BRAIN TUMOR DETECTION IN MRI BRAIN IMAGES USING THRESHOLD OPERATION

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Abstract:

Separating tumor in MRI (Magnetic Resonance Image) brain images is a stimulating task, since there are variation of tumor shape, tumorsize and tumor location on the brain. The detection of tumor is still developing in medical field. This study targeted to extract the brain tumor from the brain images and execute the exact tumor location and its size. MRI scans images are widely used in medical research and also used to detect abnormalities in our body especially tumors. In this work, the process of image segmentation is performed by Morphological operation and threshold operation. Finally the result of the segmentation is tumor region and the size of the tumor.

Keywords: MRI image, Tumor Detection, Threshold Operation, Segmentation, Top Hat filtering

1. Introduction

In the medical diagnosis and individual risk assessment in health care service are increasing day by day, image data are used effectively in the diseases cure selection and in disease prevention section. The cause of brain cancer is increasing day by day, from younger generation to adult peoples [4]. The overall occurrence of brain cancers, has been enlarged by more than 10% as per the National Cancer Institute statistics (NCIS) report. To detect cancer in the early stage by combining imaging technology and intelligence software development is a challenging task. MRI brain image is used in the diagnostic system of detecting brain cancer that has the level of expert on acknowledgement of a cancer centre specialist [5]. Near future the diagnostics of healthy people and cancer people will be one of the most demanding subject areas [4]. Discriminating the occurrence of tumors on the medical images of cancer patients and healthy people with the capability on research-based and patient-oriented system on the diagnostic of the brain tumor is necessary [6].
Brain cancer is well-defined as the uncharacteristic development of tissues/brain cells, which get multiples in uncontrollably manner [5]. It affects the normal brain cells from its function and occupies their space. This made interruption in functions of brain cells and sometimes it ends a life. There are different types of tumor such as malignant [cancer tumor] or benign [non cancer tumor] are existing for diagnosis [4]. The cause of brain tumors is unknown. The tumor can harm to other parts by spreading cancer cells. The involvement of high pixel resolution techniques to gain knowledge about brain tumor using medical imaging technique has Magnetic Resonance Imaging (MRI), Computed Tomography (CT), Positron Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT) and functional MRI (fMRI) [4]. Among all the scan images, high quality image of the human body parts are produced by MRI (Magnetic resonance Image) image [1]. MRI scanned images are used for treating the brain tumor and to check any abnormality found on the human brain. MRI images are well suitable to monitor and evaluate cerebral tumors as they developed and respond on its capability to detect difference in the compactness of soft tissues shown in MRI images. So MRI brain images are chosen as input image in this paper. Damage of the brain can be increased by the pressure or by pushing the brain tissue against the skull and shifting the brain and by invading and damaging the nerves and damaging the healthy brain tissues by the tumor located on the brain [2]. The patient has to undergo several test to identify the presence of tumor on the brain. So, it is more important to get the most accurate diagnosis possible [3]. This will help the doctor pinpoint the tumor to give the most-advanced treatment with the least impact on patient’s body.

This work proposed the accurate methodology on brain tumors and find out exactly how far they may have spread. The major task in tumor detection is the segmentation of the tumor region on the brain. There are many segmenting algorithms are used for segmenting in gray scale image stretching from modest edge based methods to high difficulty high-level approaches using advanced and modern pattern recognition methods. Top hat filtering and Threshold operation is an operational method that applied in brain image to extract objects from multifaceted backgrounds of the image. The results are compared with existing methods and visually verified by the medical experts.

1.2. Aim and Objective:

Major difficulties of medical researchers are curing cancers of the patient. The new treatment methods developed are costly and time consuming process [6]. So the origin cause of all the cancers has to find out and the method for securing
the patient has to be developed. Tumors are benign, which is non cancer tumor and it has the chance of growing bigger and spread over on the brain tissues [4]. Surgery and radiation treatment are the successful treatments on curing the cancer tumor [4]. In some cases both surgery and radiation are used for treating the cancer tumor. Now a days the malignant brain tumors are increasing in numbers without knowing the reason [5]. This proposed technique works effectively. Obviously, time is the important factor to treat the patient. So, being dangerous diseases, the growth of tumor should be controlled and also has to take care of normal brain tissues. The result of this work will be very useful for the doctors to treat their patients and get to know more information about the tumor such as type of tumor, its exact location and size. They may treat the patient quickly with this processed information.

