MRI ANALYSIS FOR MULTI-CLASS SEGMENTATION OF BRAIN TUMOR USING DEEP NEURAL NETWORKS

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ABSTRACT

With newly emerging technologies in the field of computer science, there is rising awareness about its applications in the medical sciences. One of such important applications is early and accurate diagnosis of cancer tumor. Brain tumor is a deadly disease and needs to be diagnosed accurately on time. Among many types of brain tumors, high-grade glioma (HGG) is the most belligerent type and the aggressive nature of tumors affect the survival outcomes of patients. Image processing and deep learning techniques have helped a lot in this endeavor. We have proposed 3 methods: the first method deals with a hybrid methodology that combines simple edge detection technique with deep convolutional neural network to achieve state-of-the-art results. The second method uses the VNet model and the third method makes use of the WNet model with residual blocks.

MOTIVATION & OBJECTIVES

- MRI Analysis of High Grade Glioma (HGG) Patients
- Classification- Edema, enhancing and non-enhancing
- Early diagnosis- quality of treatment and survival rate increases
- Automating The Brain Tumor Segmentation Process

RESEARCH

- Study conducted by the International Agency for Research on Cancer (IARC)
- More than 1,26,000 people are diagnosed with brain tumors - every year
- 97000 deaths occur due to brain tumors every year
- Among all types- Gliomas are deadliest type of tumor.
- Gliomas - Cancerous (Most of times)

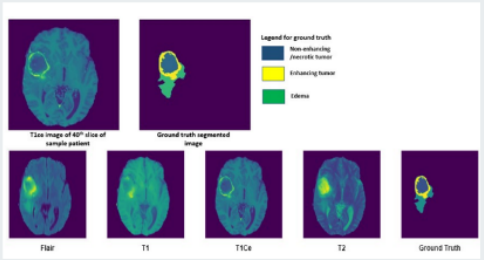
METHODOLOGIES OF PROBLEM SOLVING

1. Sobel+ Modified deep U shaped net (MD- Unet).
2. VNET for 2D MR image analysis
3. Modified WNET

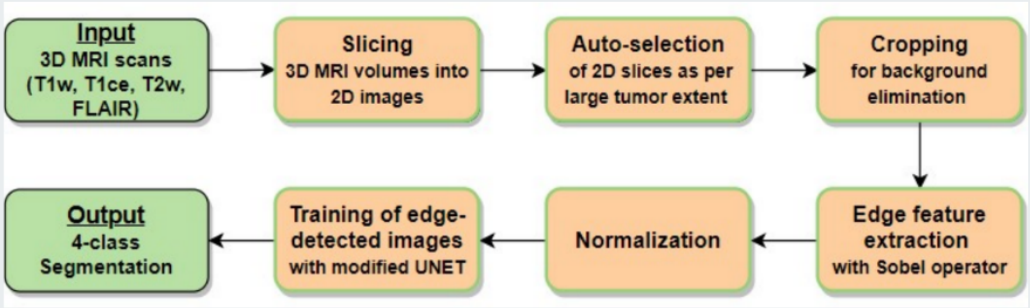
DATASET

BRATS 2018

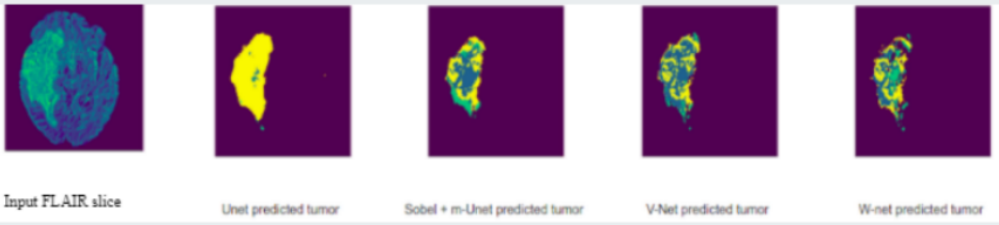
- 3D dataset MRI scans of 210 High-Grade Glioma (HGG) patients and 75 Low-Grade Glioma (LGG).
- 4 modalities- T1-weighted (T1w), post-contrast T1-weighted (T1ce), T2-weighted (T2), Fluid Attenuated Inversion Recovery (FLAIR).
- Ground truth included



SYSTEM ARCHITECTURE - md-UNet



EXPERIMENTATION AND RESULTS

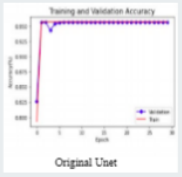


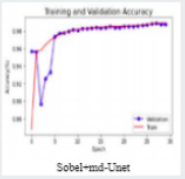
The output we received is of tumor region highlighted into three regions which are edema, enhancing tumor and non-enhancing tumor. We achieved the highest dice score of 99.64% with WNET architecture on training the dataset through our system.

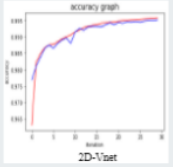
Performance Metrics Comparison Table

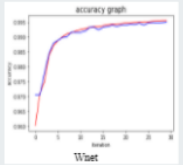
Method	Training			Validation			Testing		
	Accuracy	Dice Coefficient	Dice Loss	Accuracy	Dice Coefficient	Dice Loss	Accuracy	Dice Coefficient	Dice Loss
Original UNet	0.9571	0.9571	0.0428	0.9567	0.9567	0.0432	0.9579	0.9579	0.0420
SOBEL + md- Unet	0.9909	0.9918	0.008	0.9908	0.9917	0.0082	0.9894	0.9903	0.0096
2D Vnet	0.9943	0.9947	0.0051	0.9942	0.9946	0.0052	0.9940	0.9945	0.0054
WNet with residual blocks	**0.9957**	**0.9964**	**0.0035**	**0.9950**	**0.9959**	**0.0040**	**0.9949**	**0.9958**	**0.0041**

Accuracy Graphs

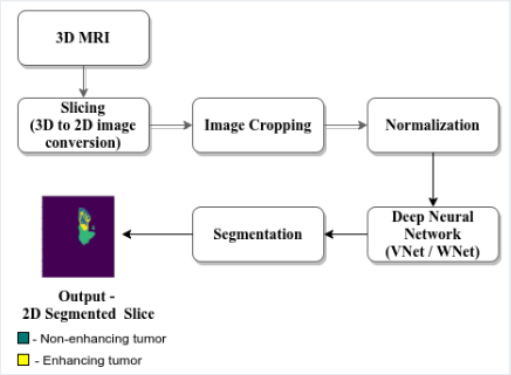








SYSTEM ARCHITECTURE - VNet/WNet



CONCLUSION

Several Deep Learning and Image processing techniques were studied in the due course of the project. We completed research work with current usage of techniques in image pre-processing, image segmentation, common feature extraction and classification recently used were analyzed and studied. We choose in total 3 systems-

1. SOBEL + MD-UNET (Dice score-0.9918)
2. 2D -VNET (Dice score-0.9947)
3. WNET (Dice score-0.9964)

FUTURE SCOPE

- Predicting survival rate of patients
- Classifying the tumor as per WHO guidelines

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