Brain Tumor Segmentation Using Machine Learning

Conference Paper · July 2023

CITATIONS
2

READS
140

5 authors, including:

Sagar Thapa
York St John University
3 PUBLICATIONS **2** CITATIONS
SEE PROFILE

Manju More
PES University,Bangalore
18 PUBLICATIONS **14** CITATIONS
SEE PROFILE

TEST Engineering & Management

May-June 2020
ISSN: 0193-4120 Page No. 4284-4287

Brain Tumor Segmentation Using Machine Learning

Rahul Kumar Jaiswal[1], Sagar Thapa[1], Akash Kumar Yadav[1], Aneev Amit[1], Manju More E[2]

[1]UG Student, School of Computing & IT, REVA University, Bangalore, India
[2]Professor, School of Computing & IT, REVA University, Bangalore, India
[1]jaiswalrahul.rj005@gmail.com, [1]sagarthapa335@gmail.com, [1]aky5899@gmail.com,
[1]aneevsinha@gmail.com, [2]manjumore.e@reva.edu.in

Article Info
Volume 83
Page Number: 4284-4287
Publication Issue:
May - June 2020

Abstract

Among the brain tumors, glioblastoma is one of the most dangerous brain tumor that can lead to a very short life expectancy. MRI (Magnetic Resonance Imaging) is a widely used imaging technique to locate such tumors but the amount of data produced by MRI is huge which makes manual segmentation a very tedious task. Because of this, automatic methods are required but the variation in the structure and location of such tumors makes automatic segmentation a very challenging task. In this paper, we have proposed different algorithms of machine learning like KNN (k-nearest neighbor), watershed algorithm, and canny edge detection for extracting patches which can easily overcome this challenge. This would not only be used to detect the exact location of brain tumor but will also predict the patient's life-span.

Article History
Article Received:*19 November 2019*
Revised: *27 January 2020*
Accepted: *24 February 2020*
Publication: *12 May 2020*

Keywords**:** *Brain Tumor, Glioblastoma, KNN, MRI (Magnetic Resonance Imaging), Pituitary, Watershed*

1. Introduction

Brain tumor is developed because of the abnormal tissues that accumulates in the brain. Generally normal tissues generate, grow and then die but abnormal tissues alter this cycle and grows uncontrollably. Tumor position and special changes in the brain tumor size can provide some very important information that can decide the treatment regime including the surgery, radiotherapy or the chemotherapy.

Brain MRI/CT (i.e Computed Tomography) images are 3D images which are analyzed by experts such as doctors or radiologists for diagnosis of the brain tumor. This analysis highly depends on them and their expertise. The shape, location and the structure of the tumor varies from patient to patient which reflect in the variation of brain tumor. To make it worse, the shape as well as the structure is also different for different patients. In fact there can be more than one region of tumor for different patients.

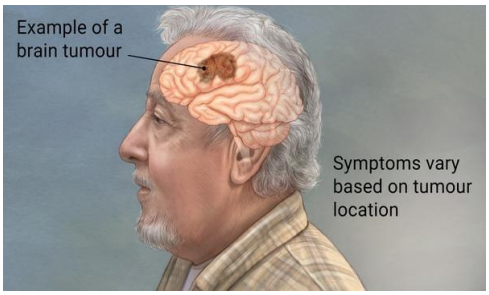

Figure 1: Brain Tumor

If such analysis can be done using computer, it can identify the tumor in the brain which can be seen using 3D images. These programs not only has that particular skill but will also help doctors in follow-up procedures and treatment.

This paper explores brain tumor segmentation and utilize KNN technique for semi-automated segmentation.

This paper will help us in finding the tumor in the brain using machine learning techniques. The first step in understanding image is to segment them and then classify

May-June 2020
ISSN: 0193-4120 Page No. 4284-4287

using different algorithms that can extract brain tumor. The output of the paper will help doctors in the treatment and other follow-up procedures.

2. Literature Survey

Many methods had been used till date for automation of scanning, imaging and identification of brain tumor. So basically these methods are classified into two types named as intelligent based and non-intelligent based method. Artificial neural networks, fuzzy logic, support vector machine and hybrid process are some of the examples of intelligent based method whereas thresholding and region growing comes under non-intelligent based method. However there is no clear division between these methods as intelligent based method are often used as non-intelligent based method. Bhima K & Jagan A did analysis of MRI based brain tumor identification in 2016 international conference where they checked for the accuracy of brain tumor detection. The major identified the drawback of the current methodologies as these mostly ignored analysis of internal brain structure which is very important in disorder detection.

