

# Survey on MRI Image Segmentation Techniques for Brain Tumor Detection

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**Abstract:** - This survey focuses on techniques available for MRI image segmentation for brain tumor detection using computer assisted image processing algorithms. The need of automated and or semi-automated tumor detection is highly regarded and required as the technology is progressing and the cases of brain tumors and edema are rising. The current technologies and available methods are reviewed in this paper.

**Index Terms**—Image segmentation, watershed transformation, wavelet algorithm, self organizing map..

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## I. INTRODUCTION

Scientific imaging has been valuable on the grounds that the graduation of modern scientific age when the X-Rays had been found out and their medical applications were formulated and utilized. After that, many new technologies in clinical imaging emerged [1]. These were computer Tomography (CT), Magnetic Resonance Imaging (MRI), and Ultrasonic Imaging and many others. All these applied sciences had ended in a new area of prognosis situated on imaging [1] [2]. Such diagnosis can be categorised as biomedical picture centered diagnosis. X-Ray, MRI, CT and many different imaging technologies exist with one-of-a-kind focal point of prognosis. For example, X-Rays are most often used for imaging related to orthopaedics whilst MRI and CT images are used for prognosis regarding tumors and brain mapping as well. MRI is centered upon the science of nuclear magnetic resonance (NMR). Detailed atomic nuclei can take in and emit radio frequency vigour when placed in an outside magnetic area [3]. In clinical and research MRI, hydrogen atoms are most-regularly used to generate a detectable radio-frequency sign that's got by using antennas in close proximity to the anatomy being examined. Hydrogen atoms exist naturally in people and different biological organisms in abundance, exceptionally in water and fats. Consequently, most MRI scans almost map the area of water and fat within the physique. Pulses of radio waves excite the nuclear spin energy transition, and magnetic area gradients localize the signal in house. By means of various the parameters of the heartbeat sequence, specific contrasts

may also be generated between tissues situated on the leisure properties of the hydrogen atoms therein [5]. Considering that its early progress in the Seventies and Nineteen Eighties, MRI has confirmed to be a tremendously versatile imaging system..

MRI has a large variety of functions in clinical prognosis and over 25,000 scanners are estimated to be in use international [6]. MRI affects analysis and remedy in many specialties even though the effect on accelerated well being outcomes is uncertain [7]. On the grounds that MRI does no longer use any ionizing radiation, its use is mainly favoured in option to CT when both modality could yield the identical knowledge [8].

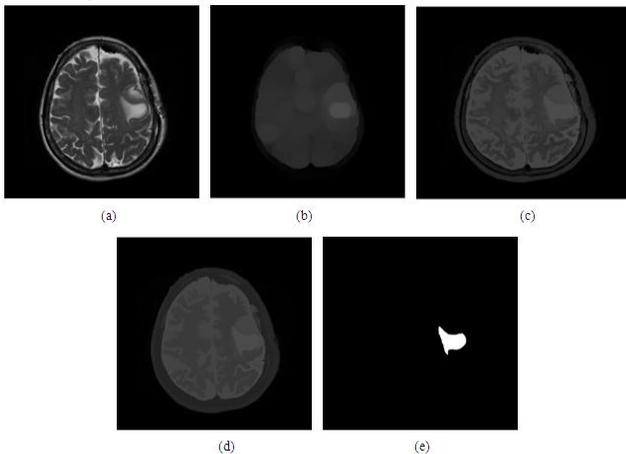
The main goal of image segmentation is to partition an picture into mutually distinct regions such that every region is spatially contiguous and the pixels inside the vicinity are homogeneous with appreciate to a predefined criterion [8].

In brain tumor experiences, the existence of abnormal tissues is also easily detectable as a rule. Nonetheless, correct and reproducible segmentation and characterization of abnormalities will not be simple [9].

