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Automatic Brain Tumour Diagnosis and Segmentation: based on SVM Algorithm

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Abstract: ***Brain tumour is undesirable expansion of destructive cell in or around the cranium. It can directly attack our healthy brain cell within the skull or it might invasion indirectly from disparate organs of the body such as lung cancer, breast lump. Its size becomes double within 25-30 days. Brain tumour is one of the highest threatening illnesses among cancerous diseases. Unfortunately possibility of death patients from brain tumour is to a greater extent in contrast with other illness. If we didn't treat the cerebrum tumour at near the beginning the possibility of patient death will be very high in just one half year. Hence it's very important for the research to find away to automatically recognize brain tumour and classify it to cancerous and non-cancerous tumor.That's why these day's one of the most widely research zone in image processing is brain tumor recognition and categorization. This article present various phase involves in brain cancer recognition and categorization such as pre-processing, cleavage, characteristics extraction, and classification of brain tumour by utilizing SVM algorithm .The proposed system execution and analysis was examined which achieved favorable outcome, high accuracy at minimal time in contrast weigh the research completed previously.***

Keywords: Peak Signal to Noise Ratio (PSNR), Support Vector Machine (SVM), Grey- Level Co-Occurrence Matrix (GLCM), Mean Square Error (MSE), Graphical User Interface (GUI).

I. INTRODUCTION

Brain tumor can be described as a condition in which cells within the cranium grows abruptly. The expansion of brain tumor initiates from the nerves appearing in gray matter, and the blood veins in most of the cases. There are two categories in which tumors can be divided. These categories are metastatic (cancerous) and kind (non-cancerous). Non-cancerous tumors grow slowly [1]. The gentle tumors don't expand in the adjacent gray matter tissue. These cancerous growths are generally not harmful. In contrast to benign tumors, the malignant tumors grow more speedily. These tumors can expand in the adjacent brain part [2]. Tumors can damage the healthy brain cells. This happens due to inflammation, load on the cerebrum areas and more stress in the skull [3].

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Digital image processing has attracted the attention of various researchers in the last few years. It is Possible to use this technique for the detection of complex diseases. These diseases include brain tumor, breast cancer, kidney stones etc. It is a complex job to detect brain tumor. In this procedure, image segmentation process is very crucial [4].
A particular body part can be scanned using different existing techniques [5].These techniques include CT scan, x rays, and MRI. Physicians analyze these scans to provide the solution of the detected issue [6]. Most of the deaths and disabilities all over the world occur due to brain cancer. Researchers have carried out various research studies over the years for gray matter tumor identification. It is possible to identify skull cancer in near the beginning stage using image processing [7]. In order to detect skull cancer, image processing and image enhancement techniques can be utilized. These techniques are used for the improvement of the picture quality for medical image processing. For highlighting the characteristics of the MRI pictures contrast adjustment and threshold approaches are used .Some techniques are used for the recognition and categorization of brain tumor and they are: histogram, edge recognition, morphological operations and segmentation [8].

A) Image Preprocessing

For the achievement of precise outcomes, the MRI picture should not contain any unnecessary information and also the picture should be in accurate format. This arrangement is categorized as image preprocessing. Image preprocessing technique involves a number of procedures such as elimination and minimization of unwanted noise, redevelopment of picture, up gradation of the image, and translation to grayscale. It may also include the elimination of cranium from MRI with respect to medical pictures. Removing of redundant noise and improving image are the two key purposes of image preprocessing. The features of the picture are improved with the help of the image preprocessing methods. The image enhancement is based on some aspects. These aspects include measurement time, measurement price, quality of the clean picture, and the methodologies employed for noise dismissal. Image preprocessing is performed using some linear and non linear techniques [9]. In the linear approach, without identifying the normal or affected image, algorithm can apply linear to all the pixels while in non linear approach, after the identification of affected and non affected picture, pixels can be applied by the algorithm. After this, unaffected images retain while the affected pictures are filtered with the help of some explicit algorithm. It is always seen that the non linear filters gives better performance in comparison with the linear filters.

B) Feature Extraction

The procedure of taken our useful data from a picture in the form of color characteristics, color contrast, shape and texture is known as feature extraction. Some methodologies are employed for the extraction of features and they are.

*1) **Feature extraction using DWT***

For the extraction of features or characteristics discrete wavelet waveform is considered a very useful technique. This technique is used for the *extraction* of coefficients of wavelets from the pictures of brain. For the localization of the frequency data of signal function, wavelet is used. This is very necessary for categorization. Four sub bands are generated when 2D discrete wavelet transform is implemented [10].These sub bands can be described as LL, LH, HH and HL. An estimation with three detailed images is displayed with the help of 2 D level decomposition of a picture visual for the showing the presence of low and high level frequency components.

