SEMANTIC SEGMENTATION BASED CNN FOR TUMOR DETECTION

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Abstract: A tumor is a growth of cells in the organs or near it. Tumors can happen in any tissue. Nearby locations include nerves, the pituitary gland, the pineal gland, and the membranes that cover the surface of the brain. Although MRI images are a popular imaging method for evaluating these tumors, the volume of data it generates makes it difficult to manually segment the images in a reasonable amount of time, which restricts the use of precise quantitative assessments in clinical settings. The enormous spatial and structural heterogeneity among tumors makes automatic segmentation a difficult task, hence dependable and automatic segmentation methods are needed. In our project we developed deep learning models based on convolutional neural network and Edge Detection algorithms to perform the automated semantic image segmentation of the MRI images of the tumor. We explored the current state of the CNNs architecture and evaluated them on the BraTS dataset. Different regularization methods and hyperparameters are tested and optimized through a series of experiments.

Keywords: Tumor, MRI images, Edge Detection, Deep learning, CNN.

I. INTRODUCTION

Semantic segmentation is a computer vision technique that involves dividing an image into regions or pixels and labeling each of them with a corresponding semantic class. In other words, semantic segmentation is the process of assigning a label to every pixel in an image based on what object or region it belongs to. This technique is used in a variety of applications, such as object detection and recognition, autonomous driving, medical image analysis, and video surveillance. The goal of semantic segmentation is to enable machines to understand the contents of an image and recognize the objects or regions present in it, which is a critical step towards building intelligent systems that can perform tasks that require visual understanding.

Image segmentation is the process of partitioning an image into well-defined regions or categories, each of which comprises pixels with comparable qualities and is designated to one of these categories. Similarly, brain tumor segmentation is the process of separating the tumorous from the non-tumorous regions of the brain. MRI is the standard technique for brain tumor diagnosis as it is non-invasive and provides good soft tissue contrast with high spatial resolution.

II. Literature Survey

Swapnil R. Telrandhe et.al.[1], in their work titled as “Implementation of Brain Tumor Detection using Segmentation Algorithm & SVM”, implemented the system for brain tumor detection from MRI images, the malignant or benign tumor region we will find by this system. The complete system includes preprocessing of MRI by using Median filtering, skull removal by morphological filtering, and segmentation by k-means algorithm; object labelling by HOG algorithm, also feature extracted by HOG, and linear SVM implementation by using extracted feature of the MRI.

Ali İluOn et.al.[2], in their work titled as “Review of MRI-based brain tumor image segmentation using deep learning methods”, said that Brain tumor segmentation is an important task in medical image processing. The purpose of their paper is to provide a review of MRI-based brain tumor segmentation methods. Recently, automatic segmentation using deep learning methods proved popular since these methods achieve state-of-the-art results and can address this problem better than other methods.

Spyridon Bakaset.al.[3], in their work titled as “Advancing The Cancer Genome Atlas glioma MRI collections with expert segmentation labels and radiomic features”, said that 5 Gliomas belong to a group of central nervous system tumors, and consist of various subregions. Gold standard labelling of these sub-regions in radiographic imaging is essential for both clinical and computational studies, including radiomic and radiogenomic analysis. The glioma sub-region labels were produced by an automated state-of-the-art method and manually revised by an expert board-certified neuroradiologist.

Eman Abdel-Maksoud et.al.[4], in their work titled as “Brain tumor segmentation based on a hybrid clustering technique”, considered image segmentation as the most essential and crucial process for facilitating the delineation, characterization, and visualization of regions of interest in any medical image. Their paper presents an efficient image segmentation approach using K-means clustering technique integrated with Fuzzy C-means algorithm. It is followed by thresholding and level set segmentation stages to provide an accurate brain tumor detection.

Xiaomei Zhao et.al.[5], in their work titled “A deep learning model integrating FCNNs and CRFs for brain tumor segmentation”, they have proposed an unified framework to obtain segmentation results with appearance and spatial consistency. We train a deep learning based segmentation model using 2D image patches and image slices in following steps: 1) training 6 FCNNs using image patches; 2) training CRFs as Recurrent Neural Networks (CRF-RNN) using image slices with parameters of...
FCNNs fixed; and 3) fine-tuning the FCNNs and the CRF-RNN using image slices. Their experimental results have demonstrated adopting 3D CRF as a post-processing step could improve the tumor segmentation performance. Their ongoing study is to build a fully 3D network to further improve the tumor segmentation performance which is a limitation of this project.

III. Methodology

3.1 Create Dataset:
Gather a dataset of MRI scans of brain images. You can select an image and upload it for detection of any tumor.

3.2 Pre-processing:
Preprocessing of the images is carried out along with data augmentation. The augmented data is then processed further.

3.3 Training:
Train a machine learning model, such as CNN for Image segmentation and classification.

3.4 Build Model:
Evaluate the performance of the model on a test set of images and fine-tune the model if necessary.

3.5 Prediction:
Develop a user-friendly interface that can take input images from a file and output any detected tumor.

IV. Experimental Results And Analysis

4.1 Segmentation and Tumor Detection:
In this project, we are using python technology to develop the project. The code is written and designed in python language using OpenCV and NumPy modules. In this project firstly we import the libraries which are to be used for further processing the input and the output. The libraries which are used in this project which need to be imported are OpenCV and NumPy. We upload an image of tumor as input. The filters in CNN will make automatic preprocessing to remove noise and the edges will be detected. Then CNN model will segment the image and classify the image. And our model will also provide segmented area as the output.

A. OPEN CV: OpenCV is a library of python that tackles PC vision issues. It is used to detect the face which is done using machine learning. It is an especially important library and is used in several projects to detect the face and recognize several frames also it supports several programming languages. It also performs object detection and motion detection. It also supports several types of operating systems and can be used to detect the face of animals also.

B. NUMPY: NumPy is the module of Python. The NumPy word shows Numerical Python, and it is utilized. This is the module that is written in c language and is said to be an expansion module. NumPy guarantees remarkable execution speed. NumPy is mostly used for performing calculations, and tasks using certain functions it provides like multiply, divide, power, etc.
4.2 Interface after running the code:
In the above screen we have 2 folders called ‘no and yes’ where no folder contains normal brain images and ‘yes’ folder contains Brain tumor images and just go inside any folder to view images like in the below screen.

4.2.1 Uploading input image:
We are using above images to train CNN for tumor detection To run the project double click on run.batch file.
4.2.2 The outputs images:

![Selecting and Uploading No Tumor Image](image1)

**Fig:** Selecting and Uploading No Tumor Image

![Result of No Tumor Image Detected](image2)

**Fig:** Result of No Tumor Image Detected
Fig: Selecting and Uploading Brain Tumor Image

Fig: Result of Brain Tumor Image Detected
V. Conclusions

In our project we have proposed a system which detects brain tumor through MRI image as input to the system. The use of Convolutional Neural Networks (CNNs) for brain tumor detection has shown promising results. By analyzing medical images, such as MRI scans, CNNs can accurately classify brain tumors and aid in the diagnosis and treatment of patients. The development of CNN models for brain tumor detection has been a significant breakthrough in medical technology and has the potential to improve patient outcomes by providing earlier and more accurate diagnoses.

References


