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Brain Tumor Segmentation Using Patch Extraction with CNN Algorithm

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Abstract: *-Among brain tumours, gliomas are the most common and aggressive, leading to a very short life. Thus, treatment planning is a key stage to improve the quality of life of oncological patients. Magnetic Resonance Imaging (MRI) is a widely used imaging technique to assess these tumours, but the large amount of data produced by MRI prevents manual segmentation in a reasonable time, limiting the use of precise quantitative measurements in the clinical practice. So, automatic and reliable segmentation methods are required. However, the large spatial and structural variability among brain tumors make automatic segmentation a challenging problem. The proposed system is an automatic segmentation method based on Convolution Neural Networks (CNN), exploring small 3×3 kernels. Our proposal was validated using BRATS database.*

Keywords: -*Brain tumor, Convolution Neural Network (CNN), Magnetic Resonance Imaging (MRI), Segmentation.*

I. Introduction

Tumor is frequently associated with a neoplasm, which is caused by uncontrolled increasing growth in cell. Brain tumors can be classified according to their origin or degree of aggressiveness. Primary brain tumors arise in the brain, while metastatic brain tumors frequently originate from other parts of the body. Tumors can directly destroy all healthy brain cells. It can also indirectly damage healthy cells by crowding other parts of the cells. Tumors are divided into two stages benign and malignant tumor. Benign tumors are those which are able to spread and affect the other healthy brain tissues. Malignant tumors are typically grows outside of brain and called brain cancer.The fundamental difficulty with segmenting brain tumors is that they can appear anywhere in the brain, in almost any shape and size. This makes this problem a typical neural network problem [5].The majority of the patients die within 9-12 months and less than 3% survive more than 3 years as there is a need for segmentation of tumor part using some tool [1]. A neural network can serve that purpose. Neural networks are the simplified models of biological nervous system [6]. So the tumor part is extracted using patch extraction technique with CNN.

The detection of tumor part is done by three main stages. They are A) patch extraction B) Image segmentation C) CNN. Patch extraction - used to reduce the noise level and to replace the corrupted parts of the image data. Image Segmentation -subdivides an image in to its regions or objects. Once the objects or regions of interest in an application have been detected the segmentation is stopped [3]. The main goal in image segmentation denotes a process of partitioning an image in to distinct regions. It is going to change the representation of an image in to a complete meaningful form so that it is easy to analyse and interpret [2].

The neural network is applied to perform he image segmentation task, where the brain is employed [4]. It depends on wide variety of factors such as complexity of the image and the objects of interest. CNN - used to win several object recognition and biological image segmentation challenges. CNN operates over patches using kernels and it has advantages of tanking context into account and being used with raw data. Neural networks have been successfully applied to problems in the fields of pattern recognition, image processing, data compression, etc.

II. Background Work

Magnetic Resonance Imaging (MRI) is a widely used method and it is a high quality medical imaging. In brain tumor diagnosis centre the detection of tumor is still done manually. The present technology needs the accurate extraction of tumors with less time and it should be accessible to the remote areas. Brain tumors have different characteristics such as size, shape, location and image intensities. They may deform neighbouring structure and if there is an edema with the tumor, intensity properties of the nearby region change an automatic segmentation of the brain, is necessary because manual segmentation requires more time and can be subjected to errors. [3].

Filtering is a technique of modifying or enhancing an image. The type of filtering used here is Median filtering. It is a nonlinear method used to remove noise from images. It is widely used as it is very effective at removing noise while preserving edges.

III. Proposed Methodology

The figure: 1 illustrates the procedure of tumor part extraction. The input images are acquired from BRATS database. Each image is pre-processed and various morphological operations are applied to extract the tumor is explained in the following sections.

3.1 Input Image: In our work the images are collected from the BRATS database. The input RGB image pixel value is up to 0-255.

3.2 Grey scale Image: The three dimensional RGB image is converted into two dimensional grey scale images. And the pixel value is up to 0-255.

3.3 Image pre-processing &filtering: Pre-processing stage removes the noise and high frequency artifact present in the image. It removes the patient name, age and other marks present in the image. Image pre-processing and feature extraction techniques are mandatory for any image based applications. In this work, suitable pre-processing techniques are developed to remove the skull portion surrounding the brain tissues.Median filtering is used as it is very effective at removing noise while preserving edges. The median filter works by moving through the image pixel by pixel, replacing each value with the median value of neighboring pixels.

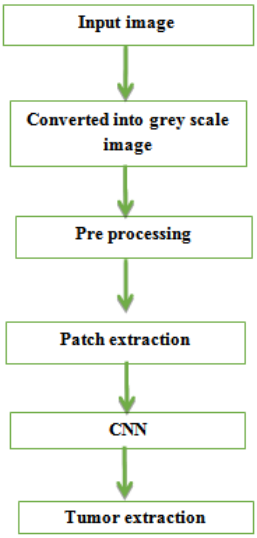
3.4 Patch Extraction: The use of 2D patches in a MRI image requires that define a plane perpendicular to an axis to extract patches. The better performance obtained using patches extracted in the axial plane can be explained by some acquisitions having lower spatial resolution in the Coronal and Sagittal planes, which can be considered a limitation of the BRATS databases.

