

MINIMUM TIME DELAY AND MORE EFFICIENT IMAGE FILTERING BRAIN

TUMOUR DETECTION WITH THE HELP OF MATLAB

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ABSTRACT

Brain tumor detection is one of the main tasks in the medical field till now. Earlier they used pneumoencephalography and cerebral angiography which had a draw -back, the drawback is overcome by CT and MRI scan techniques with the help of surgeons to providing a higher quality result in image processing. It is difficulty in distinguishing between brain tumor tissue and normal tissue because it was similar in color. Hence Brain tumor must be analyzed more precisely in order to cure it by using this image processing. The Proposed method consist total three steps, first stage is preprocessing which is converting the original RGB image to gray-scale image and then Gaussian high pass filter for noise reduction in the second stage processing system for pixel enhancement we use Median filter and in third stage is the post-processing which Entropy Filter., Standard Deviation Filter (SDF), Weiner Filter, Gradient Magnitude, Regional Maxima for various different-different results. Naïve Bayes classification is utilized for recognition of a tumor region accurately that contains all spreading cancerous tissues. Brain MRI database, preprocessing, morphological operations, pixel subtraction, maximum entropy threshold, statistical features extraction, and Naïve Bayes classifier based prediction algorithm are used in this research. The goal of this method is to detect the tumor area from different brain MRI images and to predict that detected area whether it is a tumor or not. When compared to other methods, this method can properly detect the tumor located in different regions of the brain including the middle region (aligned with eye level) which is the significant advantage of this method.

Keywords: Grayscale, Gaussian HPF, Entropy Filter, SDF, Weiner Filter, Gradient Magnitude, Regional Maxima, Bayesian classifier.

1.INTRODUCTION

Generally, tumor is which the abnormal cells are expands in our body but in brain tumor a mass of tissue in our brain cell are expanded rapidly. The symptoms of brain tumor depend upon tumor type, size and location of the tumor. The symptoms are headache vomiting nausea some other changes are speech vision and hearing problems sometime they can change their activities like personality, ability to concentrate and problem with memory. A brain tumor is categorized primary and secondary depends upon location size and its origin.

A. **Benign** tumors which type of non-cancerous mass of cells that it was expands very slowly in the brain.

It was does not spread and stay in one place. Normally benign brain tumors can be detected by CT and MRI scans.

B. **Malignant** brain tumor was rapidly expanding like cancer that spreads one area to other area of the brain and spine it.

C. Materials and Methods

A brain tumor is an abnormal new mass of tissue arising from brain cells brain structures. It can be classified as either a primary or a secondary brain tumor [7, 8]. A tumor is said to be primary if it is the major cause of the cancer in the brain and secondary if it is caused by the spread of cancer from other body organs, for example breast or lung cancer

spreading to the brain. Primary brain tumors containing no cancer cells are called benign while those that contains cancer cells are called malignant. The cells of the benign tumor rarely invade healthy tissues around them. Malignant brain tumors are likely to grow rapidly and invade neighboring brain tissues hence are often a threat to life. The malignancy of the tumor is determined based on its location, growth rate and historical features. The treatment options for people with brain tumors are surgery, radiation therapy, and chemotherapy. A combination of treatments can also be suggested. Figure 1 shows the appearance of the healthy brain from two different patients on CT and MR images.

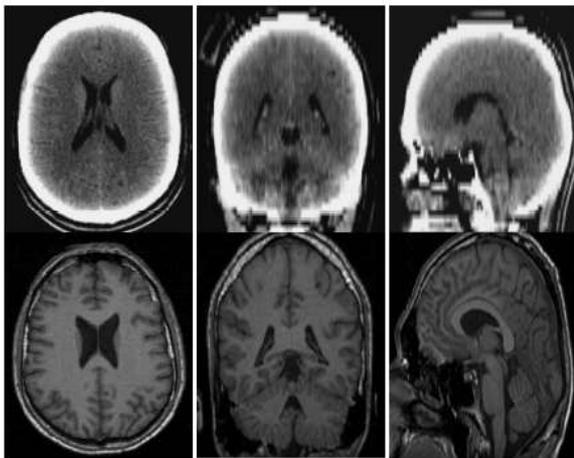


Figure 1: The appearance of healthy brain tissues on CT and MR images: (first row) axial, coronal and sagittal slice CT scan, (second row) axial, coronal and sagittal slices from MR scan.

