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Study on Brain Tumor Detection using Otsu Method

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Abstract: *With the development of computer aided technology, researchers are trying to invent new methodologies to segment different types of images. In medical image processing, segmentation is a primary criterion for detection of many diseases like brain tumor. Latest software and hardware provide accurate result while detecting a particular object or segment them from entire body parts. This is really helpful to overcome the drawbacks of previous time-consuming methodologies. In this communication, we are presenting a novel method for brain tumor detection using Otsu method. In Otsu method, segmentation is done with the help of adaptive thresholding values. Here, with the help of different variances, we have isolated a particular object so that it can be easily visible in respect of background and foreground. In addition, we have calculated the area covered by the particular object (tumor in this case) to detect the growth of the object. Though we have applied our method for tumor detection only, but by modifying the algorithm it can be applied for detecting in other areas also.*

Keywords: *Medical Image Processing, Image Segmentation, Thresholding, Otsu Method, Pixel Calculation*

INTRODUCTION:

Digital image processing is widely used for last few decades in medical and satellite image processing for proper analysis, encryption or authentication purpose. A Patra et al. worked with satellite and medical images based on optical processing and image enhancement techniques. These processes are also effective in land cover as well as medical image analysis with some post processing tasks. In addition, they have worked with alpha blending for image encryption process. [1-11]. Berkeley wavelet transformation (BWT) along with support vector machine (SVM) based classifier for brain tumor detection was proposed by N B Bahadure and his associates. [12]. In a very recent work [13], tumor detection process is divided into two phases. Initially noise is removed as the preprocessing followed by texture features are extracted from these noise free brain MR images. Hybrid clustering technique is applied [14] for segmentation of brain tumor parts. There K Means algorithm along with Fuzzy C Means is incorporated for image enhancement. In the next level, by thresholding and level set accurate brain tumor detection is performed. E. A. Zanaty [15] proposed a scheme of determination of Gray Matter (GM) and White Matter (WM) from MRI images. N. Gordillo and his associate surveyed on brain tumor detection processes [16]. In modified part of this algorithm [17], wavelet and Artificial Neural Network is applied for determination of Gray Matter (GM) and White Matter (WM) areas. K Means algorithm in addition with Fuzzy system is a popular algorithm in this field and therefore few researchers have proposed this technique. [18,19] Few researchers proposed a robust discriminative segmentation method from the view of information learning to simultaneously select the informative feature for discriminative brain tissue segmentation [20].

In our proposed technique, we have applied Otsu method to isolated tumor effected area from background as well as foreground part. Otsu method works on adaptive thresholding values, to get better classification. Thresholding is an important technique for segmentation of images. Thresholding helps to select an optimal gray-level threshold value for separating objects of interest in an image from the background based on their gray-level distribution. We have applied two different thresholding stages to get accurate result. In addition, with thresholding values, variances are also used for segmentation purpose. In the final stage, we have calculated pixels of the tumor effected area which is helpful to determine whether the tumor has reached to an alarming stage or not. The main reason of selecting Otsu method is that it is very fast compared to other methods and coding is also very simple.

METHODOLOGY:

The entire process is worked on the value of variances. The background variance is calculated with the help of Weight W_b, Mean value μ_b and Variance σ^2_b.

Similarly, foreground variance is calculated with the help of Weight W_f, Mean value μ_f and Variance σ^2_f.

Within class variance

$$\sigma^2_w = W_b . \sigma^2_b + W_f . \sigma^2_f \text{ ---------- (1)}$$

Between class variance

$\sigma^2_b = W_b . W_f (\mu_b - \mu_f)^2$ ---------- (2)

Steps Followed:

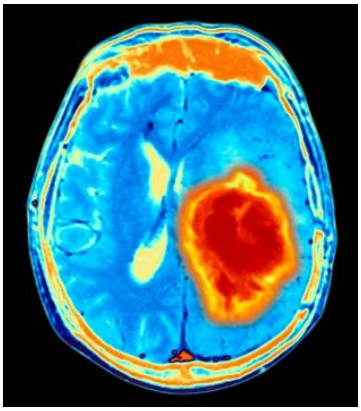
1. Histogram and probabilities of intensity level is computed
2. Assigned initial class probability and initial class means.
3. Modified through all possible thresholds intensity value.
4. Class variances are computed.

RESULT :

For our research work, we have used a color image. We have applied two thresholding values for classification.

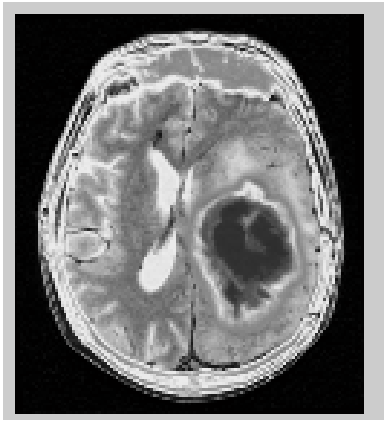
Selected image is displayed in Fig. no 1.

Grayscale version of selected image is displayed in Fig. no 2.



Selected Image

Figure 1



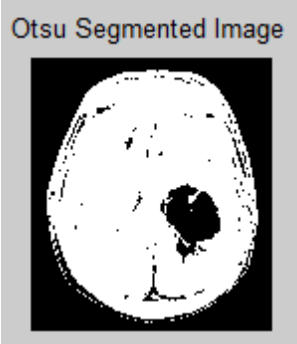
Grayscale Image

Figure 2

Output of thresholding and segmented image is shown in Figure 3 (a-c). It is achieved by calculating variances between classes.

2(a)

2(b)



2(c)

Figure 3

Output image is binarized by thresholding algorithm. Binary image of the segmented image is displayed in the Figure 4.

Binary Image

Figure 4

Pixel Count:

Total no of pixel in the image = 2830419

Total no of pixel in the tumor effected part = 166081

% of effected area = 5.87%

CONCLUSION:

The proposed method is used to determine brain tumor from MRI images. For the last few years, many methodologies have been used to detect brain tumor area. In this communication, we have applied Otsu image segmentation algorithm. By calculating with and between class variances, we have performed segmentation process which yields a satisfactory result. Pixel calculation process is really effective to calculate the area from which we can get detail information about the tumor effected part. It is a fast process compared to some previous methods and coding is also simple. After some post processing, this technique can be used to build an Earth Engine based tool for assessing the change in surface water which will be discussed in our future communication.

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