Saleck et al did tumor detection in mammography images in 14th international conference where a new approach was introduced to extract mass from the required region using FCM algorithm. This method selects the input data and the pixels to provide information that are needed for mass segmentation.

GLCM (Gray-Level Co-Occurrence Matrix) method is needed to extract feature like texture for getting the optimal threshold which helps in the separation of the selected set and the other set.

3. Objective

To separate the tumor from normal brain tissues and provide useful information for diagnosis and treatment planning using different algorithms of machine learning like KNN, watershed and canny edge detection for extracting patches which can be used to detect the exact location of the brain tumor. This not only increases the detection accuracy but also reduces the risk of time consumption. It can help doctors in treatment planning and follow-up procedures.

4. Methodology

In this paper the work has been implemented using KNN, Watershed algorithm and Canny Edge Detection. Here, watershed algorithm is used to generate segments from the provided image. To generate segmented image without any information loss, canny edge detection has been used.

The flow of project has been explained with the help of flow chart in Fig. 2

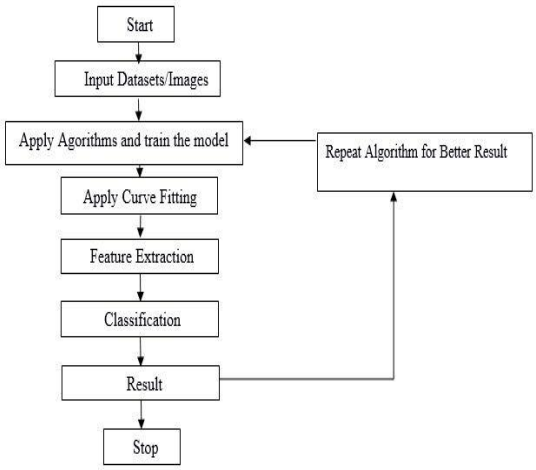

Figure 2: Workflow of the project

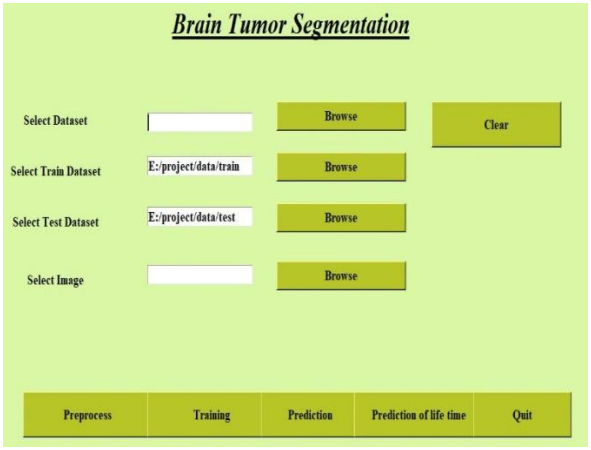

Figure 3: Front-end of the project

Fig. 3 is the front-end of the project where the dataset is provided for pre-processing. The machine is trained using the train dataset and the test dataset that are given as input in the front-end.

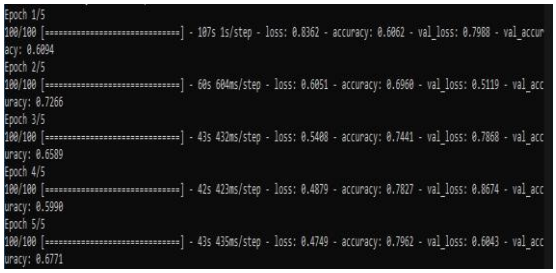

Figure 4: Training the machine

The training happens in five epochs as shown in Fig. 4

With each epoch the accuracy of the machine increases and once it's done, any MRI image can be used as an input to the machine to check for the brain tumor.

TEST Engineering & Management

May-June 2020
ISSN: 0193-4120 Page No. 4284-4287

Layer (type)	Output Shape	Param #
conv2d_3 (Conv2D)	(None, 62, 62, 32)	896
max_pooling2d_3 (MaxPooling2	(None, 31, 31, 32)	0
conv2d_4 (Conv2D)	(None, 29, 29, 32)	9248
max_pooling2d_4 (MaxPooling2	(None, 14, 14, 32)	0
flatten_2 (Flatten)	(None, 6272)	0
dense_3 (Dense)	(None, 128)	802944
dense_4 (Dense)	(None, 3)	387

Total params: 813,475
Trainable params: 813,475
Non-trainable params: 0

Figure 5: Working with different parameters for detecting tumor

Fig. 5 shows the detection of brain tumor using different parameters for the provided input. These parameters are different for different inputs of MRI images. The machine can even generate the life span of the patient according to the type of tumor they possess. A series of outputs are generated containing images like grey scale image, feature extracted image, segmented image, threshold image and the final image.

