

A Framework for Volume Segmentation and Visualization Using Augmented Reality



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ABSTRACT

We propose a two-handed direct manipulation system to achieve complex volume segmentation of CT/MRI data in Augmented Reality with a remote controller attached to a motion tracking cube. At the same time segmented data is displayed by direct volume rendering using a programmable GPU. Our system achieves visualization of real time modification of volume data with complex shading including transparency control by changing transfer functions, displaying any cross section, and rendering multi materials using a local illumination model.

OUR FRAMEWORK

Our system is composed of pre-processing, locating a seed point, and growing a region. In the pre-process, input volume data is filtered, amplified, and binarized by the magnitude of gradients of the data. Then a distance function is generated from the binary data. Figure 2 visualizes the cross sections of a MRI volume data in the pre-process. The next, the user puts a seed point at the tip of the virtual needle indicated by the controller in the region which the user wants to extract. Then the user can grow the region with the guide of the distance function mentioned above. We locally limit the expansion of a boundary surface by changing a speed function depending on the distance from the tip of the virtual needle. By using this technique, the user can freely expand regions to extract desired shapes. The combination of existing marker based motion tracking and region growing guided by geometrical features makes a success of intuitive and precise volume segmentation.

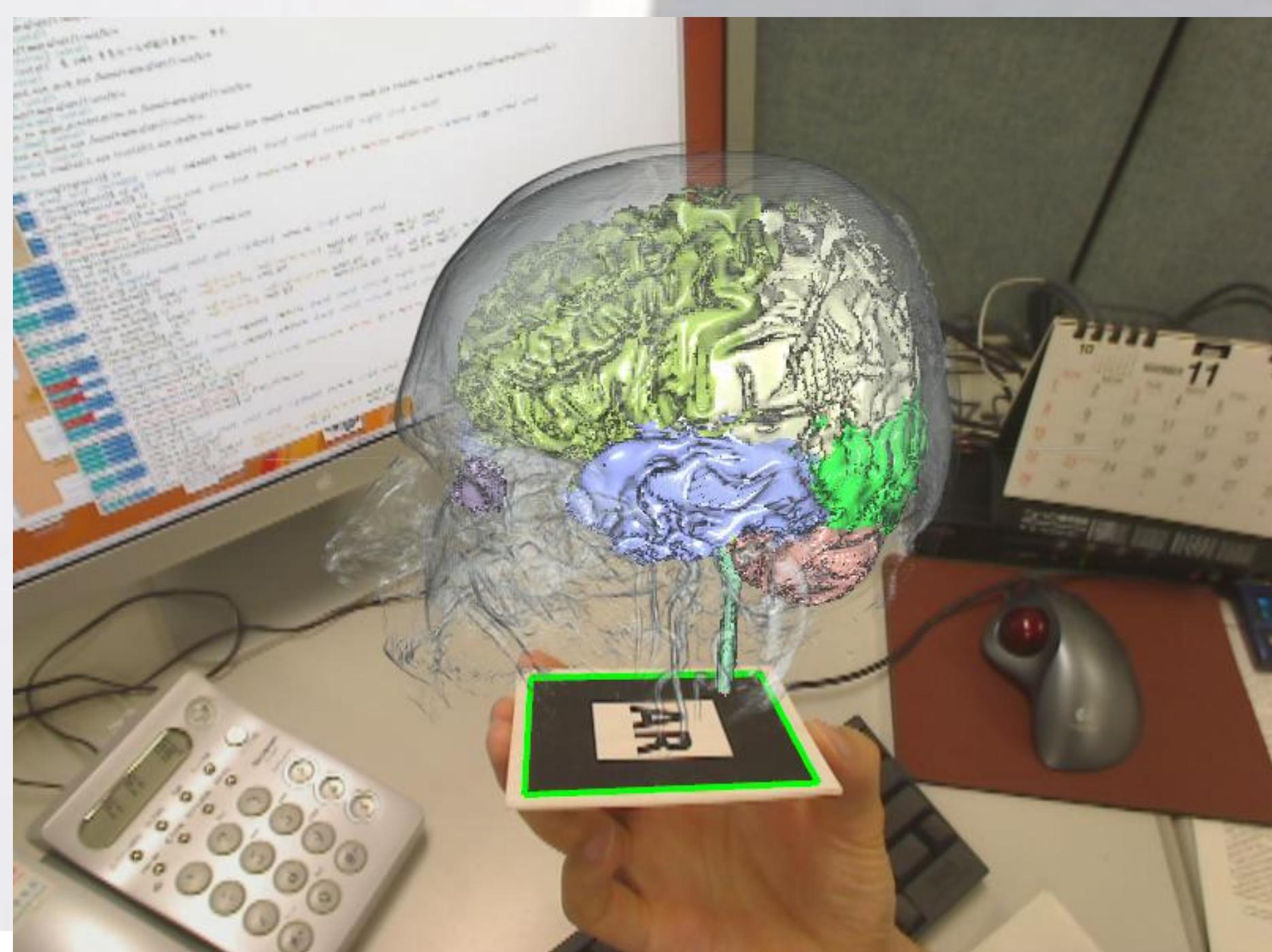


Figure 1: An example of segmentation of a human head. The user can easily extract parts of a human head by the guide of geometric features: cerebrum, cerebellum, spinal cord, and eyes. The cerebrum is further segmented to smaller parts per functionality of a human brain by the user's decision: frontal lobe, parietal lobe, occipital lobe, and temporal lobe. Such semantic segmentation without depending on geometric features can be achieved by an interactive system as we have proposed.

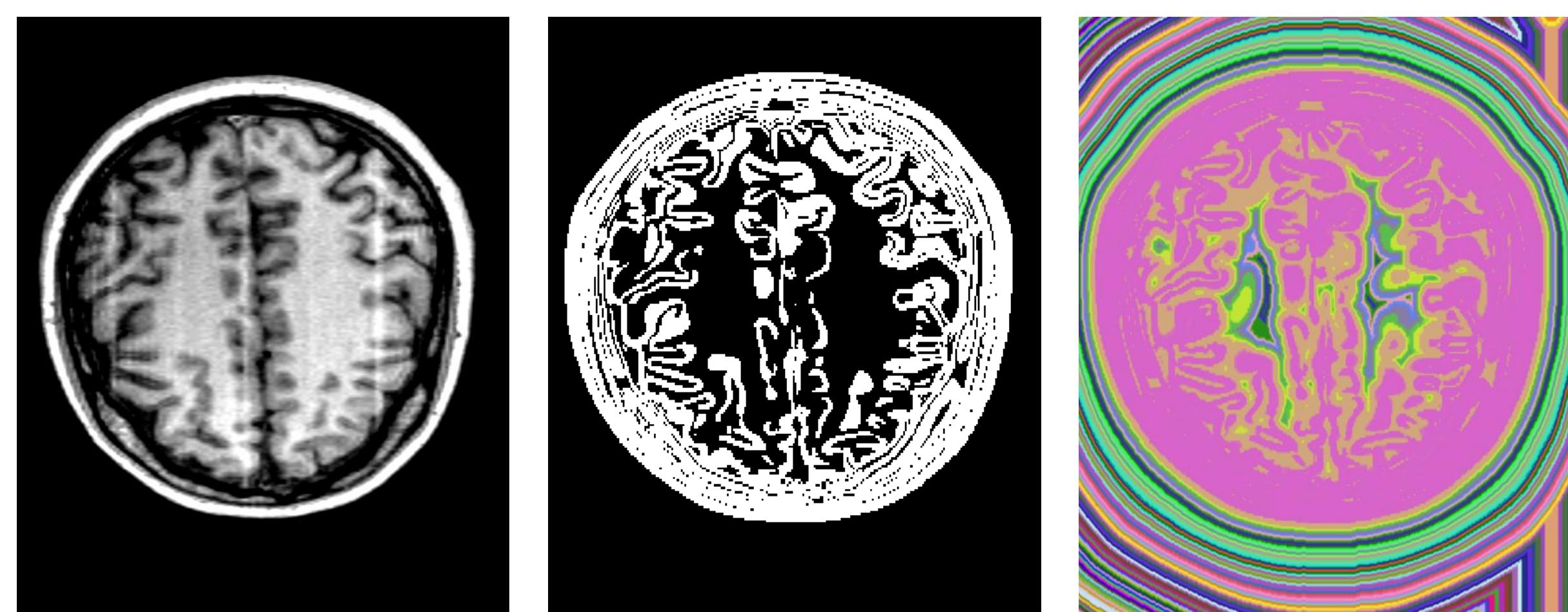


Figure 2: The cross section of a MRI volume data in the pre-process: a) input, b) binary, and c) the distance function visualized by pseudo colors.

