

Brain Tumour Identification using Deep Learning Based on Image Segmentation

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Abstract – Accurate tumour segmentation is an Important step for computer-aided brain tumour diagnosis and planning for surgery. Subjective segmentations are mostly used in clinical diagnosis and treating, but they are did not give better results. Brain tumor segmentation is strongly expected. But they are still facing some problems such as lower segmentation accuracy, demanding a priori knowledge or requiring the human intervention. In this paper, a new method is proposed for the brain tumor segmentation. This proposed system consists of preprocessing, deep learning network based classification and post-processing. The preprocessing is for the extraction of image patches for each MR image and obtains the gray level sequences of image patches as the input of the deep learning network. The deep learning network based on implementation by a stacked auto-encoder network to extract the high level abstract feature from the input, and utilizes the feature for the classification of image patches. After the classification, the result will be send to a binary image, the post-processing will be implemented to get the final segmentation result. In order to evaluate the proposed method, the experiment was applied to segment the brain tumor for the real patient dataset. The final performance shows that the proposed brain tumor segmentation method is more accurate and efficient. This project is very efficient for the identification of tumour cells in brain.

Index Terms – image Segmentation, deep learning, brain tumour segmentation, MRI.

1. INTRODUCTION

Cancer can be defined as the uncontrolled, unnatural growth and division of the cells in the body. Occurrence, as a mass, of these unnatural cell growth and division in the brain tissue is called a brain tumor. Brain tumor is a common destructive cancerous growth of the brain cells and occurs due to the development of abnormal cells that have the ability to spread to other cells of the brain. While brain tumors are not very common, they are one of the most lethal cancers. Depending on their initial origin, brain tumors can be considered as either primary brain tumors or metastatic brain tumors. In primary ones, the origin of the cells are brain tissue cells, where in metastatic ones cells become cancerous at any other part of

the body and spread into the brain. Gliomas are type of brain tumors that originate from glial cells. There are many types of primary brain tumors. They are the main type of brain tumors that current brain tumor segmentation research focuses on. The term glioma is a general term that is used to describe different types of gliomas ranging from low-grade gliomas like astrocytomas and oligodendrogliomas to the high grade (grade IV) glioblastoma multiform (GBM), which is the most aggressive and the most common primary malignant brain. The reason for occurrence of tumour cells is changes in DNA that causes cells to grow and by Radiation.

2. EXISTING WORK

In the existing systems, there are some problems like lower segmentation accuracy, demanding a priori knowledge or requiring the human intervention. MRI technique contains many imaging modalities that scans and capture the internal structure of human brain. Noise evolution in the existing system is high. The two limitations that we go through in existing systems are lack of image specification and lack of generalizability to previously unseen objects. In the existing systems, the brain tumour cells can not be identified at early stages and it is difficult to identify the tumour cells by MRI

3. PROPOSED MODELLING

In the system that we proposed here by using convolutional neural network (CNN),

->Deep learning-based interactive segmentation framework

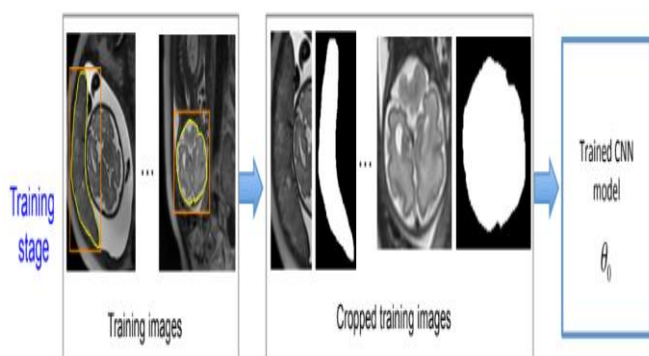
->By incorporating CNNs into a bounding box and the scribble-based segmentation pipeline

->Image-specific fine-tuning to make a CNN mode adaptive to a specific test image, which can be either unsupervised or supervised.

->Weighted loss function considering network and the interaction-based uncertainty for the fine-tuning. The

proposed system mainly focus on Segmentation and Fine Tuning and to support doctors for further treatment. This project has a drawback that it is costly when compared to existing systems.

4. IMAGE SPECIFIC FINE TUNING



5. METHODS FOR BRAIN TUMOUR SEGMENTATION

Brain tumor cells segmentation methods can be classified as manual methods, semi-automatic methods and fully automatic methods based on the level of user interaction required.

5.1. Manual Segmentation Methods

Manual segmentation requires the radiologist to use the multi-modality information presented by the MRI images along with anatomical and physiological knowledge gained through training and experience. Procedure involves the radiologist going through multiple slices of images slice by slice, diagnosing the tumor and manually drawing the tumor regions carefully. Apart from being a time consuming task, manual segmentation is also radiologist dependent and segmentation results are subject to large intra and inter rater variability. However, manual segmentations are widely used to evaluate the results of semi-automatic and fully automatic methods.

5.2. Semi-Automatic Segmentation Methods

Semi-automatic methods require interaction of the user for three main purposes; initialization, intervention or feedback response and evaluation. Initialization is generally performed by defining a region of interest (ROI), containing the approximate tumor region, for the automatic algorithm to process. Parameters of pre-processing methods can also be adjusted to suit the input images. In addition to initialization, automated algorithms can be steered towards a desired result during the process by receiving feedbacks and providing adjustments in response. Furthermore, user can evaluate the results and modify or repeat the process if not satisfied. Hamamci et al. proposed the "Tumor Cut" method.