## II. WATERSHED ALGORITHM

In the study of image processing a watershed of a grayscale image is analogous to the thought of a catchment basin of a height-map. In brief, a drop of water following the gradient of an photograph flows alongside a course to subsequently attain a local minimum. Intuitively, the watershed of a comfort correspond to the boundaries of the adjoining catchment basins of the drops of water. The term

watershed refers to a ridge that divides areas drained by using distinct river systems. A catchment basin is the geographical area draining right into a river or reservoir. So how are watersheds and catchment basins regarding examining organic tissue, studying galaxies, or gaining knowledge of new semiconductor science [10].



(a) Original image, (b) using opening function, (c) reconstruct by opening, (d) after apply opening by closing reconstruct, (e) the result after segment the image

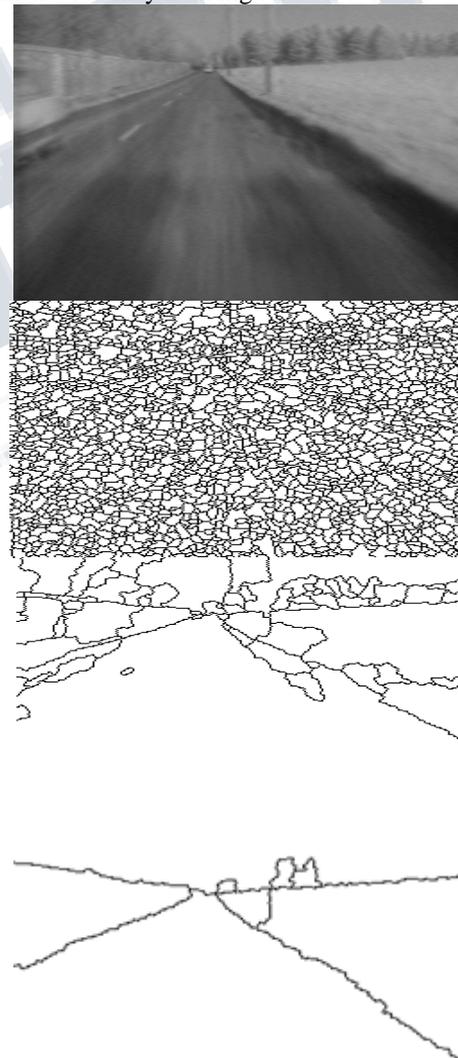
D. Jayadevappa[11] medical photograph segmentation offers with segmentation of tumor in CT and MR graphics for accelerated first-class in scientific diagnosis. Geometric Vector glide (GVF) enhances the concave object extraction potential. Nonetheless, it suffers from high computational requirement and sensitiveness to noise. This paper intends to mix watershed algorithm with GVF snake model to scale back the computational complexity, to support the insensitiveness to noise, and capture variety. Notably, the image shall be segmented firstly through watershed algorithm after which the sides produced will be the initial contour of GVF model. This enhances the tumor boundaries and tuning the regulating parameters of the GVF snake mode via coupling the smoothness of the threshold map got due to watershed algorithm. The proposed procedure is when put next with recent hybrid segmentation algorithm based on watershed and balloon snake. Superiority of the proposed work is found in terms of capture variety, concave object extraction capacity, sensitivity to noise, computational complexity, and segmentation accuracy.

Anam Mustaqem[12] during prior few years, brain tumor segmentation in magnetic resonance imaging (MRI) has emerge as an emergent research discipline in the discipline of scientific imaging system. Brain tumor

detection helps in finding the particular measurement and place of tumor. An effective algorithm is proposed in this paper for tumor detection centered on segmentation and morphological operators. Firstly exceptional of scanned image is greater and then morphological operators are utilized to notice the tumor in the scanned picture.