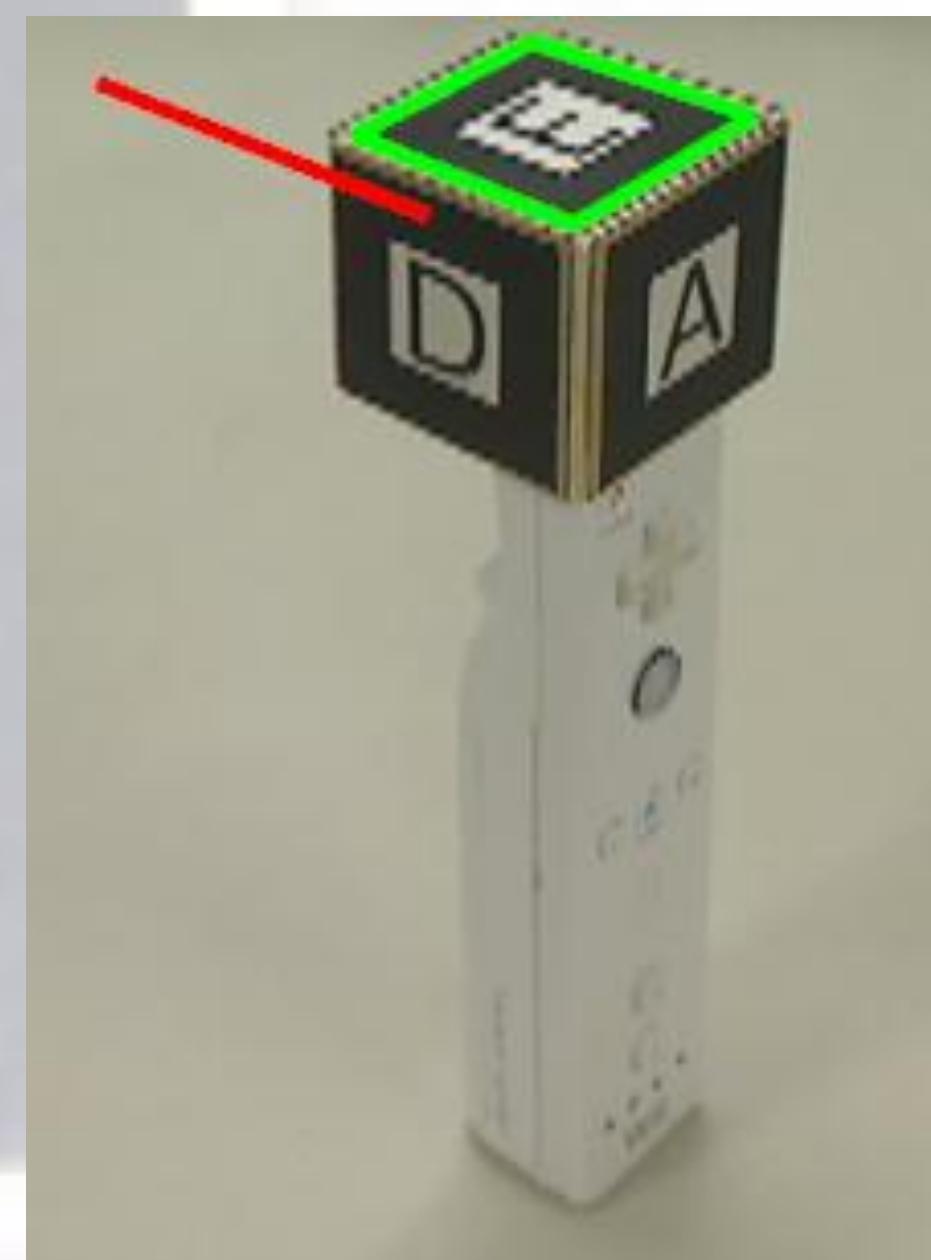


Figure 3: Our manipulator; a motion tracking cube is attached at the top of a wii remote controller. The virtual needle is drawn in the red line. The tip of the virtual needle is defined as the relative position from one of markers. The detected marker is shown as the green square.

