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Medical Image Analysis and Visualization Using Image Processing.

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Abstract: *Brain tumor segmentation is a critical task in medical image analysis, aimed at improving the accuracy of diagnosis and aiding in treatment planning. This project proposes a hybrid technique combining classical image processing and machine learning to segment brain tumors from MRI scans. A marker-based Watershed algorithm is used for segmentation by interpreting the image as a topographic map, where pixel intensities define elevations. Preprocessing steps such as Gaussian filtering, histogram equalization, and skull stripping are applied to enhance image quality and highlight tumor regions. Foreground and background markers are generated using Otsu's thresholding and morphological operations, guiding the Watershed algorithm for precise segmentation.*

To improve classification accuracy, the system initially utilizes a Support Vector Machine (SVM) model but highlights the superior performance of Convolutional Neural Networks (CNNs) for more reliable results. The goal is to automate brain tumor segmentation to assist radiologists in achieving faster, more accurate diagnoses. The proposed method also aims to integrate with existing medical imaging systems to allow real-time analysis and decision-making, ultimately enhancing patient care.

Despite the traditional success of Support Vector Machines (SVMs) in classification, this project highlights their limited performance in complex tumor structures. Alternatively, Convolutional Neural Networks (CNNs) demonstrate significantly higher accuracy in learning tumor features from medical images. The system thus provides a comparative analysis between SVM and CNN approaches, emphasizing the importance of deep learning in medical diagnosis.

This project not only improves segmentation accuracy but also proposes integration with existing PACS (Picture Archiving and Communication Systems) to support real-time clinical workflows. The ultimate objective is to provide a fast, accurate, and intelligent diagnostic tool to assist radiologists and healthcare professionals in delivering better patient outcomes...

Keywords: Brain Tumor Segmentation, MRI, Watershed Algorithm, Marker-Based Segmentation, Gaussian Filtering, Histogram Equalization, Otsu's Thresholding, Morphological Operations, SVM, CNN, Deep Learning, Image Processing, Medical Imaging, Skull Stripping, Automated Diagnosis