II. LITERATURE SURVEY

In this M.Sudharson, S.R. Thangadurai Rajapandiyam and P.U. Ilavarasi demonstrated Tumor detection and removal is one medical issue that still remains challenging in the field of biomedicine. Early imaging techniques such as pneumoencephalography and cerebral angiography had the drawback of being invasive and hence the CT and MRI imaging techniques help the surgeons in

providing a better vision. In this paper, tumor image processing involves three stages namely pre-processing, segmentation and morphological operation. After the acquisition of the source image, it is pre-processed by converting the original image to gray scale in addition high pass filter for noise removal and median filter for quality enhancement is provided which is followed by enhancement stage resulting with histogram equivalent image. Finally, segmentation is done by means of watershed algorithm. The above proposed methodology is helpful in generating the reports automatically in less span of time and advancement has resulted in extracting many inferior parameters of the tumor.[1]

Medical imaging is expensive and very much sophisticated because of proprietary software and expert personalities. This paper introduces an inexpensive, user friendly general-purpose image processing tool and visualization program specifically designed in MATLAB to detect much of the brain disorders as early as possible. The application provides clinical and quantitative analysis of medical images. Minute structural difference of brain gradually results in major disorders such as schizophrenia, Epilepsy, inherited speech and language disorder, Alzheimer's dementia etc. Here the main focusing is given to diagnose the disease related to the brain and its psychic nature (Alzheimer's disease).[2]

Brown and Hwang's bestselling textbook introduces the theory and applications of Kalman filters for senior undergraduates and graduate students. This revision updates both the research advances in variations on the Kalman filter algorithm and adds a wide range of new application examples. The book emphasizes the application of computational software tools such as MATLAB. The companion website includes M-files to assist students

in applying MATLAB to solving end-of-chapter homework problem.

Medical Image Processing is one of the most challenging and emerging topics in today's research field. Processing of Magnetic Resonance Imaging (MRI) is one of the parts in this field. In recent years, multispectral MRI has emerged as an alternative to Ultrasound (US) image modality for clear identification of cancer in Breast, Prostate and Liver etc., In order to analyze a disease, Physicians consider MR imaging modality is the most efficient one for identification of cancer present in various organs. Therefore, analysis on MR imaging is required for efficient disease diagnosis. This paper describes the proposed strategy to detect and extraction of Prostate cancer cells from patient's MRI scan image of the Prostate organ. This proposed method incorporates with some noise removal functions, segmentation and morphological functions which are considered to be the basic concepts of Image Processing. Detection and extraction of cancer cells from MRI Prostate image is done by using the MATLAB software [5].

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Rajesh Patil and Dr. AS. Balachandran, proposed Mat lab has played very important role in biomedical and it has many techniques we are working on image segmentation and by using mat lab we can solve so many problems for example the accurate data of tumor to cure it. As we know the tumor is abnormal growth of tissue and MRI can't tell the exact location of tumor up to now doctors were treating it by approximation and analysis so, to give complete information about brain tumor we are using image segmentation in mat lab. Detection and extraction of tumor from MRI scan images of the brain is done by using MATLAB software (programming).

III.PROPOSED METHOD

Our proposed system mainly consists of three stages such as pre-processing, processing and post processing stage. stage 1 involves pre-processing stage that performs enhancement. Stage two discusses about various filtering techniques and stage three defines classification stage.

