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A Novel Approach of Brain Tumor Detection Using Hybrid Filtering

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ABSTRACT
The paper presented explains how the gradient differential plays an inseparable part in demarking the tumor in brain. Areas that do not match with the benchmark set are skipped by the algorithm i.e. eminent entropy and intensity which are considered as major feature of tumor identification. The picture is finally rebuilt by evaluating regional maxima and extended maxima transformation which at the end gives us the most impressionable part of tumor. To generate final output the algorithm takes just 3.98 seconds (as an average statistics). At the end the proposed algorithm detects the tumor with high accuracy.

Keywords: Brain tumor, gabor filter, boundary, canny edge detection, extended maxima transform & image model.etc.

I. INTRODUCTION

The main cause of brain tumor in the humans is due to growth of abnormal cells that originate from the tissues. Generally this cells are died and replaced after sometime interval or when the brain does not need them. The growth of abnormal cells starts growing up and more cells joined which results into cyst. The tumor is classify into two parts first is primary tumor which is main cause of brain tumor as cells generated from the brain parts leads to tumor and other one is secondary tumor which cause cancer from the tissues gathered from different parts of the body. Tumor caused by brain cells is called malignant which is very dangerous and effects the parts of the brain function. The other tumor is benign which does not effects the human body and can easily be detected by naked eye as it shows outline around the effected area and its rate of growth is very slow than malignant tumor.

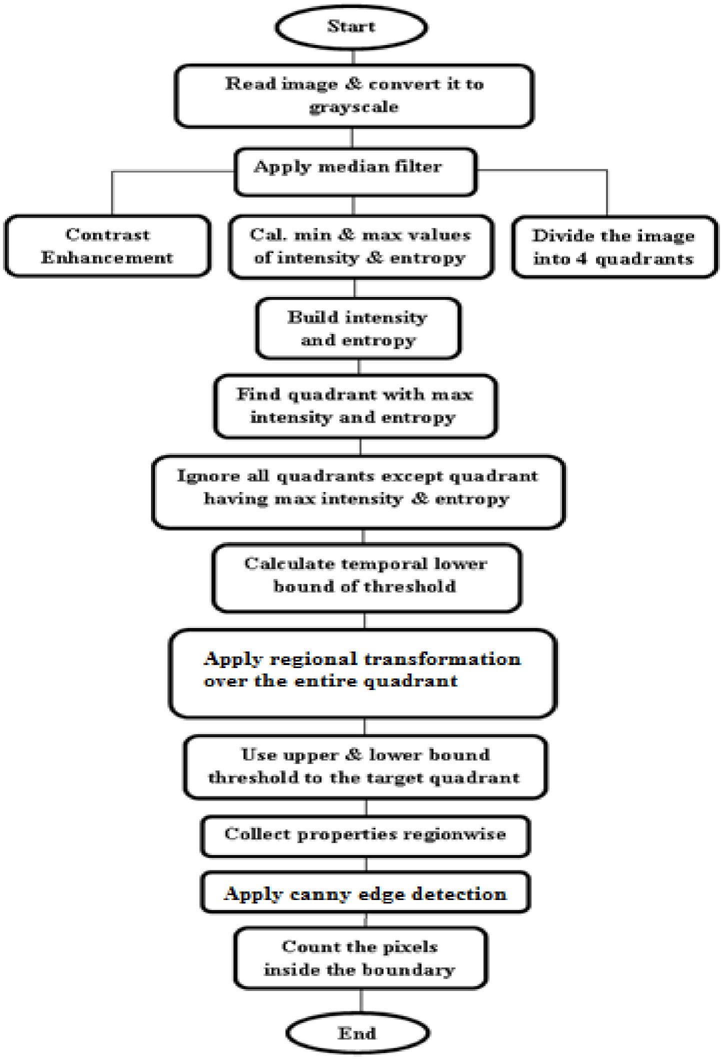
In our paper the brain tumor is detected from the MRI image of brain and the area of tumor is calculated of the effective area. Brain tumor detection is a troublesome task as there are number of pixels in the MRI image and detection of exact part of tumor in it required skillful techniques. The property of the benign tumor is having low intensity of pixels and does not show deep marks but show slightly lining outside the effective part. The first step in this technique is to slice the picture into number of parts and each part is analyses individually to detect the tumor. If there is benign tumor in the brain than it shows in some of the parts but if there is malign tumor than it penetrates into deeper parts and intensity of pixels is very high in the region. These properties are very helpful to detect the tumor part in the brain and we also look some of the similar features of the malign tumor in the brain.

