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Brain Tumor Detection a Classification Using Machine Learning Technique

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Abstract- In spite of lots of research has been reported and investigated by many researchers using the modem techniques, it seems that there is a withal scope for the improvement of the actual MRI based brain tumor segmentation, detection and classification. Based on the literature review & critical finding, the objective of the proposed thesis work is given as follows. To develop a segmentation method which provide a highest degree of segmentation score, dice coefficient, characterization of tumor tissues (white matter, gray matter, and edema), and other performance parameters from MR pictures of brain tumor. To evaluate the segmentation accuracy of these methods against a gold standard produced by manual segmentation and other available techniques. To propose segmentation with a classification scheme optimize using feature selection for categorizing the type of brain tumor classes. To evaluate the segmentation performance for the MR images available in compressed form so it will help in the advancement of e-health care technology and also to developed a auto-report generation technique for the quick diagnosis analysis.

Keywords: - Machine Learning, SVM, BWT, Feature Extraction, MRI image.

I. INTRODUCTION

In recent times, the introduction of information technology and e-health care system in the medical field helps clinical experts to provide better health care to the patient. This study addresses the problems of segmentation of abnormal brain tissues and normal tissues such as gray matter (GM), white matter (WM), and cerebrospinal fluid (CSF) from magnetic resonance (MR) images using feature extraction technique and support vector machine (SVM) classifier [1, 2].

The tumor is basically an uncontrolled growth of cancerous cells in any part of the body, whereas a brain tumor is an uncontrolled growth of cancerous cells in the brain. A brain tumor can be benign or malignant.

The benign brain tumor has uniformity in structure and does not contain active (cancer) cells, whereas malignant brain tumors have no uniformity (heterogeneous) in structure and contain active cells. The gliomas and meningiomas are the examples of low-grade tumors, classified as benign tumors and glioblastoma and astrocytomas are a class of high-grade tumors, classified as malignant tumors. One of the challenging tasks in the medical area is brain tumor segmentation which consists on the extraction process of tumor regions from images.

Generally, this task is done manually by medical a expert who is not always obvious due to the similarity between tumor and normal tissues and the high diversity in tumors appearance. Thus, automating medical image segmentation remains a real challenge which has attracted the attention of several researchers in last year's.

In this paper, we will focus on segmentation of Magnetic Resonance brain Images (MRI). Our idea is to consider this problem as a classification problem where the aim is to distinguish between normal and abnormal pixels on the basis of several features, namely intensities and texture. More precisely, we propose to use Support Vector Machine (SVM) which

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is within popular and well motivating classification methods. Magnetic Resonance Imaging (MRI) provides detailed images of brain studies. MRI data are used in brain pathology studies, where regions of interest (ROI's) are explored in detail. This assistant diagnostic device is very helpful for doctors during disease diagnosis and treatment. The plenty of acquired images show the inside to doctors, but, doctors seek to know more details about images, such as emphasizing the tumor area, quantifying its size, and so on. If these tasks are made by doctors themselves, it is possibly inaccurate or even impossible.

Therefore, image processing by computers is relevant in radiology. There are already several computer-aided diagnosis (CAD) systems which are used in disease monitoring, operation guiding tasks, etc. [1]. In fact, CAD seeks to assist doctors by providing computer outputs, which are considered as a second opinion during abnormalities detection, disease progress survey, etc. Among all medical image processing, image segmentation remains a crucial task consisting of extracting regions of interest from images. But it is still not well solved because of the complexity of medical images [1].

II. RELATED WORK

Image analysis usually refers to computer image processing with the objective of finding image objects. Image segmentation is one of the most critical tasks in automatic image analysis. It plays a crucial role in many imaging applications and consists on subdividing an image into its constituent parts and extracting the regions of interest that should be homogeneous with respect to some characteristics such as intensity or texture.

A great variety of segmentation algorithms have been developed in the last few decades and this number continually increases each year. These methods vary widely depend on the specific application and other factors. A classification on these methods was proposed in [2] on the basis of five criteria namely: region, contour, shape, structural approaches and graph theory.