Here our main aim is to define the size and location of the tumor with less time and more efficiently. For this

purpose, we are using various types of filtering techniques to study and analyze the concept of the brain tumor and tissue region in brain. Finally, the tumor part is extract with help of classifier. the total architecture of the proposed system varies as shown in the above figure. Whereas the entropy filtering is used to identify the subtle grey level changes in image whereas the concept of thresholded image is defined by the cut off thresholded value. The use of linear classification model such as Bayesian makes the whole system more efficient in all the performance parameters and minimum time delay.

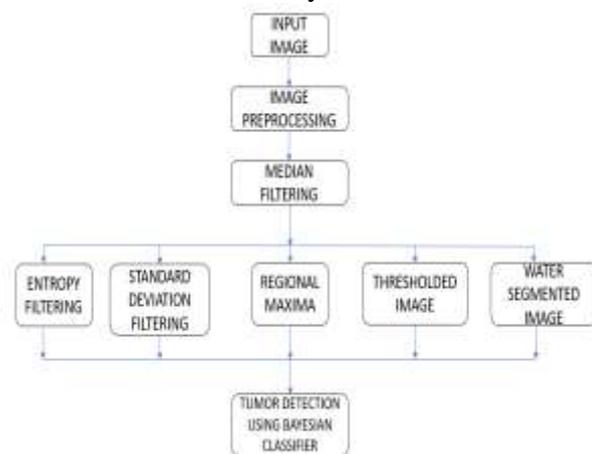


Fig.2 Proposed Block Diagram

Pre-processing:

The aim of the pre-processing is improvement of Block-Diagram as shown in Fig. 1. Those image data are suppressing with undesired distribution and it was enhancing some image for the future. The aim of Preprocessing is to reduction of the noise and to implement Contrast Enhancement [4,5] to improve the image quality. The working process of pre-processing is 1. Gray-scale 2. Noise reduction (with the help of Gaussian HPF). A. Gray Scale Gray scale image include only gray-scale values, but MRI report consist of primary colors (RGB) [6]. Gray scale is type of monochrome image where each pixel of any image possesses the information of intensity of light hence it may look similar to that of conventional

black and white image. By converting into grayscale image, it become easier for further processing of the MRI. Here we take the help of „rgb2gray“ or „binarize“ these commands help to convert the three-dimensional image into two dimensional or gray scale image.

B. Filtering:

Filtering is a technique is type of image processing where we try to reduce or keep as minimum as possible the effect of noise for this, we assume that Gaussian noise present in source. So, after the conversion into grayscale image, we try to minimize the noise effect by passing it through a type of High pass filter known as Gaussian HPF. Median filter is the type of filter provides a median value of the pixels of an image and it is used because the mean values obtained using averaging filters it makes image blur [7]. In MRI, Gaussian noise are more commonly seen or observed. Salt and Pepper noise can be reduced with the help of median filter, considering that Gaussian noise is reduced by a Gaussian high pass filter (HPF). Thus, the first stage of operation that is pre-processing is done.

C. Gaussian High Pass Filter: A high pass filter is able to pass the high frequency information of image data and it tries to block the lower terms of frequency components, thus help to the transitions of the image intensities which are required. In high-pass filter processing, the high values of pixel of image are enhanced with relative to its adjacent pixels [8] by help of kernel filter. Fig. 2 shows the after applied Gaussian HP filter.

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

D. Median Filter: The median filter has greatest advantage that it kind of filter which used to reduce or say minimize the

salt and pepper kind of noises present which is cause by motion artifacts (movement of patient during scan) in the CT & MRI images. It is done for a type of CT & MRI brain image. .

After the two stages of pre-processing and processing we come to last stage that is post-processing that we have tested resulting with some uncommon filters which are as follows:

E. Watershed Transform

Watershed transform is type of a grayscale image. The name relates to metaphorically to a geological watershed. This transform divide two adjacent drainage basins. With the help of this transformation of image one can see brain tumor appears too clearly. We used „watershed“ command to implement image.