2) **Feature extraction using GLCM**

For human display observation and machine learning, a differentiation between affected and non affected tissues is performed by text analysis. The variation between the normal and abnormal tissue is also presented by this analysis which is not accessible by the human vision [11]. In this approach extraction of textural examining characteristics information from the histogram picture intensities is performed in the very first step. After this, the measurement of the frequencies of gray level on random picture location is done. In the next step, extraction of second order textural analysis characteristics is implemented. The extraction is based on the possibility of grey level at random distances and on the whole picture inclination. With the help of grey level co-occurrence matrix (GLCM), the statistical characteristics are taken out. This matrix is also known as grey level spatial dependence matrix.

C) Image Classification

Image classification includes a number of things like image preprocessing, object division, characteristic extraction, image detection and much more. Image classification is extremely completed and imperative job [13]. The image classification contains a data set of a number of patterns. Following are the techniques present in image classification:

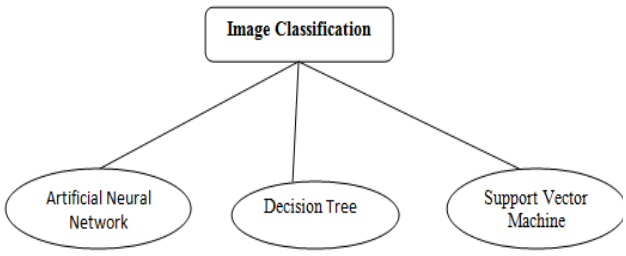


Figure 1: Representation of image classification techniques

D) Segmentation

Segmentation divides image into several segments. These segments are quite similar in terms of weave, intensity, tint, dissimilarity and gray level. Therefore the key aspire of segmentation is the dividing objects occurring within the image is the key motive of segmentation. These objects are linked to each other in some manner [12]. A block diagram representing different segmentation techniques is shown below.

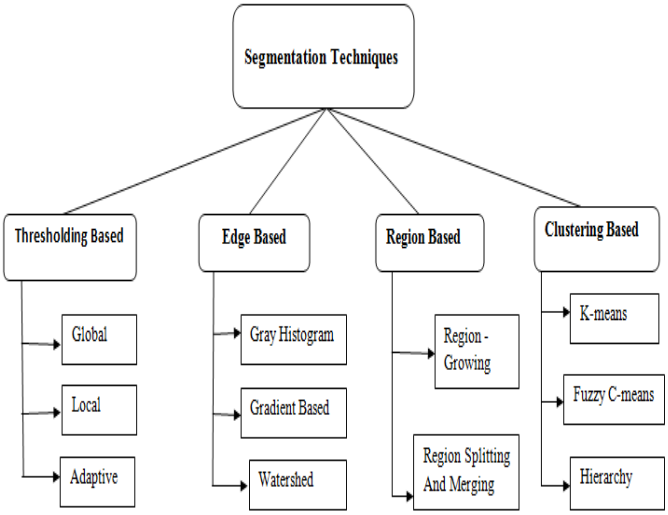


Figure 2: Representation of image segmentation techniques [12]

The rest of this paper is composed as follows. In segment II, present brief literature survey. Recommended technique based on SVM classifier is discussed with details in segment III.Section IV; illustrate outcomes subsequent to the exhibition assessment of the suggested method. The last part Section V is devoted to sum-up.

II. LITERATURE REVIEW

Manishah, Radhakrishnann, B, et.al (2017) recommended an automatic method for extracting region of interest [14]. This technique could be a wonderful alternative for surgeons. This work used brain MRI scans as input image. These scans

Provided apparent and healthy two dimensional image of the inner part of the brain. This phenomenon proved very helpful in tumor diagnosis. Truthful and precise results were provided by median filter and sobel edge detector approach. On the other hand, the faulty verification of tumor could mislead plan and healing process. Therefore, it was necessary to be careful in terms of trustworthiness and accuracy due to their importance in the tumor detection.

Mathew, A. R, et.al (2017) performed a research study for proposing and implementing a competent model to detect and classify tumor [15]. Image preprocessing for noise elimination, feature extraction, segmentation and classification were the main steps included in this study. The preprocessing of MRI brain image was carried out using anisotropic diffusion filters. Features based on Discrete Wavelet

Transform (DWT) were taken out in attribute taking out stage. The retrieved features were fed as input in the Segmentation step. Cancer partition and classification was carried out using SVM classifier.