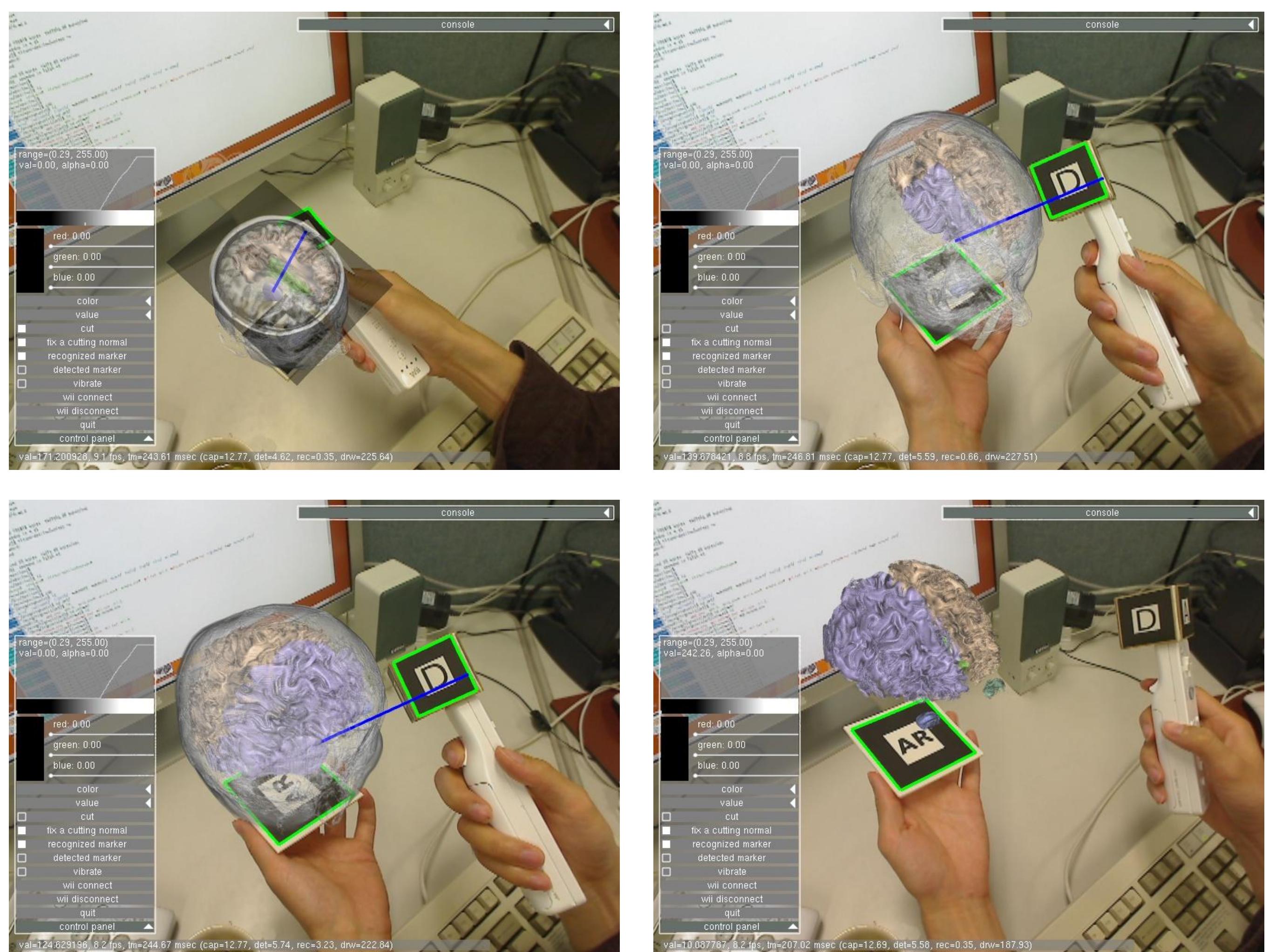


Figure 4: The image sequence of volume segmentation. The image a) shows locating a seed point. The following images represent the extraction of the right brain colored by purple.