F. Entropy Filter

The Entropy meaning is uncertainty of anything hence we called it measure of change so by applying entropy filter we measure or we try to locate where the maximum uncertain area is showing this area will corresponds to the tumor region if patient have any otherwise figure will show adverse image of grayscale image this is illustrated below with example in Fig. 4.5.

$$H(x) = -\sum_{i=0}^{N-1} p_i \log_2 p_i$$

G. Standard Deviation Filter

The implemented standard deviation filter is based on calculation two integral images and subsequent common calculation of the variance by:

$$\text{var}(x) = E[x^2] - (E[x])^2$$

The greatest advantage of implementing the STD is that the computation time is completely unaffected by the kernel size. but coming to the disadvantage part of SDF is that an extra integral based computation is there and it doesn't allow easy variation on the kernel

shape like triangle, cross circle, and as a result of all of these only rectangular kernels are supported.

H. Wiener Filter

This approach might produce better results than any of linear filtering used conventionally by using this process.

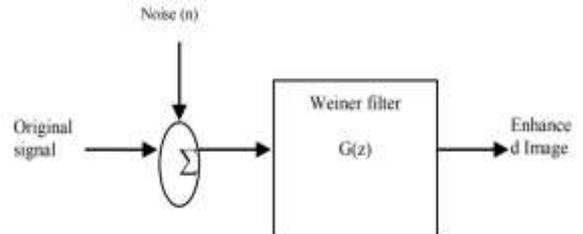


Fig.3 Block Diagram of Wiener Filter

This filter uses adaptive filtering technique that it tries to reduce the error as minimal as possible hence we can say adaptive filter has the more selectivity than a compared to linear type of filter, it passes edges and other high-frequency parts of an image. We have seen of its advantage that there is no design task to perform; we take the help of the „wiener2“ function which performs all preliminary computations and implements for the filter for an input image. But it has one drawback that need more time of computation than linear filtering. Result is shown in Fig. 4.8.

$$G(z) = \sum_{a=i}^N a_i z^{-i}$$

I. Color map

Colormap is set to be the color map for current figure map set is predefined colormaps. In this shown axes and charts use the same color mapping. The new colormap is the same length (number of colors) as the previous colormap.

J. Gradient Magnitude

The gradient of any vector image contains information of variation that means we can tell whether or not or where or when any image is changing so by this method, we have seen that the tumor

region or the abnormal region can see and it is more efficient compare to previous technique that we proposed.

The gradient magnitude is a scalar quantity that describes the local rate of change in the scalar field. For notational convenience, we will use f' to indicate the magnitude of the gradient off, where f is the scalar function representing the data.

K. Regional Maxima

Regional maxima compare the two neighboring pixels of any image and the resultant image show us where the image maxima have occurred but quality of image has reduced so we proposed this technique.

Regional maxima are connected components of pixels with a constant intensity value, surrounded by pixels with a lower value.

NAÏVE BAYES CLASSIFICATION

Threshold based on maximum entropy has better performance on the segmentation when compared to other threshold methods such as Otsu's threshold and adaptive threshold, due to large intensity variations of foreground and background image intensity in the sample MRI images. The motivation of using this method for segmentation is from Shannon's classic notion of entropy [8]. This method has been successfully applied in many medical image analysis [9], [10], [11]. In this research, the maximum entropy method is applied to the enhanced brain image to obtain the entire tumor region.

The classifier known as Naïve Bayes Classifier is well-defined as the collection of several algorithms that are classified based on Bayes' Theorem. It is the grouping of several algorithms but not a sole algorithm where all of them always being shared with a mutual value, i.e. each couple of landscapes being confidential is always autonomous of each other. To flinch with, we will deliberate a dataset mentioned above. Consider a imagined

dataset that defines the tumor symptoms, origination and treatment for the occurrence of the tumor. Given the tumor dataset, every tuple categorizes the actions as if it is fit then it shows "yes" else it shows "no" for the occurrence of tumor.