This semi-automatic segmentation method requires the user to draw the maximum diameter of the tumor on input MRI images. After initialization a cellular automata (CA) based seeded tumor segmentation method run twice, once for tumor seeds provided by the user and once for the background seeds to obtain a tumor probability map. This approach includes separately applying the algorithm to each MRI modality (e.g. T1, T2, T1-Gd and FLAIR), then combining the results to obtain the final tumor volume. A recent semi-automatic method employed a novel classification approach. In this approach segmentation problem was transformed into a classification problem and a brain tumor is segmented by training and classifying within that same brain only. Generally, machine learning classification methods, for brain tumor segmentation, requires large amounts of brain MRI scans (with known ground truth) from different cases to train on. This results in a need to deal with intensity bias correction and other noises. However in this method, user initializes the process by selecting a subset of voxels belonging to each tissue type, from a single case. For these subsets of voxels, algorithm extracts the intensity values along with spatial coordinates as features and train a support vector machine (SVM) that is used to classify all the voxels of the same image to their corresponding tissue type. Despite semi-automatic brain tumor segmentation methods are less time consuming than manual methods and can obtain efficient results, they are still prone to intra and inter rater/user variability. Thus, current brain tumor segmentation research is mainly focused on fully automatic methods.

5.3. Fully Automatic Segmentation Methods

In fully automatic brain tumor segmentation methods no user interaction is required. Mainly, artificial intelligence and prior knowledge are combined to solve the segmentation problem.

5.4. Deep Learning Methods

Recent performances of deep learning methods, specifically Convolutional Neural Networks (CNNs), in several object recognition and biological image segmentation challenges increased their popularity among researches. In contrast to traditional classification methods, where hand crafted features are fed into, CNNs automatically learn representative complex features directly from the data itself. Due to this property, research on CNN based brain tumor segmentation mainly focuses on network architecture design rather than image processing to extract features. CNNs take patches extracted from the images as inputs and use trainable convolutional filters and local subsampling to extract a hierarchy of increasingly complex features. Although currently very few in number compared to other traditional brain tumor segmentation methods, due to state-of-the-art results obtained by CNN based brain tumor segmentation methods. This figure shows how the CNN is working

6. EVALUATION PARAMETERS

The classifier are evaluated based on sensitivity, specificity, recall and precision rate.

$$\text{Sensitivity} = \text{TP}/(\text{TP}+\text{FN})$$

$$\text{Specificity} = \text{TN}/(\text{TN}+\text{FP})$$

$$\text{Recall} = \text{TP}/(\text{TP}+\text{FN})$$

$$\text{Precision} = \text{TP}/(\text{TP}+\text{FP})$$

TP= Number of malignant brain tumors classified as malignant brain tumors

TN = Number of benign brain tumors classified as benign brain tumors

FP = Number of benign brain tumors classified as malignant brain tumors

FN = Number of malignant brain tumors classified as benign brain tumors

7. CONCLUSION

Automatic segmentation of the brain tumors for cancer diagnosis is a challenging task. Recently, availability of public datasets and the well-accepted BRATS benchmark provided a common medium for the researchers to develop and objectively evaluate their methods with the existing techniques. In this paper, we provided a review of the state-of-the-art methods based on deep learning, and a brief overview of traditional techniques. With the reported high performances, deep learning methods can be considered as the current state-of-the-art for glioma segmentation. In traditional automatic glioma segmentation methods, translating prior knowledge into probabilistic maps or selecting highly representative features for classifiers is challenging task. However, convolutional neural networks (CNN) have the

advantage of automatically learning representative complex features for both healthy brain tissues and tumor tissues directly from the multi-modal MRI images. Future improvements and modifications in CNN architectures and addition of complementary information from other imaging modalities such as Positron Emission Tomography (PET), Magnetic Resonance Spectroscopy (MRS) and Diffusion Tensor Imaging (DTI) may improve the current methods, eventually leading to the development of clinically acceptable automatic glioma segmentation methods for better diagnosis.

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REFERENCES

- [1] Guotai Wang, Wenqi Li, Maria A. Zuluaga."Interactive Medical Image Segmentation using Deep Learning with Image-specific Fine-tuning"IEEE paper.
- [2] Andrea Valsecchi, Pablo Mesejo, Linda Marrakchi-Kacem, Stefano Cagnoni."Automatic Evolutionary Medical Image Segmentation using Deformable Models"IEEE Congress on Evolutionary Computation (CEC).
- [3] Annapa Reddy and Dr.Ch.Phani Krishna."A Survey on Applications and Performance of Deep Convolution Neural Network Architecture for Image Segmentation"International journal on pure and applied mathematic (2018).
- [4] G R Sinha, PhD Professor, Myanmar Institute of Information Technology. Mandalay Adjunct Professor,IIT Bangalore,India."Deep Learning based Analysis and Classification of Medical Images in Indian context"Published on 2017.
- [5] Holger R. Roth, Hirohisa Oda, Xiangrong Zhou, Natsuki Shimizu."An application of cascaded 3D fully convolutional networks for medical image segmentation"IEEE paper published on 2014.