2. Proposed Method:

The extracting and detecting of brain tumor from MRI brain images has many existing proposed methods. Many proposed method has special algorithm such as fuzzy algorithm, k-means algorithm, canny edge detection algorithm etc. The main concept of this paper involves Segmentation process. The feature segmentation has the power to extract the tumor. In this work segmentation has been performed by applying filters as pre processing on the input image and morphological filtering technique has the capacity to extract the image by using open method is applied. Then Thresholding operation is applied to assign the value according to the intensity value of the image after filtering process has been applied.

2.1. Segmentation:

Dividing a digital image into various segments by the sets of pixels are known as super pixel sets. The aim of segmentation is to represent an image in a meaningful way and easy to analyse [6]. Segmentation is use full to locate the specific objects such as tumor, boundaries (lines, curves, etc.) and edges on the image. Labels are assigned to each and every pixel of an image, while segmentation, which will helps to share certain information among the same labelled pixels [4].

Characteristics: In case of medical image segmentation the aim is to:

- The anatomical structure study of an image.
- To deduct and locate tumor, lesions, abnormalities and the region of Interest on the image
- To calculate the size of the tumor to help in radiation therapy planning and in radiation dose calculation in radiation therapy.
Using segmentation technique in medical image is a very important task for detecting the abnormalities, study and tracking progress of diseases and surgery planning.

**Gray Scale Image Conversion**

Magnetic Resonance Image is used to find the abnormalities of the particular organ which it taken [2]. MRI brain image, which is affected by brain tumor can be taken to analysis. In detection of tumor, initially, the input MRI brain image is converted to grayscale image [1]. The color is not an important aspect in our image processing. So, we convert it into grayscale image.

![Gray scale conversion](image)

**Fig 2.2.1 Gray scale conversion.**

**2.2. Flow Chart:**

```
START

READ MRI IMAGE AS INPUT IMAGE

CONVERT TO GRAYSCALE

APPLY TOP HAT FILTER ON GRAYSCALE

MORPHOLOGICAL OPEN OPERATION

FINAL TUMOR IMAGE

THRESHOLD VALUE ON THE RESULTANT IMAGE

END
```
Gray scale image is a digital image which has intensity value for each and every pixel ranging from 0 to 255 [7]. This gray scale images are otherwise known as black and white image. They are self-possessed completely of gray shades, varying from black (0 intensity value) at the lowest intensity to the strongest intensity value of white (255 intensity value) [7]. This gray scale imaging technique is used for detecting tumor in MRI brain images.

B. Applying Filters on the Grayscale Image:

Filter has been used to improve an image in better way. Filtering can be involve in sharpening, blurring, Locating definite features in an image, deblurring and etc [7]. Images may be despoiled by illumination operation, random variations in image intensity and having poor intensity and unable to use the image directly. For this situation, filtering technique is used to transform the intensity values of the pixel to expose positive characteristics of the image.

- **Enhancement:** increases pixel contrast
- **Smoothing:** noises are removed
- **Template matching:** known patterns on the image are detected.

Filtering the content of image is comes under image processing. Principally an algorithm used for modifying a pixel value is known as filtering or convolution kernels, which consider the surrounding pixel values and the original pixel value of the image [4]. Filtering is useful when make an attempt to remove noise from the image. Fine parts of the image are emphasized in using sharpening technique [7]. This types of filters will not differentiate between edges and noise, so they incline to smooth out image content that would not be smoothed out, so this may also remove the necessary information from the image.

![Fig 2.2.2 Applying filters on grayscale image.](image-url)
C. Morphological Operation

Morphological image processing technique is a group of non-linear operations linked to the shape of the image part or features of an image [3]. Morphological operations depend on only on the comparative checking of pixel values, not on their arithmetical values and consequently they are expressly suitable for the binary image processing. Morphological operations may be applied to grey scale images, in such that image light transferal functions are anonymous and hence their complete pixel values are not in interest or minor in interest [6].

