Volumetric Segmentation and Multimodal Classification of Brain Tumors Using Point Sampling and 3D CNNs

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Timely detection of brain tumors is vital in increasing a patient's chance of recovery. Magnetic resonance imaging (MRI) Segmentation is used to detect and diagnose brain tumors, traditionally Brain MRI's are divided into 2-D 'slices' which are then annotated manually by a radiologist. As MRIs may contain over a hundred slices, however, manual segmentation is a time-consuming task and not very efficient, while maintaining a spatial sense of the tumor segmentation becomes impractical when the segmentation tool is limited to 2-D slice-based views. This project aims to design an efficient framework for brain tumor segmentation and classification using deep learning techniques. It employs voxel-based segmentation on a point cloud generated with a saliency attention map of the MRI images, followed by the classification of the tumor using CNNs into GD-Enhancing, Necrotic Core, Peritumoral Edema and tumor-free regions. A minimalistic interface is designed for the classification of tumors, making it easily accessible to gain insight into the nature and magnitude of the tumor. Furthermore, its efficient execution speed and impressive accuracy given the size of the dataset positions it as a potentially more effective decision-support tool for radiologists in medical diagnostics than other DL methods. This project highlights the promise of leveraging a novel point-based neural network in the classification and volumetric segmentation of brain tumors. The presented model stands out for its time efficiency, robust performance, and potential as a valuable tool for tumor radiologists.