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Brain Tumor Segmentation Through Watershed Transformation

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Abstract: The medical images of the human body get from the various sources such as CT, PET, SPECT, and MRI. Magnetic Resonance Imaging is a technique which is used to produce quality images of the human anatomy. The objective of the segmentation is to subdivide an image in to number objects which are called as Region of Interest (ROI) .In this work we use the MRI images of the human brain to recognize tumour affected area from the medical images. In this paper we have presented the watershed transformation and semiautomatic segmentation method for extracting the region of interest that is tumour affected area from the MRI images. Our method is fully semiautomatic.

Keywords: MRI, ROI, Watershed, Semiautomatic Segmentation.

I. INTRODUCTION

The arrival of medical imaging sources such as Computed tomography (CT), Positron emission tomography (PET) and magnetic resonance imaging (MRI) has improved the diagnosis of various diseases of human being. The medical image segmentation is one of the difficult tasks in the image processing and segmentation of Region of Interest may give accurate measurement or inaccurate measurement. Medical imaging is used for most of the medical applications for interpreting as well as for diagnosing purpose of various diseases related with human being. Most of the researchers use various techniques that are applied over the medical images to get the better results. In this paper we have tried to segment the tumor affected area from the medical image of the human brain, for this we have used the watershed transformation as well as the semiautomatic segmentation method to get the good result[1].

Watershed algorithm which is applied to the gradient magnitude of the MRI data. The watershed segmentation algorithm is a very powerful segmentation tool, but it also has difficulty in segmenting MR images due to noise and shading effect present. The known drawback of the watershed algorithm, over-segmentation, is strongly reduced by making the system interactive (semi-automatic), by placing markers manually in the region of interest which is the brain as well as in the background. The background markers are needed to define the external contours of the brain. The final part of the segmentation takes place once the gradient magnitudes of the MRI data are calculated and markers have been obtained from each region. Catchment's basins originate from each of the markers, resulting in a common line of separation between brain and surrounding.

A. Magnetic Resonance Imaging

A magnetic resonance imaging instrument (MRI Scanner) uses powerful magnets to polarize and excite hydrogen nuclei i.e. proton in water molecules in human tissue,

producing a detectable signal which is spatially encoded, resulting in images of the body[2]. MRI uses three electromagnetic fields I) A very strong static magnetic field to polarize the hydrogen nuclei, called the static field. II) A weaker time varying field(s) for spatial encoding called the gradient field. III) A weak radio frequency field for manipulation of hydrogen nuclei to produce measurable signals collected through RF antenna. The brain can be viewed from three directions a) Tran axial view b) Sagittal view c) Coronal View[3].

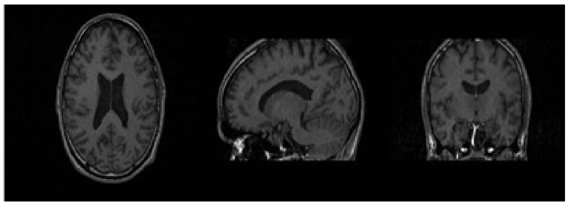


Figure 1: a) Tran axial view b) Sagittal view c) Coronal view.

II. METHODS AND MATERIALS

A. MRI Data

The MR images are acquired on a 1.5T using T2-weighted axial contrast images.

B. MRI Images

The source for the MRI images is Human Brain Atlases (HBA) from where we collect various images of the normal human brain images as well as disease affected human brain images. We have collected all T1-weighted MRI images for the image processing and to segment the correct and accurate region of interest from the Medical images. All these images are collected in coronal view direction different slices are used for the experimental work[4].

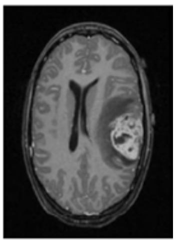


Figure.2 Tumor affected Brain Image

C. Preprocessing

Image preprocessing is the very first step in the image processing. In this process the image is Converted into the accessible form. Also image “intensity adjustment” and “noise reduction” processes are carried out. After this the Gaussian image filtering is performed. Filtering is necessary because it reduces the noise present in the image[5].

D. Watershed Transformation

Watershed by flooding

It consists in placing a water source in each regional minimum, to flood the relief from sources, and build barriers when different sources are meeting. The resulting set of barriers constitutes a watershed by flooding[6].

Watershed by topographic distance

Intuitively, a drop of water falling on a topographic relief flows most rapidly toward a minimum. The previous definition does not verify this condition.

Inter-pixel watershed

1. Label each minimum with a distinct label. Initialize a set S with the labeled nodes.
2. Extract from S a node x of minimal altitude F, that is to say F(x) = min{F(y)|y in S}. Attribute the label of x to each non labeled node y adjacent to x, and insert y in S.
3. Repeat Step 2. Until S is empty[7].

The spontaneous idea underlying the watershed notion comes from the field of topography: a drop of water falling on a relief follows a descending path and eventually reaches a minimum. Watershed lines are the divide lines of the domains of attraction of drops of water. This intuitive approach is not well suited to practical implementations, and can yield biased results in some cases. An alternative approach is to imagine the surface being immersed in a lake, with holes pierced in local minima. Water will fill up basins starting at these local minima, and, at points where waters coming from different basins would meet, dams are built. As a result, the surface is partitioned into regions or basins separated by dams, called watershed lines.
Segmentation using the watershed transforms works well if you can identify, or "mark," foreground objects and background locations. Marker-controlled watershed segmentation follows this basic procedure:

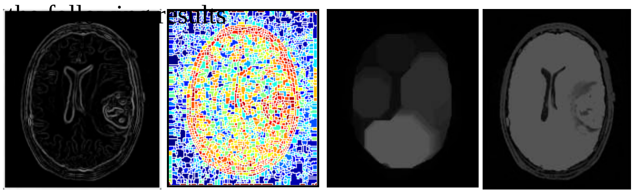
1. Compute a segmentation function.
2. Compute foreground markers. These are connected blobs of pixels within each of the objects.
3. Compute background markers. These are pixels that are not part of any object.
4. Modify the segmentation function so that it only has minima at the foreground and background marker locations.
5. Compute the watershed transform of the modified segmentation function.

E. Finding Region of Interest

In the given medical image of the human brain we have to select the tumor affected area and for this purpose we use the semiautomatic segmentation technique in which the user outlines the region of interest with the mouse clicks and particular algorithm is applied so that the path that best fits the edge of the image is shown.

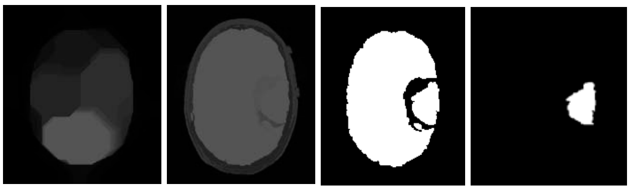
III. RESULTS

When we apply the watershed transformation method as well as the semiautomatic segmentation technique we get the following results



(a) *(b)* *(c)* *(d)*

Figure2: a) Gradient magnitude of an image
b) Watershed image
c) Foreground Markers of an image
d) Opening-by-reconstruction image



(a) *(b)* *(c)* *(d)*

Figure 3: a) Closing-by-reconstruction image
b) Complement reconstructed image
c) Use Regional-maxima for best foreground markers
d) Region of Interest

IV. CONCLUSION

In this paper we have presented the watershed transformation method as well as the semiautomatic segmentation technique to find out the region of interest (ROI) that is tumor affected area from the given MRI image. We have used only semiautomatic segmentation technique in which human interaction is needed but it is also possible to convert this technique as a fully-automatic.

V. REFERENCES

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