This is consummate by building a structured element and used in the morphological strel function [7]. There are several types of structuring elements are available, each and every structuring element has their own distinctive properties. Morphological technique follows the objectives of eliminating deficiencies by accounting in the shape and structure of the images [6]. The simple effect of an opening is as like morphological erosion in that it has a tendency to remove some of the foreground (bright) pixels from the edges in the foreground region.

![Morphological image](image)

**Fig 2.2.3: Morphological image.**

Commonly it has fewer destructive than erosion. As like other morphological operators, the rigorous process is resolute by the structuring element [7]. The result of this operator is to reserve foreground regions of the image that has a similar shape of the structuring element or that can be absolutely has the structuring element shape, while removing all other regions of the foreground pixels [1].

D. Threshold Operation

Threshold operation takes grey scale image as input and convert grey scale image to binary image using threshold value [5]. Partition an image into a foreground and background is a simple and effective way to do using image threshold
operation. This is a type of image segmentation technique used for image analysis and also separates different parts of the image by converting the given grayscale image into binary image [4].

Image thresholding has greatest energetic on images, which pixel value has high intensities of contrast. The objective of segmentation is to make things easier and/or conversion the illustration of an image into just about that has further eloquent and at ease to evaluate [5]. Image segmentation is archetypally used to pinpoint parts of an image and to detect boundaries (lines, curves, etc.) in the images. More specifically, image segmentation is the process of transmission [4].

Segmentation using threshold is one of the best segmentation technique, which is very useful in separating the foreground and background of an image. The binary form of an input grey scale image is given as output by the threshold operation. The process is centred on a threshold value, the corresponding pixel value will be one when the pixel values are greater or equal to the threshold value, otherwise the corresponding pixel value is zero on converting grey scale image into a binary image. The core reason is the assortment of a threshold value choosing. By the assistance of the thresholding operation, tumor region has been detected, since it calculate the value on rough part of the given input image.

2.3. Performance Analysis:

<table>
<thead>
<tr>
<th>IMAGE</th>
<th>SIZE</th>
<th>MEAN</th>
<th>PSNR</th>
</tr>
</thead>
<tbody>
<tr>
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<td>304.7500</td>
<td>Mean1=93.143</td>
<td>7.5719</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean2=0.0077</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5.2.1. Performance Analysis.

<table>
<thead>
<tr>
<th>Image Number</th>
<th>Mean1</th>
<th>Mean2</th>
<th>Performance Score</th>
</tr>
</thead>
<tbody>
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<td>93.0927</td>
<td>0.0335</td>
<td>7.3986</td>
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<tr>
<td>840.3750</td>
<td>60.2059</td>
<td>0.0166</td>
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<td>67.6554</td>
<td>0.0265</td>
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</tr>
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</table>

**3. Results and Discussion:**

In Table 5.2.1 shows the original input image and final segmented tumor image. For this work, the real time patient MRI images and observations are taken for analysis. Normally, there are two type of brain images. They are normal brain...
images and tumor brain images. The proposed concept has less execution time than existing techniques. The proposed work involves three steps to make the work efficient. Top hat filters is used to enhance the image. Morphological open and close operations are used to segment the enhanced image. Threshold operation can assign the value by itself according to the hard part of the image. Finally, it detects the tumor and calculates the area of the tumor.

3.1. Results:

![Fig: 5.1 Original input images.](image1)

![Fig: 5.2 Final tumor images.](image2)

4. Conclusion:

In medical field, image processing can be used in various ways. Magnetic Resonance Image (MRI) is used to detect the abnormalities of the organs. So, MRI brain image is used to implement on this system. And, the pre-processing step is important to segment the brain. It is used to enhance the attribute of given image. The resultant image is undergo with morphological operation. Morphological operation used to detect and extract the tumor. It makes less execution time. Undergoing various segmentation techniques, the intensity of the normal tissue and tumor cells can be separated. Finally, the threshold operation can be done. Thresholding is the methodology of assigning value for the rough part of brain image. Brain tumor is actually extra brain cells. However, processing of the image, the cluster of cells can be remain in image. By using this simple logic, thresholding operation is used to find its exact size and location of the tumor. However, the tumor is determined by pixels. This method gives exact results and reliably in faster way. This proposed method is working better than the existing works.

References:


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