The main basic Naïve Bayes hypothesis is known as each and every feature varieties an: \square independent \square equal contribution with a required outcome. With matching to the above dataset, we can easily classify this as: At first we undertake that any pair is reliant on with each other. For example, the origination is from 'kidneys' has no work to do with the symptoms or if the tumor is 'astrocytoma' has no effect on the treatment. Hence, the features here are always known to be not dependent to each other. And next each and every feature is possessed with the same weight(or importance). For example, knowing only origination and symptoms alone can't predict the outcome accurately. None of the attributes is irrelevant and expected to be underwriting similarly to the conclusion. Note: We can say here that the following assumptions that we made by the Naïve bayes classifier is not always correct in the real time situations. So we can say that the independent assumptions are not correct always but it works well for the purpose of practice. Now, we first discuss about the Bayes' theorem.

In this stage, many morphology features and intensity features are extracted from the grayscale image of the segmented tumor area. Eight region properties (area, perimeter, eccentricity, equivalent diameter, solidity, convex area, major axis length, minor axis length) and three intensity features (maximum, mean, minimum), the total of eleven variables are extracted and saved in a specific matrix to be trained in Naïve Bayes classifier.

The Naïve Bayes classification is a supervised classification of machine learning, based on a probabilistic approach

which uses Bayes' theorem of probability [12]. The Naïve Bayes algorithm is called "naïve" because it makes the assumption that the features occurrences are independent of each other. That is the main reason why we use this algorithm for detecting brain tumor from different locations with different types of features. As in most fields that deal with events under randomness, probability considerations become significantly effective due to independence on the occurrence of the extracted features. The extracted features matrix is subjected to be trained in the Naïve Bayes classifier so that it could predict the test image whether it is normal or tumor. More false tumor objects are trained than tumor objects for better performance since the false tumors are detected in different locations.

IV. RESULTS AND DISCUSSION

Simulation and performance evaluation of the proposed algorithm is accomplished through various images processed on MATLAB platform. The proposed algorithm outputs are as shown in below figures. These are the outputs that are obtained at various stages i.e., preprocessing stage, morphological stage and postprocessing stage.

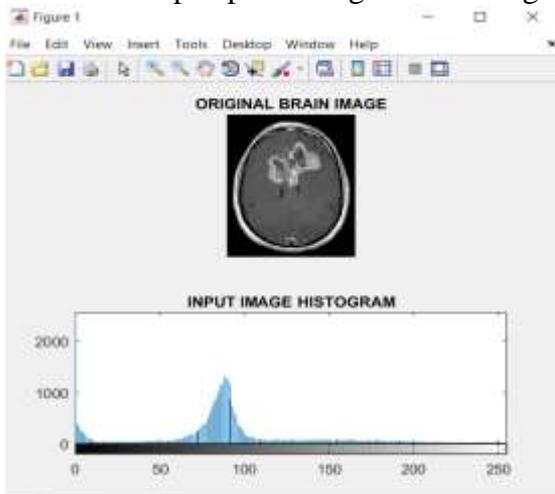


Fig.4 Original Image

In the above figure, we get histogram image for the original brain image.

Histogram is defined as graphical representation of original image. Histogram condenses a data series into an easily interpreted visual by taking many data points and grouping them into logical ranges or bins. A histogram allows you to see the frequency distribution of a data set. It offers an "at a glance" picture of a distribution pattern, charted in specific categories.

In the first step, it undergoes preprocessing which is as shown in the below figure. Preprocessing is a process in which RGB is converted into grayscale image. While converting, there is an occurrence of the noise i.e., salt and pepper noise. It is identified and it is removed by using Gaussian High pass filter.