Kapoor, L, et.al (2017) reviewed various Medical Image Processing methods. These techniques were significantly utilized to detect brain tumors from MRI scans [16]. Initially, different existing medical image processing techniques were studied thoroughly. Several existing case studies in the context of medical image processing were reviewed as well. Afterward, a list of several existing methods was made. This work also described every approach briefly. It was analyzed that segmentation was the most important and promising step among all the steps involved in brain tumor detection.

Islam, M. R., Imteaz, M. R, et.al (2018) explained a novel framework that had the ability of detecting brain tumor more accurately [17]. This framework efficiently analyzed the several traits of the tumor. This framework recommended a novel technique based on computer aided image processing. The core objective of this recommended scheme was improving precision rate of cerebrum cancer identification via calculating sarcoma and its position. The proposed technique provided valuable information on the basis of which tumor was categorized as cancerous or non-cancerous. The explained framework used MRI images for brain tumor detection. This framework integrated thresholding and morphological procedure with histogram based technique for this purpose. This framework thoroughly analyzed these techniques. A database named BRATS of MR images was used to carry out tests. The proposed approach showed detection rate of 86.84%.

Reddy, D, et.al (2018) used dicom Magnetic Resonance Image (MRI) as input. An effort was made in this work for extracting tumor cells from the input image [18]. The noise was eliminated from the image using Pre-processing method. K-means clustering algorithm was implemented on the preprocessed image. Later, morphological operations were applied on the achieved clustered image for extracting brain area. This was done for the efficient detection of tumor cells. At last, image thresholding was implemented on this image.

Afterward, level set segmentation was performed for tumor cells extraction. The accuracy level of propose technique was assessed in terms of different performance metrics.

Archa, S. P. et.al (2018) proposed a new and totally automated and consistent segmentation algorithm for accurately segmenting brain tumor [19]. The proposed algorithm was based on CNN approach. A positive effect against over fitting had been provided by the 3x3 kernels. Intensity normalization was applied in the preprocessing step. It was not generally utilized in Convolutional Neural Network (CNN). It was advantageous to have accurate boundaries of the specific Tumor for some applications. These applications included knothole and the Nano computerized operation. On the image,

Clever boundary discovery and edge detection with WDT techniques were carried out. In order to improve image, PCNN technique was used. In future, the edge detection by image

enhancement would make possible wide-ranging surgical applications in healthcare sector.

Chew, K. M, et.al (2018) made a discussion on the BSP and 2-Dimention illustration of a real-time Radar micro wave study scheme [20]. In this work, a monostatic ultra wideband textile aerial was used to detect brain tumor. A cerebral vision with tumor was developed for the simulation of brain tumor. A fresh configuration of agar, sucrose and H2O founded on the respective permittivity of the actual individual cerebrum was used to do this. In order to find out the reflection point, they have put into practice 5 standard pane role and a scheme position utility was implemented.

III. PROPOSED METHODOLOGY

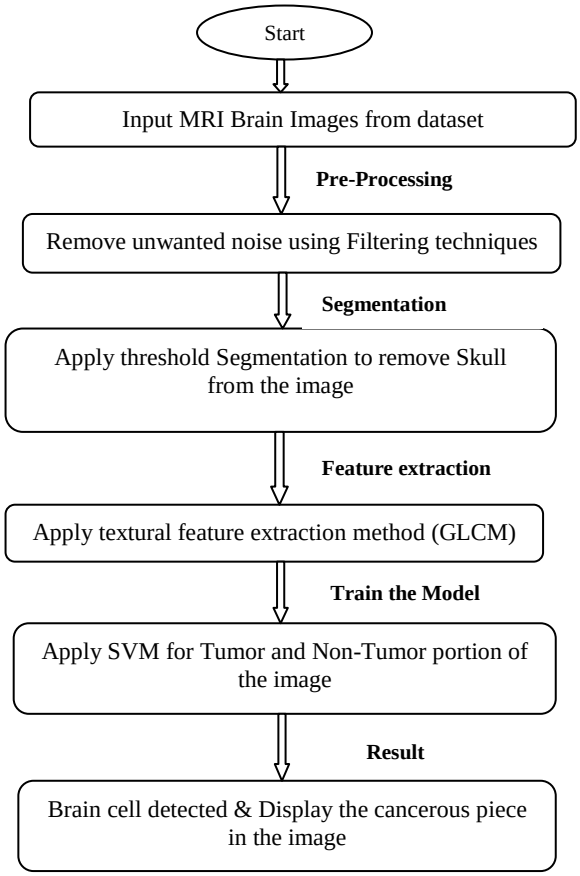


Figure 3: **Proposed Methodology Flow-Chart**

The above chart shows recommended technique of brain tumor detestation and classification using SVM classifier Figure 3. Image classification includes a number of things like image preprocessing, object division, characteristic extraction, image detection and much more [21]. Image classification is extremely completed and imperative job. The image classification contains a data set of a number of patterns.