**Disadvantage of Watershed Transform**

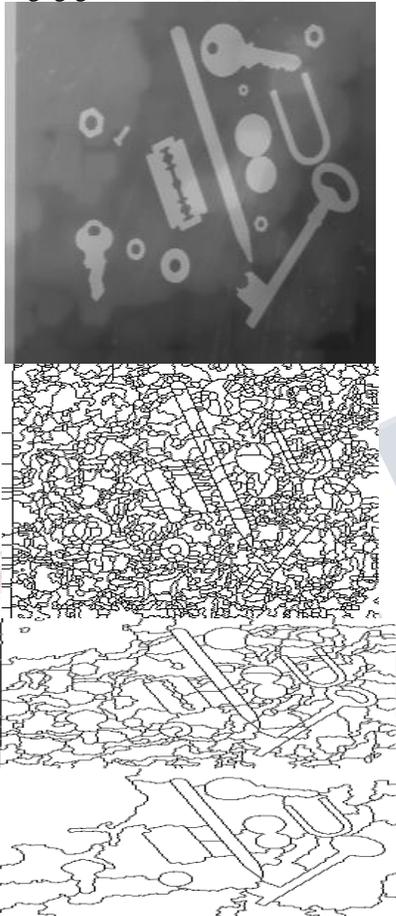
The primary disadvantage of the Watershed grow to be is that for many usual pix it produces excessive over segmentation. The primary one comes from the fact that it's complex to discover a "good" degree of hierarchy. Very in general, the first level of hierarchy dramatically enhances the segmentation by way of disposing of plenty of non tremendous contours, however it's not consistently ample. If the Waterfalls grow to be is utilized once more, the brand new segmentation may look higher... Or worse...



Successive levels of hierarchy of the gradient watershed of

*the left image. Does level 2 (third image) seem better?*

The second predicament is even more severe. When applying successive Waterfalls transforms, the intermediary levels of hierarchy received before the process ends with the empty set are generally strange with, certainly, non giant contours that are removed but additionally, and it's rather disturbing, gigantic ones [13].

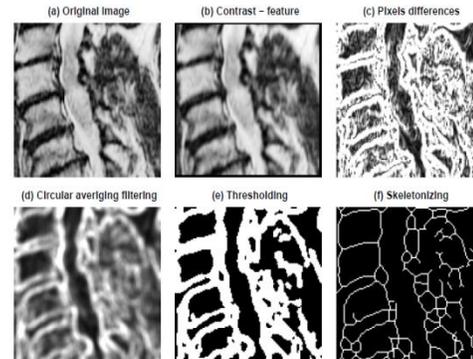


*Successive levels of hierarchy produced by successive Waterfalls transformations*

### III. WAVELET ALGORITHM

A wavelet is a wave-like oscillation with amplitude that begins at zero, increases, after which decreases back to zero. It will possibly almost always be visualized as a "brief oscillation" like one could see recorded by a seismograph or coronary heart screen. Probably, wavelets are purposefully crafted to have specified properties that make them useful for sign processing. Wavelets can be mixed, utilising a "reverse, shift, multiply and integrate" method known as

convolution, with parts of a known signal to extract information from the unknown sign [14].



*Wavelet based image segmentation involves all the segmentation steps using the Contrast Feature*

R Mishra [15] Magnetic Resonance Imaging (MRI) is a non-invasive technique for assessing abnormalities of tissue composition. The objective of the paper is to advance an educated method which is able to diagnose mind Tumor with the absolute best accuracy using synthetic neural network. After extracting facets from MRI knowledge utilising wavelet packets, we use artificial neural networks to determine the irregular and traditional spectra. The abilities of wavelet packets is that it offers richest analysis compared with the wavelet transforms there by means of including benefits to the efficiency of the procedure. Two cancer detection tactics were discussed on this paper founded on which the conclusion is drawn. Error again Propagation training studying rule is used to educate the neural community system.

