise a framework for a fully automatic 3D volume segmentation for the sample ultrasound breast images provided with the lab manual. After going through the tutorials and trying out various segmentation techniques, the following framework was finalized as displayed in Figure 1:-

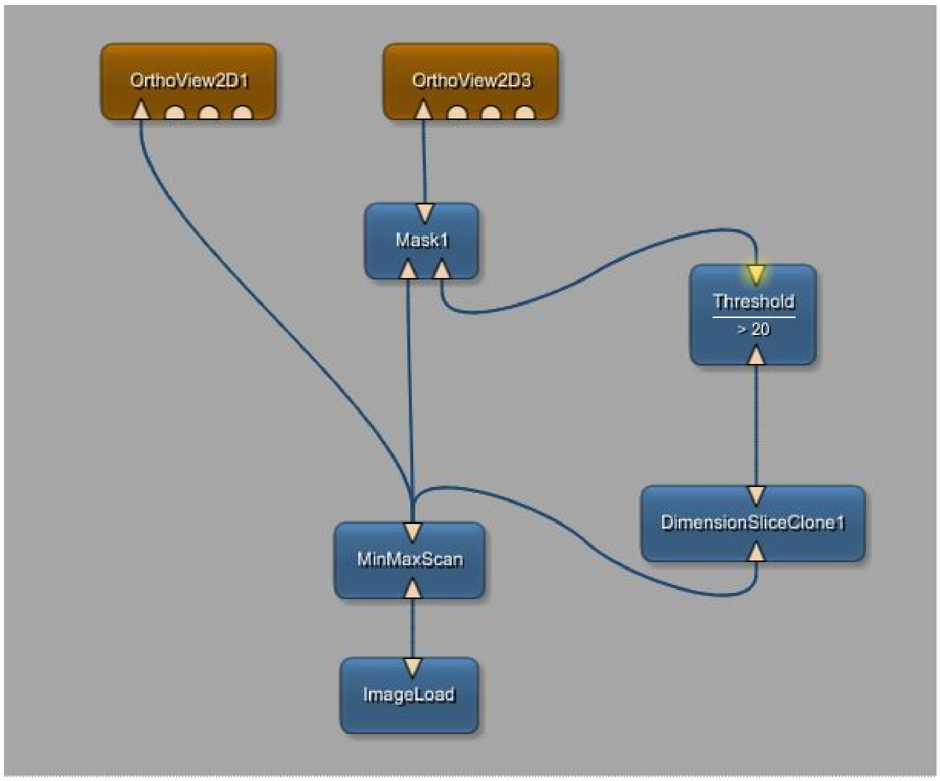

Figure 1: Flowchart of the segmentation framework implemented

The dicom images provided are first input to the system using 'ImageLoad' block. The images have very low contrast and thus can not be visually seen directly, so they are passed through a contrast stretching phase accomplished by the 'MinMaxScan' block. The resulting image is displayed through the 'OrthoView2D' (left side block in Figure 1) block.

If we directly apply the threshold segmentation technique on the entire volume, it was noted that not all the slices produce the appropriate result. This is caused by the different intensity ranges of the background for different slices. For example, the slices at the bottom have a white background while the ones at the top have black backgrounds. So, the solution uses 'DimensionSliceClone' block to extract only one slice (with the best result) form the volume and duplicate it to the dimensions of the entire volume. This chosen slice is passed through the thresholding step that produce a black and white image that is later used as a mask which is applied on the entire volume to produce the segmented output. The cloned slice being used is shown in Figure 2 for one of the input images.

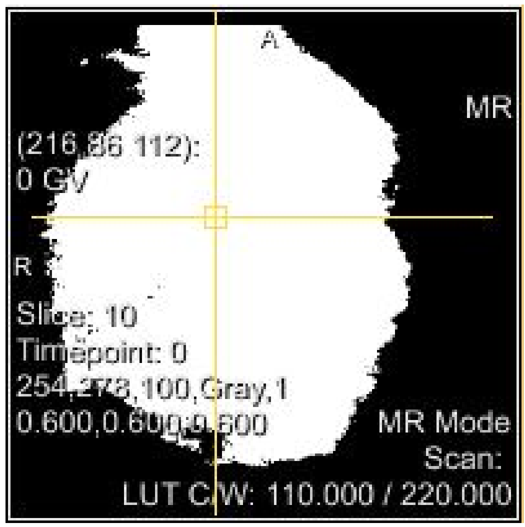

Figure 2: Slice being used to mask the entire volume (t0200217102ar.dcm)

This result can be seen from the 'OrthoView2D' block (the one on the right in Figure 1). The main problem here was that since all the three dicom images provided to us were not of same dimensions, so the result was sometimes being shown as black. To solve this issue, the chosen slice was replicated 100 times of the size of the image as there is no way to pass the dimension as a parameter to the 'DimensionSliceClone' block. Next the 'Output image size' parameter of the mask block was changed to only use the dimensions as of the smaller of the two inputs. This solve the issue, however, it is using more memory now.

