Brain Segmentation from Medical Images for Guided Surgery

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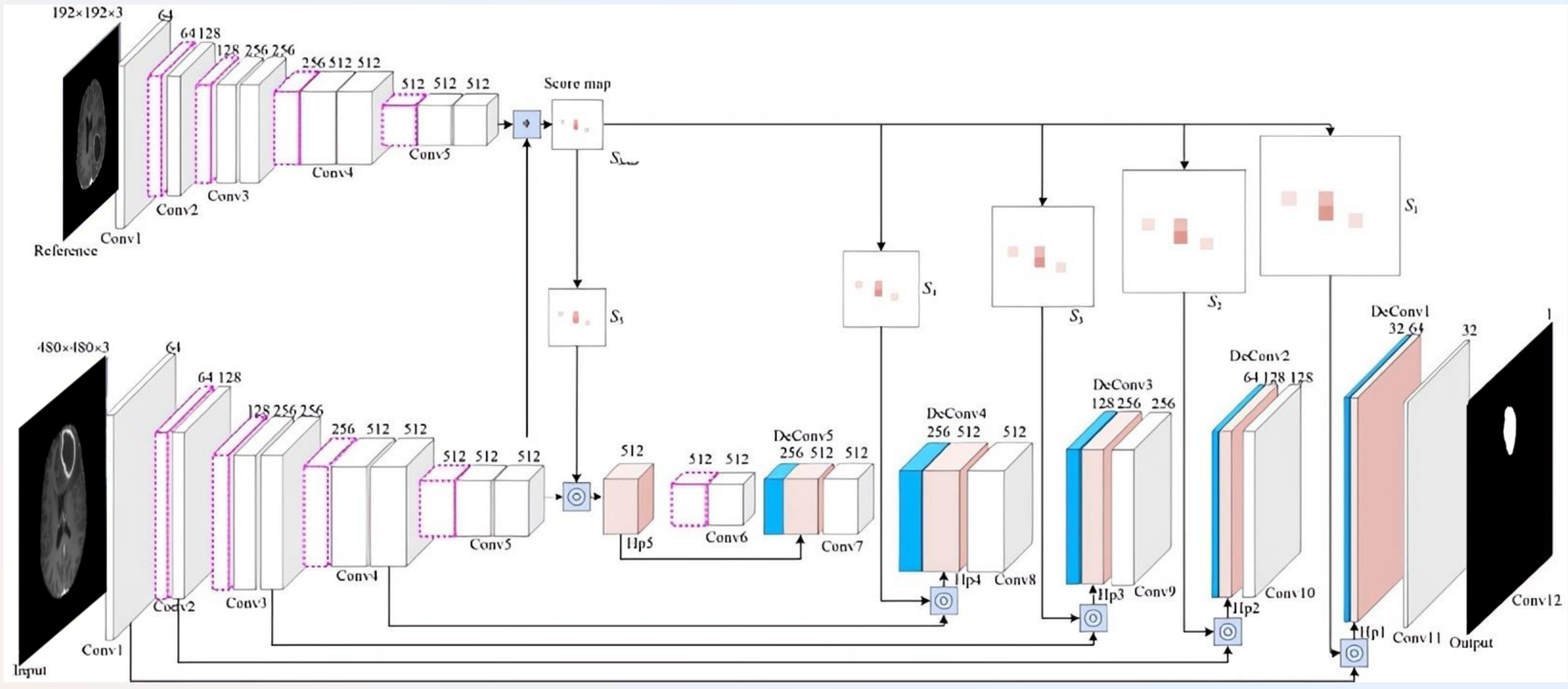
Introduction

The aim of this study is to segment brain tumors from MRI images and model them in three dimensions using machine learning. This project can be used in the diagnosis and analysis of brain tumors, preoperative planning, patient monitoring, and the education of medical students.