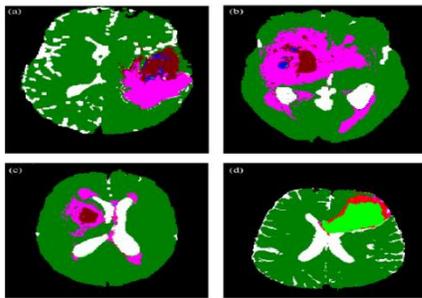
Stavros A. Karkanis [16] This scheme is constructed on the wavelet decomposition. The facets named as color wavelet covariance (CWC) are situated on the covariances of second-order textural measures and an premier subset of them is proposed after the applying of a resolution algorithm. The proposed method is supported with the aid of a linear discriminant evaluation (LDA) procedure for the characterization of the photo regions along the video frames. The entire methodology has been applied n actual information units of color colonoscopic movies.

The essential drawbacks are [17]:

- ♣ for quality evaluation, it turns into computationally intensive
- ♣ its discretization, the discrete wavelet turn out to be (comp. Efficient), is less efficient and natural
- ♣ it take some power to invest in wavelets to turn out to be ready to opt for the proper ones for a distinctive intent, and to put in force it correctly.

#### IV. SELF ORGANISING MAP (SOM) ALGORITHM

A Self-organizing Map is an information visualization procedure developed by using Professor Teuvo Kohonen within the early 1980's. SOMs map multidimensional data onto scale back dimensional subspaces the place geometric relationships between elements indicate their similarity. A self-organizing map (SOM) or self-organising feature map (SOFM) is a sort of artificial neural community (ANN) that's knowledgeable using unsupervised finding out to produce a low-dimensional (traditionally two-dimensional), discretized representation of the enter area of the educational samples, referred to as a map. [18].



The segmentation outcome of SOM: (a–c) excessive grade tumor; (d) low grade tumor. Darkish crimson: excessive grade tumor, gentle crimson: low grade tumor, mild green: cystic part of tumor, violet: edema, blue: necrosis, darkish green: ordinary tissue (white + gray matter), white: CSF.

C. Vijayakumar [19] An accurate pc-assisted process to perform segmentation of brain tumor on obvious diffusion coefficient (ADC) pictures and review its grade (malignancy state) has been designed utilising a combination of unsupervised artificial neural networks (ANN) and hierarchical multiresolution wavelet. First of all, the ADC snap shots are decomposed with the aid of multiresolution wavelets, which might be due to this fact selectively reconstructed to form wavelet filtered photos. These wavelet filtered images together with aptitude and T2 weighted images were utilized because the aspects to unsupervised neural network – self organizing maps (SOM) – to phase the tumor, edema, necrosis, CSF and traditional tissue and grade the malignant state of the tumor. The influence sshows that the SOM performs good in differentiating the tumor, edema, necrosis, CSF and typical tissue sample vectors on ADC portraits. The outcome are validated against manually segmented pictures and sensitivity and the specificity are found to be zero.86 and nil.93, respectively.

T. Logeswari [20] image segmentation denotes a method of partitioning an image into certain areas. In this paper, a clustering centered method utilising a Self Organizing Map

(SOM) algorithm is proposed for clinical picture segmentation . This paper describe segmentation procedure consists of two phases. In the first section, the MRI mind photo is acquired from sufferer database. In that movie artifact and noise are eliminated. In the second section (MR) image segmentation is to adequately establish the major tissue constructions in these snapshot volumes. A brand new unsupervised MR picture segmentation process situated on fuzzy C-approach clustering algorithm for the Segmentation is presented.

#### *Disadvantages of SOM Algorithm [21]:*

##### 1. Drawbacks

- bad organization
- bad visualization
- too unbalanced classes
- strong dependence of the initialization.

#### V. CONCLUSION

In this paper, we focused on the various techniques used for the segmentation of brain tumor region. This survey focuses on techniques available for MRI image segmentation for brain tumor detection using computer assisted image processing algorithms. Our main emphasis is mainly on watershed segmentation technique, wavelet segmentation technique and self-organizing map (SOM) segmentation technique. Every method has its drawback in some techniques the region is over segmented, difficult to maintain hierarchy, bad visualization, and not preferable for fine analysis, these are only few examples. We have studied various techniques and we need to develop a better algorithm to address these issues. This will be our future work.

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