The results for the three dicom inputs can be seen in Figures 3, 4 and 5. The chosen threshold value is 20 and cloned slice number is 40.

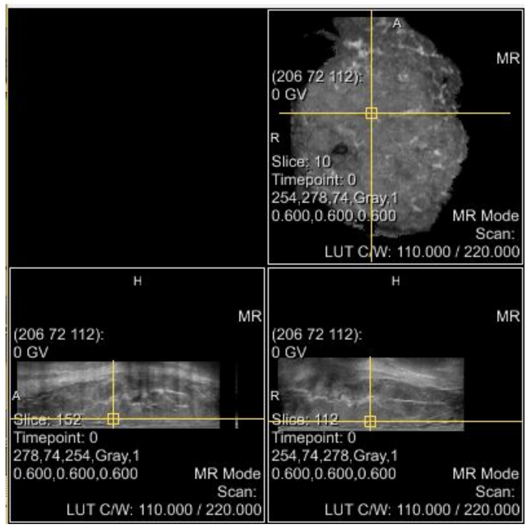

Figure 3: Segmentation result of the proposed algorithm on ultrasound volume (t0200217102ar.dcm)

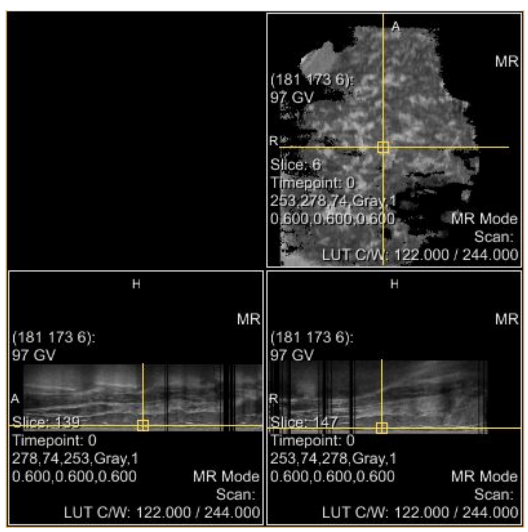

Figure 4: Segmentation result of the proposed algorithm on ultrasound volume (t0200254601ml.dcm)

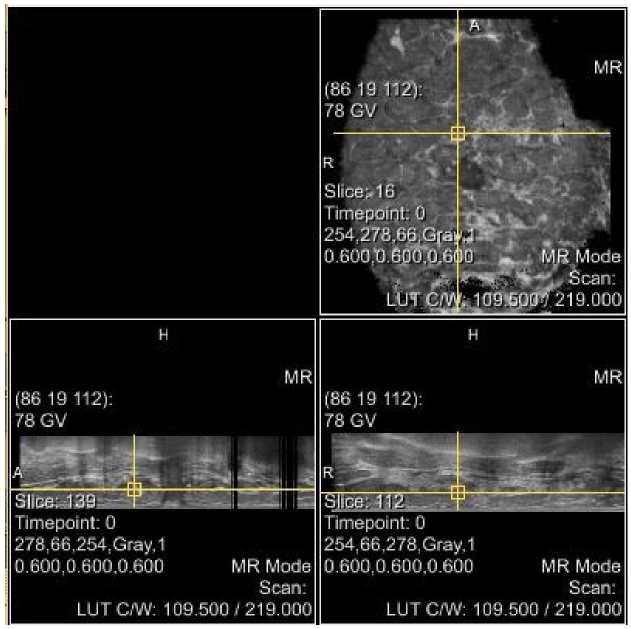

Figure 5: Segmentation result of the proposed algorithm on ultrasound volume (t0200403301al.dcm)

It is important to note that if any other images are used, then it might be necessary to change the threshold values or the slice clone value to some other suitable value that can be applied on all the images. The parameters chosen here were determined after observing the effects on the three images provided to us.

4 Conclusion

In this lab work, a basic volume segmentation framework was implemented on MeVisLab. The framework is specifically designed for breast ultrasound images. Thresholding based segmentation technique was successfully implemented. Among all the images provided, one of them (the second one), was a bit different from the others causing us to tweak the parameter values a bit to adjust to it. However, the parameter provided in the script file as default produce satisfactory results for all the images.