Below figure shows the images that are generated.

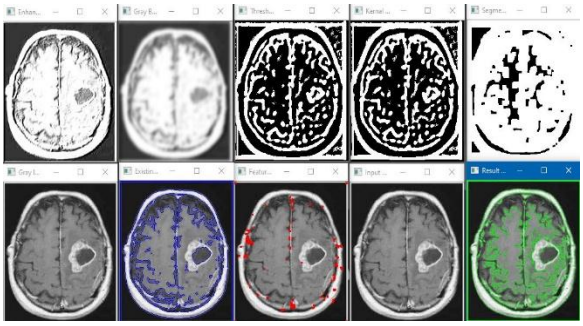

Figure 6: Series of images that are generated as output

Algorithms Used

KNN Algorithm

KNN is a supervised learning algorithm. It does not learn from the function used instead it tries to memorize the input dataset. 'K' in the algorithm determines the number of nearest training examples. The minimum value should be 1 but practically k value is greater than 1 to perform classification.

The output of the algorithm summarize the dataset using a property value.

Watershed Algorithm

Watershed algorithm is used for segmentation which is commonly used technique for tumor detection. It is used for separating different objects in an image. The watershed transform an image completely and assigns each pixel to a region. Since there are lot of noise present in the medical image data, a large number of small regions arises. This is known as over-segmentation.

The result of this algorithm is segmentation and high accuracy.

Canny Edge Detection

To detect edges in any image, we make use of canny edge detection technique. Because of this feature it has been used in various computer vision systems.

This algorithm consists of five steps:

- Noise reduction
- Gradient calculation
- Non-maximum suppression
- Double threshold
- Edge tracking by hysteresis

5. Results and Discussions

We have used different datasets of brain tumor to get the desired results. Early detection and classification of tumor helps in selecting the most convenient treatment. But this is a tedious task and confusing in some complicated cases and highly depends on the expert. Our paper provides a series of outputs that solves this problem and helps doctors, radiologists to detect proper tumor in less time by making it more clear for human vision. The output predicts the tumor class for the provided image along with the final output image.

Figure 7 gives us the output as Pituitary Tumor for the input MRI image.