Fig.5 Filtered Image

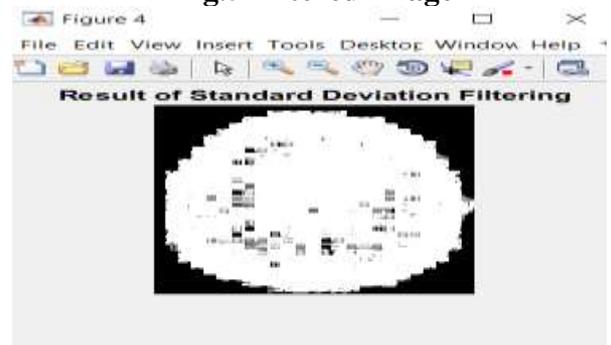


Fig.6 Standard Deviation Filtered

In the below figure, it undergoes thresholding. It is a process of segmenting images where we change the pixels of an image to make the image easier to analyze.



Fig.7 Thresholded Image

After obtaining thresholded image, apply watershed transform to the above image. Watershed transform is type of a grayscale image. The name relates to metaphorically to a geological watershed. This transform divide two adjacent drainage basins. With the help of this transformation of image one can see brain tumor clearly. We use watershed command to implement the process which is as shown in the below figure

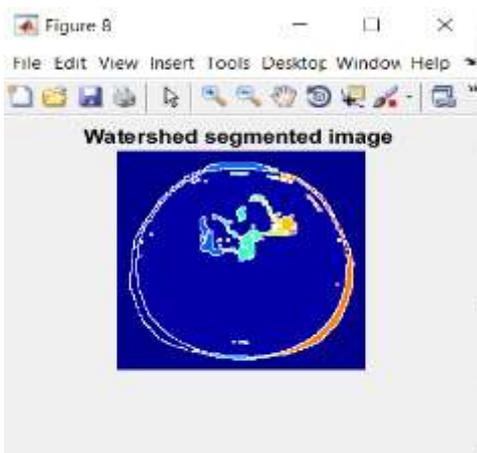


Fig.8 Watershed Segmented Image

Finally, by using the SVM classifier we get the required output which is as shown in the figure 10. SVM is a supervised machine learning algorithm which can be used for classification or regression problems. SVM means support vector machine and by using the SVM we get required brain tumor region for the given input image.

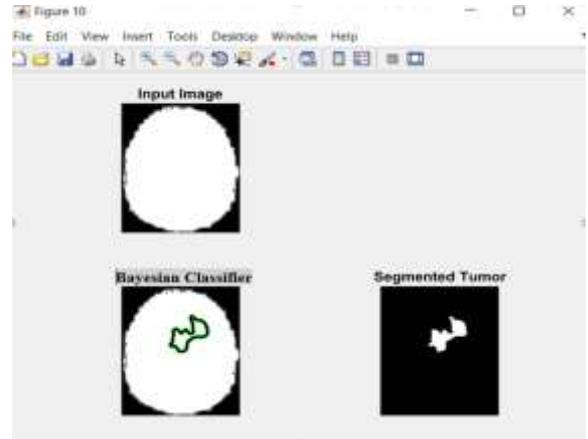


Fig.9 Final Segmented Tumor Image

Preprocessing image please wait . . .

Removing noise

Filtering Completed!!

Press any key

classifying tumor boundary

Mean = 66.0461

Standard Deviation = 60.0786

Entropy = 5.6194

RMS = 12.1506

Variance = 2.8665e+03

Elapsed time is 12.773992 seconds.

V. CONCLUSION

All the discussion is aiming to detect the brain Tumor from or the abnormal behavior of the any one's brain through CT and MRI brain images. The brain tumor is detected more accurately using image processing and various type of the morphological operations, image filtering are performed for analysis or to observe and to obtain the various parameters like Mean, Standard deviation, Third moment, Area, Entropy of the image. used for the detection of brain tumor type among several kinds of patients. we used classification to predict the type of brain tumor in patients Naïve Bayesian, Using these algorithms the type of tumor has been found and it allows analysis of historical data from data sets which helps neurologists to predict the type of tumor. From the above prediction analysis we have found that the decision tree predicts

more fastly and accurately than that of the naïve Bayes classifier.

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