Since we are interested in brain tumor segmentation, then tumor regions can be scattered all over the image. This explains the fact that determining the regions of interest is also called pixel classification and the sets are called classes. In fact, pixel classification rather than classical segmentation methods are often preferable especially when disconnected regions of interest belonging to the same class should be extracted. Detection and classification of brain tumors from modem imaging methods is a major problem. But this is a time-consuming and tedious job done by a radiologist or clinical supervisor.

The exactness of radiologist detection or organization of tumor phases depends only on their experience. Therefore, the use of computer-aided technology is very important in helping diagnostic accuracy. Image processing techniques such as segmentation, improvement or edge detection etc. have been widely used for more than a decade. Image analysis related to this field such as panchromatic sharpening [4], medical image analysis [5, 6], biomedical analysis [7, 8] are extremely important. Image processing plays a significant role for analyzing MR images. Advanced techniques or algorithms need to be developed for automatic detection of brain tumor from MR images so that the doctor can take informed decision during drug administration

In this thesis, we investigate the problem of automatic detection of brain tumor with the help of image processing techniques by comparing segmentation score, accuracy of the classification and dice similarity index. We have studied and extract different features for classification of tumor type. In this work, we extracted features; features are selected for the classification of the tumor type using optimization technique. To recover classification accuracy, we study or apply different soft computing techniques such as support vector machine, self organizing map, and genetic algorithm for such purpose. Our proposed technique based on Support Vector Machine (SVM) based optimization and classification technique gives 98.00% accuracy for organization of tumor type.

The investigational outcomes are performed with feature extraction and without article removal and detailed comparison have been reported in the thesis. To recover overall presentation of recognition or organization by means of quality parameters, the image improvement is functional on the MR images. Quantitative analysis have been carried out on several available image processing techniques such

as histogram analysis, adaptive histogram analysis, intensity value adjustment, wiener filtering, median filtering and fuzzy based techniques to judge the performance of the enhancement algorithm for the MR images.

Through the experimental analysis it is found that Fuzzy Clustering Means (FCM) is significantly better than the other enhancement techniques. We propose a novel segmentation technique based on Berkeley Wavelet Trans-formation (BWT) by comparing it with the other advanced techniques such as FCM, Discrete Cosine Transformation (DCT) and Lifting Wavelet Transformation (LWT) we also discuss the merits and weaknesses of each segmentation method by means of segmentation score.

Average segmentation score varies from 0.55 to 0.67 for watershed based segmentation, 0.72 to 0.80 for FCM based segmentation, 0.77 to 0.87 for DCT based segmentation, and 0.82 to 0.93 for Berkeley Wavelet Trans-formation (BWT) based segmentation. Higher the segmentation score, better the Algorithm is. Therefore, high segmentation score exhibited by the BWT based segmentation prove its significance over the other available methods.

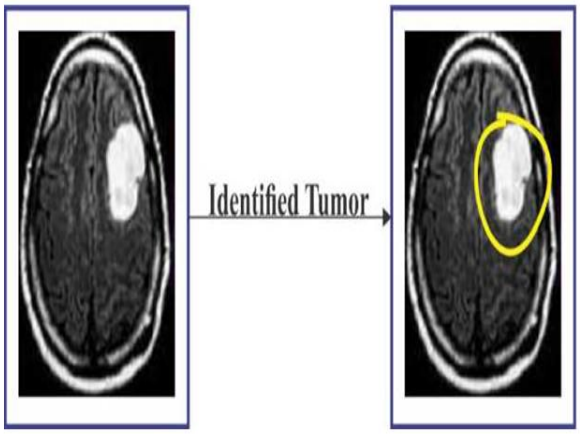

Fig 1. Identified area of the tumor in MR image.

The proposed thesis work integrates the study of feature extraction, feature selection and classification for the purpose of automatic brain tumor detection. Feature removal and selection are completed for accurate diagnosis analysis.

The detection of brain tumor and then deciding the right therapy is a long process, and once it is acquainted then time to time evaluation and its progress is extremely important.

III. PROPOSED METHOD

In this study, to improve the performance and reduce the complexity involves in the medical image segmentation process, we have investigated Berkeley wavelet transformation (BWT) based brain tumor segmentation. Furthermore, to improve the accuracy and quality rate of the support vector machine (SVM) based classifier; relevant features are extracted from each segmented tissue.