II. RELATED WORK

Tumor segmentation from magnetic resonance (MR) images by hybrid approach helps to detect tumor and tumor treatment by tracking the tumor growth. Nobuyuki Otsua [1] has given a technique of automatic threshold the picture segmentation. Michael R. Kaus et.al [2] had made an automatic brain tumor analysis method which was gives precise results as compare to manual segmentation with 3-D magnetic resonance images. Lynn M. Fletcher-Heath et.al [3] in their research stated that the automatic analysis method which separate brain tumors which are non-enhancing from cells in MR images which helps in calculating tumor size over time. Alain Pitiot et.al [4] presented a fully automated technique for medical figures. Djamal Boukerroui et.al [5] Strong method to specially analyse noisy images, within a Bayesian framework. Kristin R. Swanson et.al [6] Inspects the aspects of advancements in mathematical modeling of gliomas in the study. Yuri Boykov et.al [7] gives low/high flow graphs to determine energy in low level vision. Stuart S. C. Burnett et.al [8] developed a deformable-template algorithm for the semiautomatic delineation of normal tissue structures on computed tomography images. Weibei Dou et.al [9] proposed a framework of fuzzy information fusion in this paper to automatically segment tumor areas of human brain from multispectral magnetic resonance imaging (MRI) such as T1-weighted, T2-weighted and proton density (PD) images. Kyungsuk (Peter) Pyun et.al [10] has developed a multiclass image segmentation method using hidden Markov Gauss mixture models (HMGMMs) and provide examples of segmentation of aerial images and textures. Hassan Khotanlou et.al [11] has presented a new general method for segmenting brain tumors in 3D magnetic resonance images. Under the scope of this paper the basic features of tumors demarcation such as texture information have not been taken into consideration while designing the algorithm. Jason J. Corso et.al [12] presented a new method for automatic segmentation of heterogeneous image data that takes a step toward bridging the gap between bottom-up affinity-based segmentation methods and top-down generative model based approaches. T. Logeswari et.al [13] in their paper had described a segmentation method consisting of two phases. Sufyan Y. Ababneh et.al [14] has proposed a new, fully automated, content-based system is proposed for knee bone segmentation from magnetic resonance images (MRI). P. Narendran et.al [15] tried to segment brain tumors, their components (edema and necrosis) and internal structures of the brain in 3D MR images. Sudipta Roy et.al [16] in their work introduced a fully automatic algorithm to detect brain tumors by using symmetry analysis. Mukesh Kumar et. Al [17] used the texture analysis and seeded region growing method which is based on texture of the MRI. Although the author tried to minimize the total execution time of this method but still it takes minimum more than 8 seconds to provide its results.

III. PROPOSED WORK

The presented research paper constitutes of an algorithm that was crafted using the hybrid approach of combination of the technique of image model, another is extended maxima transformation, followed by regional maxima transformation. Later on through canny edge detection algorithm the edges of the tumor has been outlined for clear cut view of the tumor potion. Before applying hybrid approach onto the image the combination of filters i.e. gabor filter and median filter are also being applied.



Step 1: Read and conversion of RGB to grey scale image: first the input image is converted into the greyscale and arranged in the form of matrix. The data shows blue, red and green conversion at a particular location. By using the imread command image is analysed from the graphics file. Next step is to convert a color image into the grayscale by using either of two methods luminosity method or average method. Average method gives less precise results as it is taken by simply average of the colors.

Grayscale image = (R + G + B / 3)

The wavelengths of these color contributes much in analyzing the image But due to different wavelengths the output will be black in shape. To overcome this we used the luminosity method to decrease the effect of the red color by using new grayscale equation

New Grayscale image = ((0.3 * R) + (0.59 * G) + (0.11 * B)).

Accordingly the Red has contributed 33%, Green is 59% (> red and blue colors) and Blue is just 11%.

Step 2: Processing : To get a clear image of MRI which helps in detecting of tumor median filter is applied to remove unwanted noise in the pictures. After denoising the image the retain information is used to arrange the intensity values. Than intensity values are arranged with respect to their local values.

Step 3: Contrast Enhancement of Image: The most important thing in detecting tumor is contrast enhancement in grayscale image. The clarity of image is improved by brightening up the image which leads to the increase in intensity of pixels of the effected area. The contrast of the picture is increased by using imadjust function in matlab by using (γ) gamma transformation. (γ) gamma transformation function plays a vital role in brightening up and darkening up the values of gamma. These values are adjusted according to the image quality and size of tumor in the brain.

Gamma compression is defined by following terms:

$$V_{out} = AV_{in}^{\gamma} \quad (1)$$

where *A* is a constant.

Step 4: Dividing into quadrants: The MRI image is divided into four equal quadrants and each part is analysed to calculate the minimum and maximum value of pixels and compared to crop out the highest intensity portion in the brain. Entropy is applied over it by the following analysis

etp = - sum(p.*log2(p)) (2)

where p contains the histogram counts returned from imhist.

Step 5: Formation of Matrix: the intensity of each part is adjusted and compared after applying entropy and highest values giving quadrant is separated out after building up a matrix. The most susceptible quadrant having tumor is located out and next task is to locate the exact tumor in the brain

Step 6: Thresholding: The temporal values is calculated of the selected quadrant and thresholding by upper and lower bound theorems. Average mean square error of lower bound theorem is used to analyse the quadrant and than upper bound is applied over it.

