DESIGN AND DEVELOPMENT OF A COMPUTER-BASED AUTOMATED SYSTEM FOR BRAIN TUMOR SEGMENTATION

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Abstract- The research study focuses on diagnosing brain tumors from medical images using a combination of image processing and machine learning techniques. Early detection of brain tumors is crucial for improving the chances of patient survival. The study is organized into five chapters, each addressing a specific aspect of the research.

Chapter 1 functions as an introductory section, offering a comprehensive view of the problem domain. It succinctly outlines the motivation driving this study, followed by an exploration of diverse information concerning the brain and brain tumors. Additionally, it elucidates the importance of early tumor detection and delineates the associated challenges. Finally, a proposed work plan is outlined in this chapter.

In Chapter 2, the focus is on the preparatory procedures for MRI (Magnetic Resonance Imaging) and CT (Computed Tomography) images. These processes encompass various methods, such as eliminating background, refining images through enhancement, and removing the skull. The removal of the background serves to eliminate extraneous information, while enhancement techniques work to elevate the overall image quality. The objective of skull stripping is to isolate the brain region by separating it from the surrounding structures. An innovative method involving generating an ellipse-based mask for Head Masking has been proposed. Moreover, the use of the Distance-versus-Angle feature is implemented to distinguish CT images that lack a patient table structure in the CT slice. In the case of contrast enhancement, a straightforward geometric transformation is employed on the sectional Gamma-transformation mapping graphs. As for skull stripping, the approach involves applying adaptive intensity slicing and iterative morphology.

In Chapter 3, the approaches employed for the identification and delineation of tumors are examined. These algorithms carefully analyze the pre-processed images to identify regions that potentially contain tumors. To enhance the accuracy of tumor detection and segmentation, a variety of techniques are employed, spanning conventional image processing methods and machine learning approaches. A novel method of feature extraction, specifically the ”Expanded Local Histogram,” is introduced for tumor detection. Additionally, two inventive thresholding approaches, namely ”Peak Difference” and

"Least Center Distance," are proposed for tumor segmentation. Furthermore, an original super-pixel classification method is suggested for the segmentation of tumors in both CT and MRI images.

Chapter 4 delves into the outcomes of the implemented algorithms. A comprehensive evaluation is conducted, comparing the proposed methods with cutting-edge techniques to demonstrate their efficacy. This section underscores the significant impact of the proposed algorithms, emphasizing their accuracy and potential to enhance patient outcomes. The introduced head masking achieves an average Jaccard coefficient value of 94% for MRI images and 93.4% for CT images. The patient table detection algorithm exhibits a remarkable accuracy of 99.4%. The proposed contrast enhancement method not only outperforms comparable methods in contrast value but also maintains a high correlation of 98% and the maximum entropy value. The skull stripping method proposed attains an accuracy of 97% for MRI images and approximately 99% for CT images. In the realm of tumor detection, the proposed method achieves accuracy rates of up to 99% for MRI images and 100% for CT images. The tumor segmentation, employing the peak difference threshold, demonstrates an accuracy of 95.63%, while the Least Center Distance (LCD) method achieves 96.64% accuracy. The superpixel classification method attains over 99% accuracy for MRI images and 98.64% for CT images.

Finally, the conclusive outcomes of the proposed methods, limitations, and future scope have been discussed in Chapter 5.

Overall, the research study aims to contribute to the field of brain tumor diagnosis by introducing a set of algorithms for medical image enhancement, skull stripping, tumor detection, and tumor segmentation. The proposed methods utilize both traditional image processing strategies and machine learning approaches. The results and comparisons provided in the study help evaluate the effectiveness of these algorithms in enhancing early tumor detection and, consequently, increasing the possibility of patient survival

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