The experimental results of proposed technique have been evaluated and validated for performance and quality analysis on magnetic resonance brain images the MR image is pre-processed, such as grayscale conversion, filtering, and image enhancement, to create an image that can be used in subsequent steps. The steps that we used in the proposed method are shown in Figure 2.

The segmented image is used to extract types. For this reason, in addition to BWT, GLCM is also used, and due to the richness of noise, irrelevant or deceptive skin, feature selection should be made. In the proposed system, the brain tumor MR images are taken and the tumors are first segmented using threshold segmentation and SVM classification in used for classification.

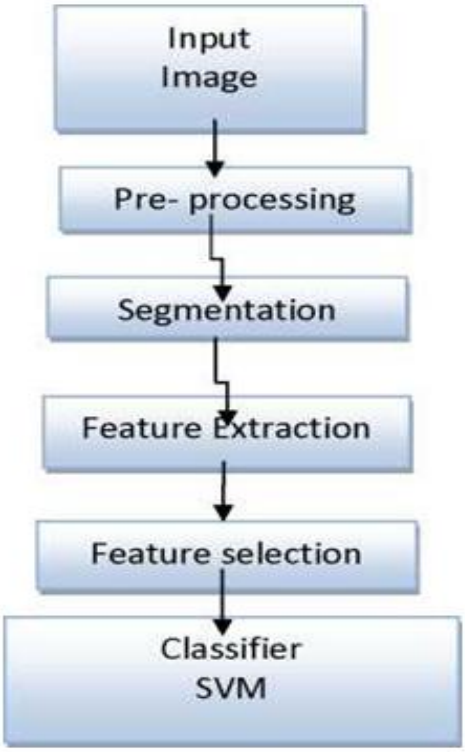

Fig 2. Proposed Flow Chart.

1. Preprocessing:
The primary task of preprocessing is to improve the quality of the MR images and make it in a form suited for further processing by human or machine vision system. In addition, preprocessing helps to improve certain parameters of MR images such as improving the signal-to noise ratio, enhancing the visual appearance of MR image, removing the irrelevant noise and undesired parts in the background, smoothing the inner part of the region, and preserving its edges [5].

To improve the signal-to-noise ratio, and thus the clarity of the raw MR images, we applied adaptive contrast enhancement based on modified sigmoid function [14].

2. Skull Stripping:
Skull stripping is an important process in biomedical image analysis, and it is required for the effective examination of brain tumor from the MR images .Skull stripping is the process of eliminating all no brain tissues in the brain images. By skull stripping, it is possible to remove additional cerebral tissues such as fat, skin, and skull in the brain images. There are several techniques available for skull stripping; some of the popular techniques are automatic skull stripping using image contour, skull stripping based on segmentation and morphological operation, and skull stripping based on histogram analysis or a threshold value. Figure 2 provides the stages of the skull stripping algorithm. This study uses the skull stripping technique that is based on a threshold operation to remove skull tissues. [15]

3. Segmentation and Morphological Operation:
The segmentation of the infected brain MR regions is achieved through the following steps: In the first step, the preprocessed brain MR image is converted into a binary image with a threshold for the cut-off of 128 being selected. The pixel values greater than the selected threshold are mapped to white, while others are marked as black; due to this two, different regions are formed around the infected tumor tissues, which is cropped out. In the second step, in order to eliminate white pixel, an erosion operation of morphology is employed.

Finally, the eroded region and the original image are both divided into two equal regions and the black pixel region extracted from the erode operation is counted as a brain MR image mask. In this study, Berkeley wavelet transformation is employed for effective segmentation of brain MR image.

4. Feature Extraction:
It is the process of collecting higher-level information of an image such as shape, texture, color, and contrast. In fact, texture analysis is an important parameter of human visual perception and machine learning system. It is used effectively to improve the accuracy of diagnosis system by selecting prominent features. [12] Introduced one of the most widely used image analysis applications of Gray Level Co occurrence Matrix (GLCM) and texture feature. This technique follows two steps for feature extraction from the medical images. In the first step, the GLCM is computed, and in the other step, the texture features based on the GLCM are calculated. Due to the intricate structure of diversified tissues such as WM, GM, and CSF in the brain MR images, extraction of relevant features is an essential task. Textural findings and analysis could improve the diagnosis, different stages of the tumor (tumor staging), and therapy response assessment.

