Brain Tumour Detection From MRI Images By Image Processing Using Matlab

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Abstract

The diagnosis and treatment of life-threatening diseases are significantly influenced by biomedical technology. Brain tumours have emerged as one of the most prevalent fatalities in recent years. The treatment of brain tumours is contingent upon the expertise and expertise of physicians. This is why it is crucial for radiologists and physicians to have an automated tumour detection system to aid in the identification of brain tumours. In order to identify brain tumours, it is imperative to conduct a precise analysis of magnetic resonance imaging (MRI) scans. This paper suggests a feasible approach to brain tumour prediction that implements machine learning with Matlab.

Keywords

Machine learning, brain tumor detection, medical images processing.

1. INTRODUCTION

An aggregation of abnormal cells that develop within the human brain is referred to as a brain tumour. Over the past two decades, there has been a rise in the prevalence of brain tumours among individuals of all ages. There are various forms of brain tumours that are affected in a variety of ways, and some of them can be life-threatening. The majority of patients are affected by either malignant (high grade) or benign (low grade) tumours. A high-grade brain tumour is more susceptible to tissue injury and grows at a rapid pace in comparison to a low-grade brain tumour [1]. Consequently, the quality of life is considerably impacted by a primary malignant brain tumour. The optimal method for diagnosing brain tumours is undoubtedly magnetic resonance imaging (MRI). Thin slices (<2 mm) are typical MRI techniques that are available for high-resolution imaging [2]. The medical image processing discipline employs the Matlab algorithms. The cost and analysis time of brain tumour detection can be reduced by utilising advanced image processing technologies in MRI [3]. Machine learning is primarily employed in image processing techniques for the segmentation, identification, and classification of MRI images, as well as for the classification and detection of brain tumours. The classification and segmentation of MRI images of the brain have been the subject of extensive research, including the detection of breast cancer using deep convolution neural networks and MRI images [4], as well as the identification of lung opacity using a mathematical model based on deep learning [5].

Badran et al. [6] employed a canny edge detection model that was accumulated with adaptive thresholds to extract ROI. The dataset consisted of 102 images. The images were initially pre-processed, and the first set of neural networks underwent fine edge detection, while the second set was subjected to an adaptive threshold. The Harris method is employed to extract the features from the segmented image, which is subsequently represented by a level number. Then, two neural networks are employed: the first to identify a healthy or tumour brain, and the second to ascertain the type of tumour. The canny edge detection method has demonstrated the highest level of accuracy by comparing the two models and depicting the results.

Soltaninejad et al. [7] achieved an 88% total bone score of complete tumour segmentation for LGG and HGG tumours by combining an exceptionally randomised tree classification with super pixel-based over-segmentation for a single FLAIR sequence-based MRI scan. There were two datasets that were utilised to evaluate the proposed method: (1) proprietary clinical dataset: 19 FLAIR MRI images of patients with grade II to IV gliomas and (2) BRATS 2012 dataset: 30 FLAIR images, including 10 low-grade and 20 high-grade images. The proposed method's high detection and segmentation efficacy has been demonstrated by the experimental results with an average sensitivity of 89.48%, BER of 6%, and an overlap coefficient Dice of 0.91. This was achieved using the ERT classifier.

Abdolmaleki et al. [8] Created a three-layer backpropagation neural network to differentiate between utilising thirteen distinct functions to differentiate between benign and malignant tumours. The radiologist's perspective is the basis for the selection of these features. In experiments conducted with MRI data from 165 patients, their proposed method obtained a classification accuracy of 91% and 94% for malignant and benign tumours, respectively. The system was developed to accurately predict the likelihood of a malignant or benign disease by analysing the characteristics derived from pre- and post-contrast MRI images.

Ruan et al. [9] suggest a method for the classification of brain tissue in MR images that is based on the use of partial volume modelling. Two classes are being examined by the researchers in the brain dataset. The initial class is referred to as the pure class and comprises three primary categories of brain tissue: cerebrospinal fluid, white matter, and grey matter. Mixed is the term used to describe the second class, which is primarily composed of composites. Markov random field (MRF) models are employed in each of the two phases of the proposed method. The initial stage involves the segmentation of the brain into pure classes and mixed classes. The second step involves the reclassification of the mixed classes into pure classes, utilising some knowledge of the resulting pure classes. Simulated and real-life MRI images of the brain have been employed to evaluate this approach.

2. METHODOLOGY

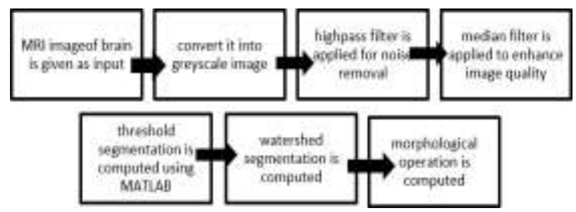


Figure 1 System Level block diagram

A. Grayscale image

Grayscale image is preferred format for image processing because gray scale images are much less complex and one can talk in detail about contrast, brightness, and edges without considering colors(Roy and Bandyopadhyay 2012). Colors are much more complex since they are composed of three channels that are why image is converted into grayscale before further processing in image segmentation.

B. Morphological operations

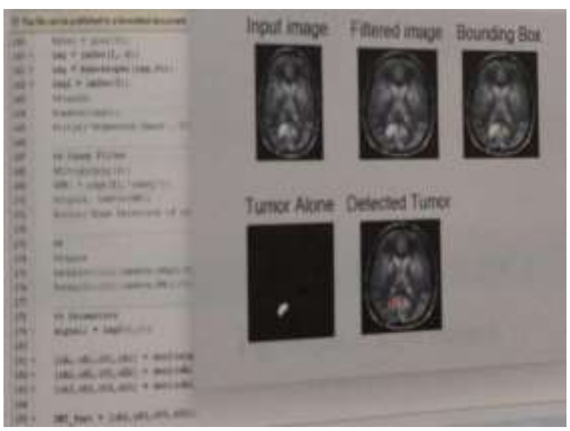
Top hat filter is used to highlight the sharp peaks and gradients in image. Apply morphological operations in which 'strel' i.e. structuring element of disk shaped is taken and applied on the grayscale image for extracting the tumor from MR image of patients(Deng, Xiao et al. 2009). The tumor obtained in the above step has no clear edges or boundaries but it has somehow sharpened the tumor in the image.

C. Watershed segmentation

Watershed image is superimposed over the image after high pass filter has been applied. Watershed transformation is done to segments the cells in an image. It is applied on gray scale image using MATLAB watershed algorithms. For this work, real world patient data is taken for analysis from 'brain web'. As the tumor in MR images has more intensity than the background that's why it becomes easy to locate and extract the tumor from MR image.

3. RESULT

Tumor can be detected in the image. By applying further MATLAB algorithms we can detect the size of this tumor. Since the intensity of tumor is much more than background of image that's the only reason tumor can be detected in MRI (Mancas, Gosselin et al. 2005).For now we can locate the tumor in image Arecisely.



(a)

(b) (c)

Figure 2. Results of proposed method (a) Matlab coding with outputs (b) input and (c) Detected output

4. CONCLUSION

The above results have been obtained using different algorithms in MATLAB as stated in methodology section. These results have been obtained just to detect the exact location of tumor in the MRI images of real data set of patients. There are number of alternate techniques which can also be used for segmentation. All these techniques use different algorithms in MATLAB for tumor detection. There are number of future prospects in this field. This work if elaborated further it can be used to detect tumor size, stage and type using image processing techniques.

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