Support Vector Machine:

Classification is performed by generating a hyperactive level or set of hyperactive levels in lager dimensional area by applying SVM classifier [22]. The hyper plane that is farthest away as of the closest instruction information position of every group helps in achieving good separation. Basically, the generalization error of classifier is less in case when the margin is large.

It is possible to handle more input data in a very efficient manner by using Non-parametric with binary classifier technique in SVM. Depending upon the chosen hyper plane and kernel parameter, the performance and accuracy are achieved. SVM is one of the most efficient algorithm used classification in image processing [23]. Support vector machine classifier can be used for linear as well as non-linear types of data [24]. These metrics included entropy, kurtosis and correlation, efficiency, and also root mean square error (RMS).

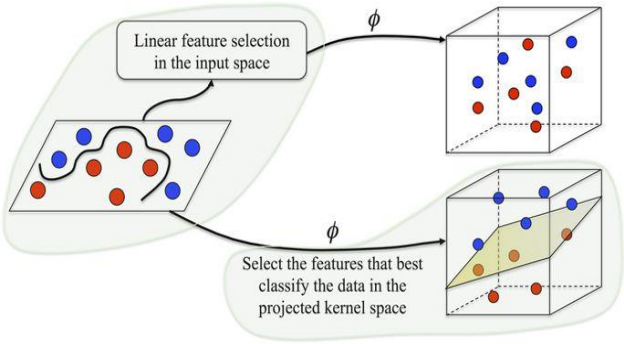


Figure 4:**Non-Linear Support Vector Machine scheme for hyperspace [23]**

The recommended technique outperformed the comparatively with available techniques in terms of Accuracy and RMS error as per the achieved simulation results [25]. The above fig.9 shows support vector machine topology for a hyper-plane.

IV. RESULT AND DISCUSSION

The propped model ‘‘Automatic Brain Tumor Diagnosis and Categorization’’ using MRI image is implemented by utilizing MATLAB software[26,27].To get the required result successfully Graphical User Interface(GUI) is planned to carry out the deliberated job, which is to spot abnormal segments in certain MRI images and display its variables (Accuracy PSNR, MSE, Fault rate Detection) likewise.

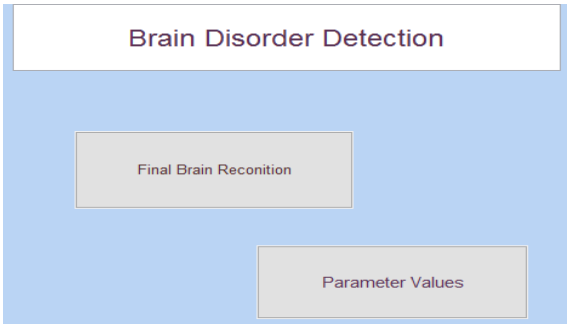


Figure 5: **Graphical User Interface (GUI)**

In the above figure, the 1st button accomplishes different algorithms and subsequently the 2nd computes parameters [28].

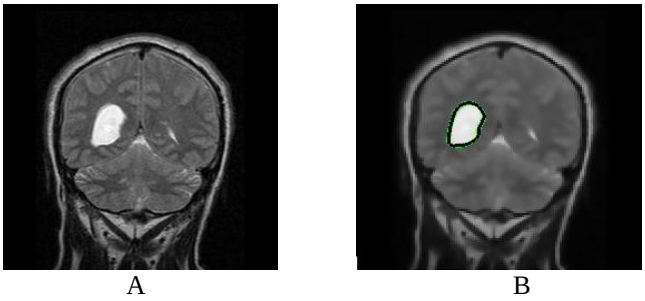


Figure 6 :(A) Input image, (b) Result of SVM classifier, (c) Identified Tumor

Graphical User Interface (GUI) performed to task brain rmal detection and parameter values. To find out where ... patient have brain cancer or not the user will ask to select the MRI image then the selected image will loaded towards analysis and processing such as filtering operation, segmentation, feature extraction and eventually end up on the result which shows where the patient brain has abnormality or not[29,30]. To find parameter values for given MRI input image, the user will be asked to press the button for parameter values therefore after running the code measurable factors will be computed and exhibited on the screen.