3.5 Histogram calculation: The Histogram equalization is used to enhance the quality of the image. The histogram block computes the frequency distribution of the elements in the input. The continuous probability density function and cumulative probability distribution functions are calculated [2]. The equation is used to calculate probability distribution function. From the histogram equalization, we can observe that the contrast of the image is enhanced.

3.6 Segmented tumor: The image is segmented into foreground and background using active contour. This is used to segment the tumor part from the brain image.

3.7 Feature extraction & tumor detection: Local feature enable the algorithm to better handle scale changes and rotation. Entropy energy and normalization are the features extracted from the original image. These features are concatenated and the data is saved.

3.8 CNN (Convolutional Neural Networks): Convolutional Neural Networks (CNNs) are multi-layer feed-forward networks specifically designed to recognize features in 2-dimensional image data. CNNs are primarily used for 2D image recognition, so we will illustrate their architecture on a 2D rectangular image consisting of pixels. Each pixel generally carries color information. Colon can be represented by multiple channels (e.g.3 RGB channels). The essence of CNNs is the convolutions. The main trick with convolutional networks that avoids the problem of too many parameters is *sparse* connections [5].



(Fig: 1 the procedure of tumor part extraction)

IV. Results

The experiment of extraction of tumor is carried out using MATLAB and the snapshots of various stages of image processing are shown below. Each step shows how the extraction of tumor is processed.

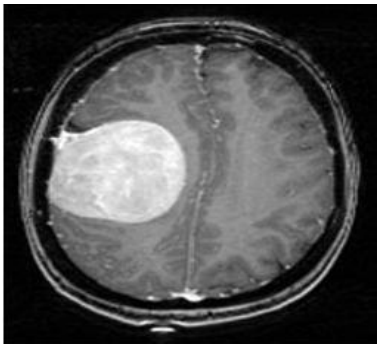


Fig: 2 Input image

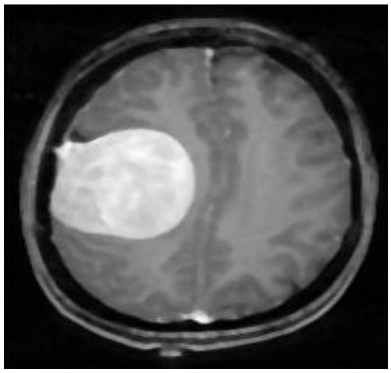


Fig: 3 Filtered image

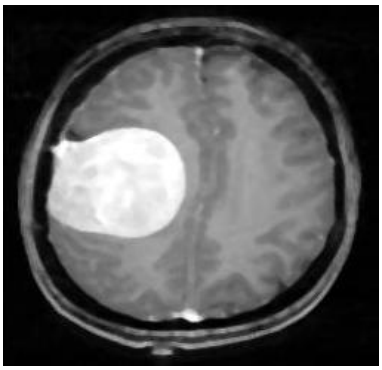


Fig: 4 Enhanced image

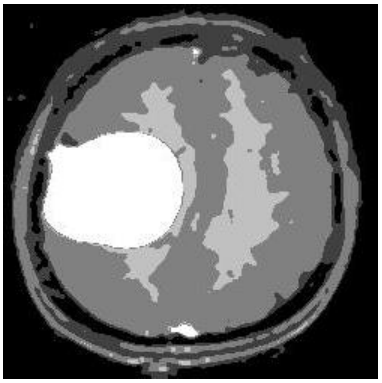


Fig: 5 segmented image

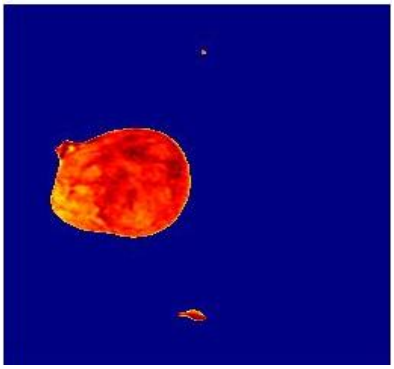


Fig: 6 Extracted image

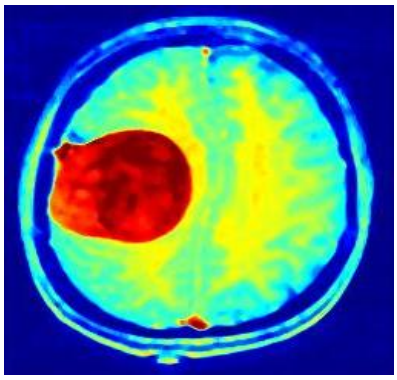


Fig: 7 Final overlapping image

V. Conclusion

In this work method for Image acquisition, Image Pre-processing using median filter, image enhancement using image adjust option in MATLAB, Segmentation using probability distribution technique and then the detection of tumor. Some of the features of the tumors are extracted which will be helpful in medical applications.

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