Step 7: Maxima Transformation: To detect the tumor portion with highest intensity extended and regional maxima transformation is applied. The portions with low intensity of pixels is neglected as there is very rare chance of occurrence of tumor in that portion and transformation is applied on the maximum intensity part.

Step 8: Regional Properties: The characteristic of the connected tumor portion is found out by using regionprops command of matlab to check that whether it is a tumor portion or not. The properties like solidity is also checked to get the actual shape of tumor generally uneven in nature to get sure of the tumor part which is convex in nature.

Step9: Used Canny Edge Detection algorithm: In digital image processing the canny edge detection mechanism has been proved very useful in identifying the object's edges. So in this work the advantage of canny edge detection algorithm has taken for demarking the brain tumor.

Step 10: The outer edges of a suspicious region has been marked so as to detect the area that is having intensity maximum of all. Now the perceived tumor portion is partitioned out and finally the region that got impacted by the tumor is easily recognizable and analyzed as well.

Step 11: Now the size of the tumor is quantified by calculating the pixels that fall inside the edges and are highlighted.

IV. RESULTS AND ANALYSIS

The following figure i.e. fig. 1 firstly shows the original input image, secondly the resultant image after applying median filter and gabor filter over the input image. Third snapshot shows the quadrant having tumor and after enhancing the contrast of that quadrant so that the objects could be identified more clearly followed by the output of canny edge detector when applied over the quadrant. Finally at the end the tumor present is being highlighted.

The table 1 followed by the snapshots gives statistical description of each image. It shows the results of 5 images of 5 different patients, in terms of tumor size (in pixels) and execution time.

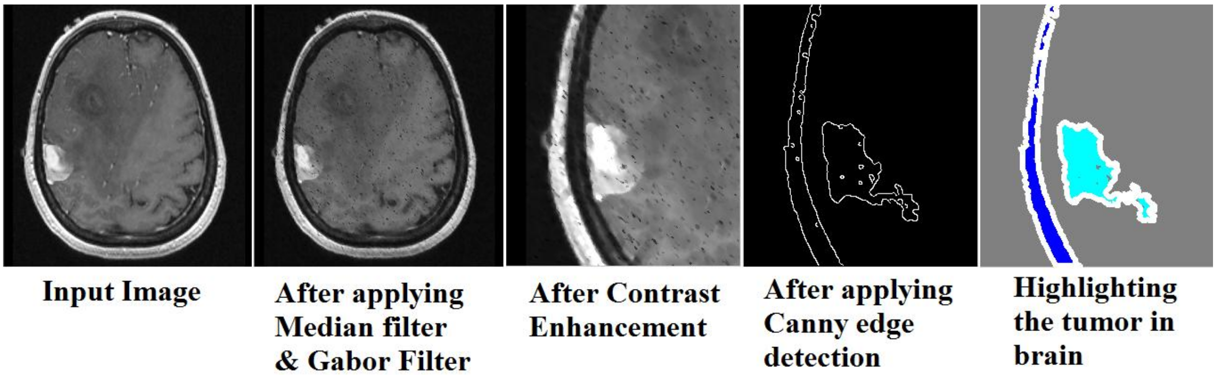


Fig 1. Snapshots of results

Table 1: RESULTS OF 10 DIFFERENT CASES

Case	Name	Type of Tumor	Time Taken (in sec.)	Size (in pixels)	A	B	C	Cumulative Precision (A/D)	Cumulative Recall (A/E)
1	Dorcas	Malignant	2.54	62002	1	0	0	0.022	0.02
2	Jonquil	Malignant	2.34	50626	2	0	0	0.044	0.04
3	Helli	Malignant	2.59	66754	3	0	0	0.066	0.06
4	Daniel	Benign	1.05	17685	4	0	0	0.088	0.08
5	Rhoda	Malignant	2.17	49873	5	0	0	0.111	0.10
6	Amos	Malignant	3.12	122145	6	0	0	0.133	0.12
7	Laura	Wrong output	2.47	50626	0	1	0	0	0
8	Asaph	Benign	1.59	28983	7	0	0	0.155	0.14
9	Wasila	Benign	1.48	26588	8	0	0	0.177	0.16
10	Diana	No output	0	0	0	0	1	0	0

V. CONCLUSION AND FUTURE SCOPE

The table 1 shows that the crafted algorithm has shown improved results than the earlier one in terms of execution time taken and clarity in understanding the image even for a non-technical person. The constructed algorithm has very less complexity as it chooses 1 quadrant out of 4, which possesses the tumor and for that matter the quadrant having quadrant having highest entropy, intensity and solidity matrix is found. Moreover the data processing will also be reduced as the algorithm has to work on just one quadrant out of four. Now in future scope the scholar could prepare machine learning algorithms of non-parameterized features and try to classify the horizons to the areas that possess tumor and even to those areas that do not possess tumor via using regression decision tree.

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