These parameters are:

MSE

Stands for Mean-Square-Error, characterize accumulative square fault of the primary image and the squeezed picture.MSE can be determined as following function:

$$\boldsymbol{Rmse = \frac{1}{PxQ}\sum_{i,j}^{i,j}[K1(r,s) - K2(r,s)]^2} \quad (1)$$

Where K1 and K2 are two images and P, Q are the number of rows and columns. It’s a function the correlate with anticipated value of error square, lower the values of the MSE minimum will the error [31, 32].

PSNR

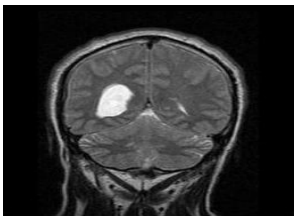
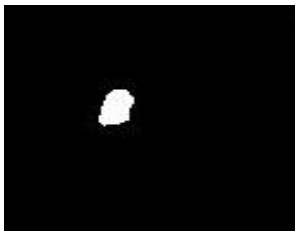
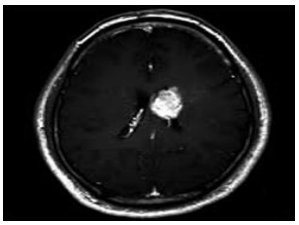
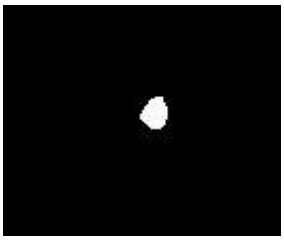
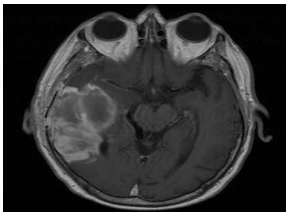
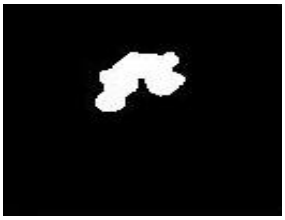
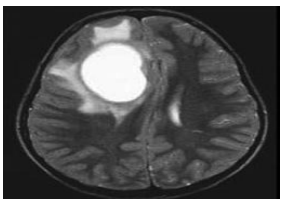
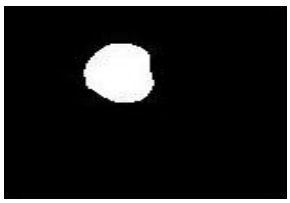
Peal signal to noise ratio (PSNR) it is the proportion of the highest feasible capacity (power) of a signal and the capacity (power) of degrading unwanted signal (noise) which have an impact on the reliability of its exposition[33,34]. Mathematically it’s given by following function:

$$\boldsymbol{P(str) = 10Log(\frac{R^2}{E})\ db} \quad (2)$$

Where R is the highest pixel value and E is the mean square error.

PSNR and MSE are applying to contrast fault among primary picture and the rebuilder picture. A high PSNR indicate a high-standard and low signifies poor quality so the relationship between MSE and PSNR is inversely proportional.

Table 1: Results of MR images

Input Images	Identified Tumors
	
	
	
	

V. CONCLUUSION

In this paper, an automatic prototype is proposed for the segmentation and categorization of brain tumor through using MR Imaging. The Functionality of every single one of sense organs is coordinates and controlled by brain limb. It's significant to identify any sort of abnormality before it developed indefinite impairment of several functionality. Therefore in recommended work MR image is fed as input. Various techniques have been applied for the partition of patient sore. Shape, texture; intensity is execrated from the MR image of the patients. In the final phase the MRI image is classified and the tumor part is marked by utilizing SVM algorithm. This proposed method achieved accuracy around 90%, 18.4682 PSNR, 1400.0 MSE and an average of 0.32842 Fault rate dust Detection.

Table 2: Parameter Results

MSE	PSNR	FRDD	Accuracy (%)
1339.051	18.58658	0.32784	86.1265
1401.346	18.36952	0.33675	90.2584
1253.536	17.18573	0.51578	88.3423
1403.346	16.69853	0.51754	89.2587

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Harpreet Kaur is presently an Assistant Professor in Department of Computer Science at Chandigarh University,Mohali (India).She has presented many research papers in various national and international conferences in India and abroad. Her areas of interest includes cloud computing, big data, machine learning, IOT, artificial intelligence, image processing and network security