IV. RESULT AND DISCUSSION

Detection and classification of brain tumors from modem imaging methods is a major problem. But this is a time-consuming or deadly job done by a radiologist or clinical supervisor. The precision of radiologist detection o of tumor phases depends only on their experience. Therefore, use of computer-aided technology is very significant in helping diagnostic accuracy.

Imaging techniques such as separation, enhancement and edge detection etc. have been widely used for more than a decade. In this paper we investigate the problem of automatic detection of brain tumor with the help of image processing techniques by comparing segmentation score, accuracy of the classification and dice similarity index. To advance precision of classification, we investigate and apply various soft computing techniques such as support vector machines, self-organizing maps, and genetic algorithms. Our technology based on SVM support optimization and classification technology provides 98.00% accuracy for tumor type classification. The experimental results were performed without extraction of properties, and a detailed comparison image improvement is smear to MRI images.

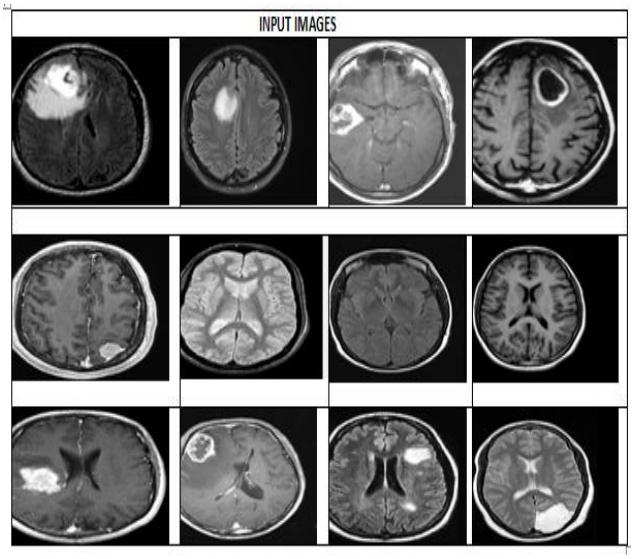

Fig 3. Input of brain MR image.

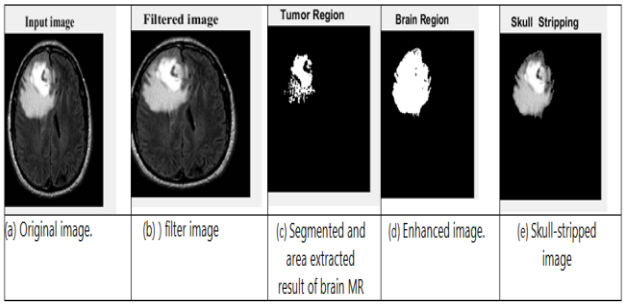

Fig 4. Figure (a) original image (b) filter image (c) Segmented and area extracted result of brain MR (d) Enhanced image. (e) Skull-stripped image

Table 1. Comparatively Analysis.

Parameter	Existing Work (%)	Proposed Work (%)
Accuracy	90.54	92.23
Sensitivity	76.54	99.74
Specificity	94.2	90.90
PSNR	55.45	66.42
MSE	1.86	0.0373

V. CONCLUSION AND FUTURE WORK

In this paper an algorithm in Matlab GUI has been developed for the detection and classification of brain tumor from MRI scanned brain images based on various operations like preprocessing, C-segmentation, and feature extraction and by using SVM classifier. The proposed hybrid approach was applied to brain MRI Images in order to classify brain tumor either as benignant or malignant. Automatic brain tumor detection approach reduces the manual labeling time and avoids the human error. Initially, input image is passed through pre-processing steps in which noise reduction and image smoothing is performed. It is used for noise reduction as well as enhances image quality with good resolution.

After then image is segmented using different thresholding Final analysis is based on extracting features GLCM From segmented images, the extracted features can be further classified using classifier. Based on analysis of different methods mentioned in this paper, the result achieved with good accuracy through SVM classifier. Amongst all these methods many reached good results with accuracy.

In the future, approaches and ideas which are proven to work well from methods which were already proposed can be extracted, combined and further improved.

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