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A SURVEY ON ALZHEIMER DISEASE IDENTIFICATION USING SEGMENTATION TECHNIQUES

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Abstract

Image segmentation is a critical field of research in medical engineering. Segmented brain images are used to assess volume and statistically analyze anatomical and cortical components. Because of advances in Magnetic Resonance Imaging, segmented brain tissues provide an anatomical framework for visualization, with potential uses in neuro-science research and neurosurgery planning (MRI). The technique of separating pixels into discrete sections is known as segmentation. At a higher level, these regions may be recognized as anatomical structures and then aggregated over several slices to offer three-dimensional descriptions of these structures. This article reviews 25 research papers for Alzheimer disease segmentation and explores the potential of computer-assisted methods for Alzheimer disease and staging. This method is useful at segmenting the brain without the need of humans and accurately recognizing differences in the brain's overall volume or size. The goal of this investigation is to detect any minor changes in brain volume.

Keywords: Alzheimer Disease, MRI, Segmentation

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I Introduction

Image processing applications, notably in medical imaging Among the many imaging modalities are X-rays, CT scans, and MRIs, to mention a few, which image bodily components and provide a general view of the inside organs [1]. The ill or affected organs of interest must be segmented and separated from the rest for better understanding and investigation. The tiniest region of interest may be emphasized with extensive information using segmentation techniques [2-8]. The vast majority of segmentation methods are completely or partly automated. Brain segmentation is a topic that has piqued the curiosity of scientists. Human brain image segmentation is critical for monitoring volumetric changes inside the brain. MRI generates a large amount of data, a series of 2D images that need extensive processing. When the images reflect the brain of an illness, the computational complexity rises [9-13]. Segmentation and volumetric analysis are used to diagnose multiple sclerosis, stroke, and Alzheimer's disease. Changes in white matter (WM), grey matter (GM), and cerebrospinal fluid (CSF) volume are essential for accurate identification of these disorders (CSF) [14-18].

Alzheimer's disease (AD) is a progressive, irreversible brain degeneration disease characterised by memory loss and cognitive impairment. Approximately 90 million people have been diagnosed with Alzheimer's disease, and the number of AD sufferers is expected to reach 300 million by 2050. There are currently no effective medical therapy for Alzheimer's disease, and existing Alzheimer's drugs can only relieve symptoms or slow the progression of the illness. As a result, early or prodromal detection of Alzheimer's disease is critical for preventing and treating its progression. For example, mild cognitive impairment (MCI) is a risk factor for Alzheimer's disease (AD). Over the past few decades, neuroimaging technologies have been widely exploited to find significant biomarkers in the human brain for AD and MCI diagnosis. Magnetic resonance imaging (MRI) is a non-invasive imaging technique that may produce detailed 3D anatomical images of inner body organs such as the brain. It has been widely utilised to help us understand the morphological and functional brain alterations associated with Alzheimer's disease.

This article offers a comprehensive strategy for managing the intensity variations of pixels. The goal of this study is to develop an affordable and practical method of diagnosing and

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treating Alzheimer's disease that can be used by neurologists and other medical professionals. Alzheimer's disease causes dementia in about 40% of the older population, producing great social anxiety. Eleven instances of early Alzheimer's disease were found in a research [1] of 103 old people between the ages of 60 and 80 who met the criteria for the disease. Since early treatment may slow the disease's progression, identifying Alzheimer's in its earliest stages is crucial. In the early stages of the disease, memory impairment and cognitive loss are quite modest and unrecognised.

2. Background study

Liu, M.et al. (2020) Based on multi-model deep CNNs, the author proposed a new classification framework for hippocampal segmentation and disease categorization. Initially, a multi-task deep CNN model was created to uncover features for hippocampal segmentation and sickness classification at the same time. The proposed approach may provide the result of hippocampal segmentation in addition to giving the sickness condition.. The experimental results based on the ADNI dataset demonstrated that these author proposed technique for diagnosing AD and MCI performed well.

Shanthi, K. J.et al. (2013) This article discusses serial segmentation, which was the process of segmenting images progressively.. The present study might be extended by discovering the three-dimensional link and removing all cortical tissues. This method has the potential to improve the algorithm's speed-related efficiency. Currently, the accuracy of the SRG approach was determined by the number of iterations.

Rangini, M., & Jiji, G. W. (2013) In the majority of the experiments provided in this study, AdaBoost and Ada-SVM surpass FreeSurferr. The generalizability of the methodologies shown here as a function of the MRI acquisition parameters was an attractive area for further investigation. While this was fascinating, it was already relevant to large-scale studies with constant scanning settings, where one may manually separate 20 brains for training purposes and then automatically segment the remaining.

Lazli, L. et al. (2018) This article's main contribution was an improved CAD system for the early identification of Alzheimer's disease. The approach uses two phases to distinguish

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Alzheimer's patients from healthy people: tissue segmentation based on a hybrid fuzzy-possibilistic algorithm and image classification using SVM.