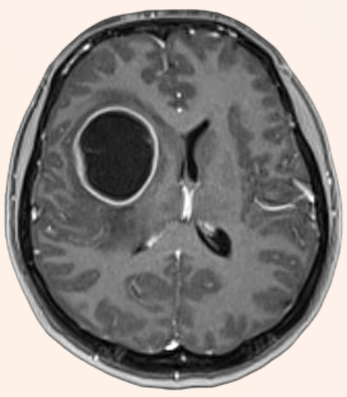
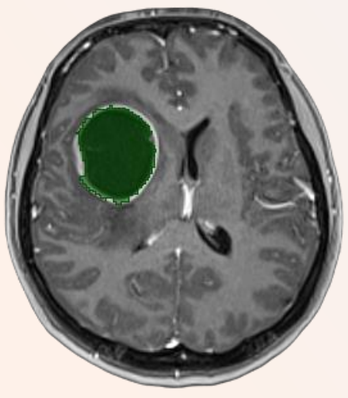
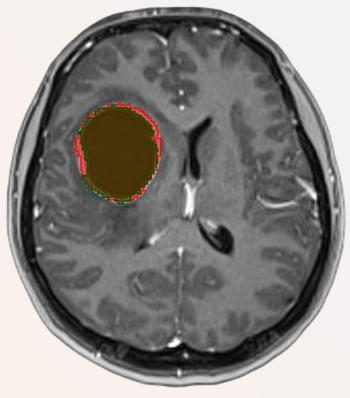
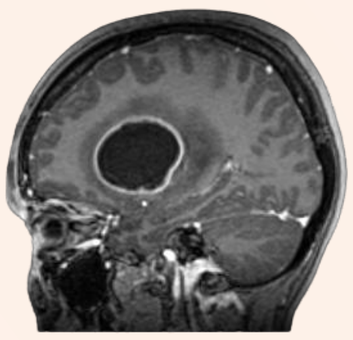
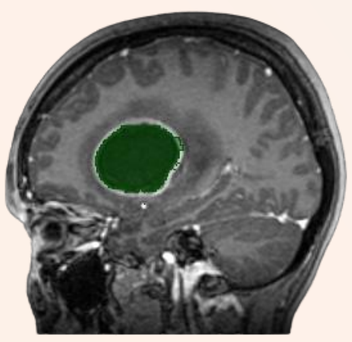
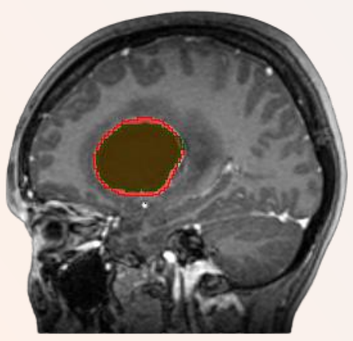
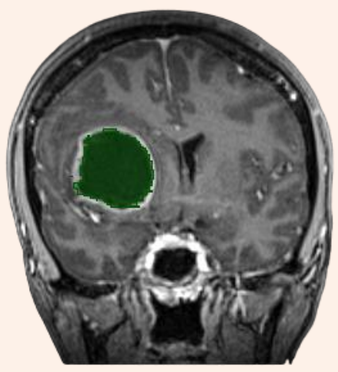
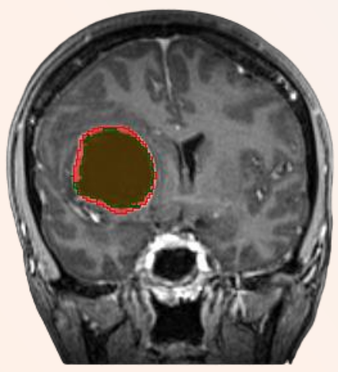
Methodology

For tumor segmentation, the AGUnet architecture was utilized. It combines a fully-convolutional Siamese network for annotating regions with a U-net for segmentation.

Dataset: The training data is made of 2,134 MRI volumes originating from 14 different hospitals, and one public challenge. And the test data is made of 189 MRI volumes provided by Hacettepe University Faculty of Medicine.



Results

	ORIGINAL IMAGE	GROUND TRUTH	GROUND TRUTH VS SEGMENTATION
HORIZONTAL PLANE			
SAGGITAL PLANE			
CORONAL PLANE			
3D VIEW			

Confusion Matrix

		GROUND TRUTH: TUMOR	GROUND TRUTH: NOT TUMOR
SEGMENTATION	TUMOR	True Positive 1.07%	False Positive 0.25%
SEGMENTATION	NOT TUMOR	False Negative 0.014%	True Negative 98.7%

Evaluation Metrics

Dice coefficient	88.8%
Precision	80.5%
Recall	98.7%
Accuracy	99.8%

References

- Bouget, D., Pedersen, A., Jakola, A.S., et al., 2022. Preoperative Brain Tumor Imaging: Models and Software for Segmentation and Standardized Reporting. Frontiers in Neurology, 13, 932219.
- Yin, Y., Xu, D., Wang, X., Zhang, L., 2021. AGUnet: Annotation-guided U-net for fast one-shot video object segmentation. Pattern Recognition, 110, p.107580. ISSN 0031-3203.

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