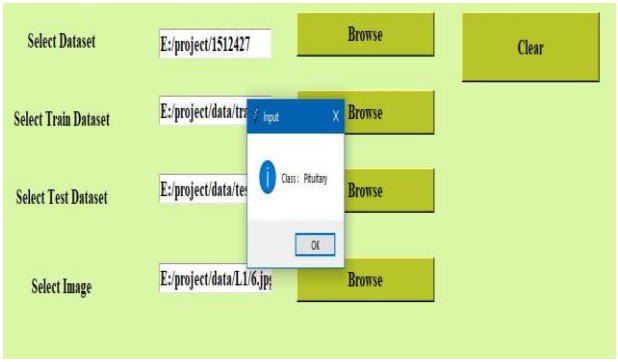

Figure 7: Predicted tumor class

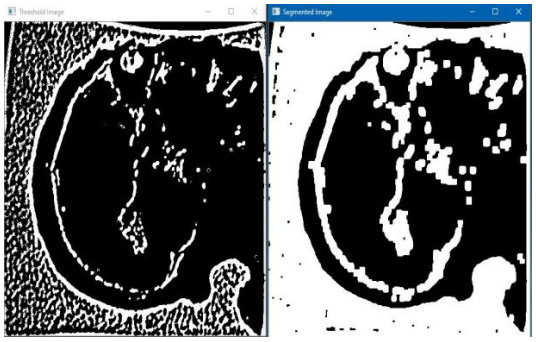

Figure 8: Threshold and segmented image

TEST Engineering & Management

May-June 2020
ISSN: 0193-4120 Page No. 4284-4287

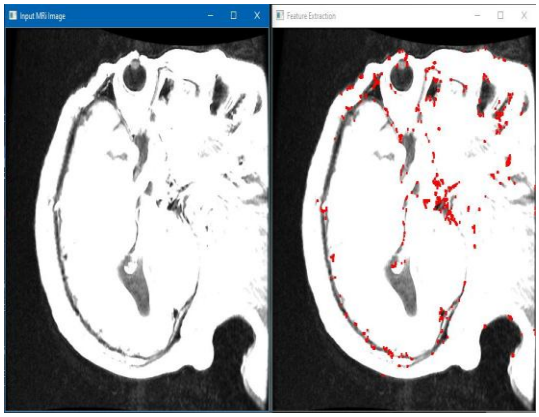

Figure 9: Input image with applied feature extraction technique

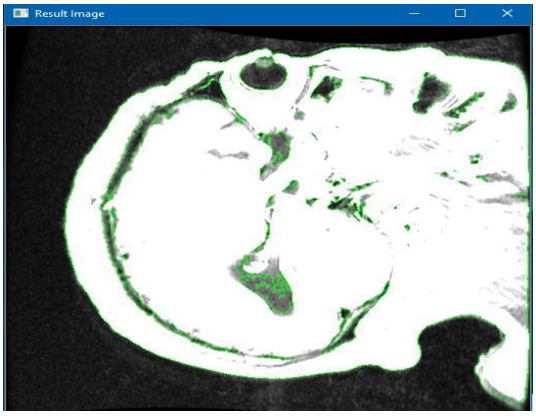

Figure 10: Final Image

Figure 8 and figure 9 are among the series of images that are generated which helps in getting more information about the tumor along with the final image containing the tumor.

6. Conclusion

We have looked at the problem of manually segmenting tumor from the MRI image and we have come up with different algorithms for extracting patches which can be used to detect brain tumor. Numerous imaging techniques can be used but MRI is supposed to be the most common and most effective technique. Our model achieved the highest accuracy of 96.13% and 98.7% concerning the two datasets which are used in this project.

7. Future Work

While our paper provides promising results, it can still be upgraded in the coming future. During operation it is really important to remove as much tumor mass as possible without damaging the surrounding healthy tissues. This can only happen if we increase the segmentation accuracy. So the present work can be used to develop more advanced techniques that can help in identifying brain tumor more accurately.

References

[1] Abiwinanda, Nyoman, et al. Brain Tumor Segmentation Using Convolutional Neural Network, Springer, Singapore, 2019.

[2] Rafiei, Shima, et al. Liver, 2018 25th IEEE International Conference on Image Processing (ICIP). IEEE, 2018.

[3] Nasr-Esfahani, Mina, et al., "Left Ventricle Segmentation in Cardiac MR Images Using Fully Convolutional Network," 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), 2018.

[4] Parihar, Anil Singh. Study on brain tumor segmentation using neural network, International Conference on. IEEE, 2017.

[5] Abhishek Chaurasia, Eugenio Culurciello "LinkNet: Exploiting Encoder Representations for Efficient Semantic Segmentation," in Computer Vision and Pattern Recognition, 2017.

[6] Havaei, Mohammad, et al. Tumor segmentation using deep neural networks, Medical image analysis, vol. 35, pp. 18-31, 2017.

[7] Semi-Automated Brain Tumor Segmentation of Glioblastomas Naomi Joseph, Parita Sanghani, Hongliang Ren,2017 IEEE

[8] Saleck, M. M., ElMoutaouakkil, A., &Moucouf, M. (2017, May). Tumor Detection in Mammography Images, 2017 14th International Conference on (pp. 122-125). IEEE.

[9] Kadkhodaei, Mahsa, et al. Segmentation of multimodal brain tumor,38th Annual International Conference of the, pp. 5945- 5948, 2016.

[10] Jafari, Mohammad H., et al. Skin lesion segmentation in clinical images, 2016 23rd International Conference on IEEE, 2016

[11] Brain tumor Segmentation Approaches in Machine Learning, Ankit Vidyarthi, Namita Mittal, 2015

[12] Optimization Technique,Curve Fitting and Machine Learning used to Detect Brain Tumor in MRI;Sneha Khare, Neelesh Gupta,Vibhanshu Srivastava,2014 IEEE

[13] Vidyarthi, A., & Mittal, N. (2013, December). A hybrid model for extraction of brain tumor, 2013 International Conference on (pp. 202-206). IEEE.

[14] Vrji, K. A., & Jayakumari, J. (2011, July). Detection of brain using CAD System with watershed segmentation, 2011 International Conference on (pp. 145-150). IEEE.

[15] An Efficient Approach To Predict Tumor in 2D Brain Image Using Classification Techniques, K.S.Deepak, K.Gokul, R.Hinduja, S.Rajkumar.