S.No.	Author	Techniques/Algorithm Used	Merits
1	Khadidos et al., (2017)	Medical Image Segmentation	Accurate boundary Detection
2	Qian and Weng (2016)	The Fuzzy C-Means (FCM) and the Level Set algorithm	Feasible solution
3	Li et al., (2016)	Fuzzy, selective image Segmentation	Detects and track any arbitrary combination of the components of image
4	Dhanalakshmi et al., (2016)	Spatial fuzzy segmentation with a modified PSO (MPSO)	Performs well when noise and other artefacts were being presented
5	Harikumar and Kumar (2015)	Modified Expectation Maximization (MEM) and PSO	Best method for edge detection of the medical images

Yadav *et al*. (2016) based on threshold and morphological techniques, suggested a unique method for segmenting Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) images. Brain MRI and CT Angiography were being used to verify the proposed approach. There was evidence that this technique was preferable to prior approaches, based on criteria such as accuracy and thoroughness.

Khadidos *et al*. (2017) created an innovative technique for medical image segmentation based on active contours. The proposed technique makes use of an alternative level set development based on the energy minimization of the objective's energy terms, which have been weighted based on their reputation in border detection. This method was used to segment areas in original MRI, CT, ultrasound, and X-ray images. Experiment results show that the proposed strategy outperforms state-of-the-art edge-based level set segmentation techniques, especially around weak edges, by obtaining more exact boundary detectio.

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Qian,Weng (2016) introduced a medical imaging segmentation approach based on Fuzzy C-Means (FCM) and the Level Set algorithm. The FCM approach was thought suitable for resolving difficulties with fuzzy and unclear grey level images. The targets were segmented correctly after numerous rounds of level setups. The method has been tested on various photographs. Experiment results demonstrated that the proposed approach for image segmentation utilising the FCM and Level Set algorithms will be feasible and successful.

Sharma, Sungheetha (2017) More attention was made on successfully categorising brain tumour images and segmenting them from images of current sickness utilising a number of methodologies. The fundamental issues and aims of feature extraction, image classification, and image segmentation for medical images have been investigated.

Author Name	Techniques Used	Merits	Merits
Yang et al. (2015)	Waveletenergy based approach and BBO	To optimize the weights of the SVM	Abnormal brains
Zhang et al. (2015)	PBD, WPTE and FSVM	Tsallis entropy performs better than Shannon entropy and the proposed method WPTE + FSVM was effective in PBD.	PBD problem
Rajalakshmi & LakshmiPrabha (2015)	IGSFFS and MC-SVM	Performs better cluster partition in brain tumor datasets	Local optima problems
Shanthi & Karthikeyan (2016)	MRI, Gabor filter, Optimal filter and CS	Improved performance of the machine learning process.	NP hard Problem
Yazdani & Jolai (2016)	Lion Optimization	Special lifestyle of lions and their	Computational Complexity

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	Algorithm	cooperation characteristics were used in this method	
Kaboli et al (2017)	Rain-fall Optimization Algorithm	Rain-fall deals with raindrops during an optimization process	-

Lapuyade-Lahorgue *et al*. (2017) The idea was for a multisource fusion approach based on the Gaussian copula. This proposed fusion model was part of a statistical framework that use hidden Markov field inference to outline a target volume using a multisource image. Tumors were segmented using an iterative approach based on Gibbs sampling on a multisequence MRI. The results revealed that the Gaussian copula-based image segmentation strategy was more effective.

Taie,Ghonaim (2017) Furthermore, an automated framework for brain tumour identification was built, which would detect and categorise the tumour as well as distinguish between persons diagnosed with brain tumours that indicate the disease's progression. The first findings of the proposed system demonstrate the system's effectiveness and utility for categorising brain tumours in magnetic resonance imaging (MRI) and encourage the system's applicability to additional tumour types.

3. Discussion

We proposed and validated a new method for fully automated segmentation of white matter hyper intensities (WMHs) from MR images. The proposed method makes use of a number of location and intensity-based variables, as well as a linear regression methodology, to generate a continuous output that can be interpreted as a subject-specific probability map of lesions, which can then be threshold to generate binary WMH segmentations. The advantage of subject-specific continuous WMH maps over binary segmentations is that they may be threshold with different values, balancing the desired degree of sensitivity and specificity dependent on the objective of the segmentation. Furthermore, such lesion probability maps may provide more

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information about the voxel tissue than a simple binary valued segmentation; for example, lesion probabilities may be utilised to differentiate between dirty and healthy white matter tissue. Because higher WMH intensities are linked with more extensive cognitive impairments, these continuous values may indicate the amount of tissue damage.

4. Conclusion

The method proposed in this study is technologically advanced for detecting Alzheimer's disease utilising FMRI images of the brain. The recommended procedure diagnoses in stages. First order grey level parameters, multiscale features, textural measures, and moment invariant features are employed for feature extraction. Categorization is based on the derived ADFMRI image features. The ANFIS (Adaptive Neuro Fuzzy Inference System) classifier is used in the proposed system's classification phase to classify FMRI images as malignant or benign. Once the pictures have been identified to be cancerous, they are segmented section extracted. During the segmentation process, the Alzheimer's disease is retrieved. The multistage step comes before the segmentation phase. All experiments show that the proposed technique outperforms previously existing segmentation and classification algorithms. The approach achieved 98% classification accuracy and exceptionally accurate segmentation results, allowing the Alzheimer's disease region to be readily extracted from FMRI brain images.

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