Brain Tumor Detection by Fusing Machine Learning and Neural Network Practices

Mrinal Paliwal

Abstract— An unusual cell number or mass in a living being brain is termed as "brain tumor". A living being's brain is present in the skull and the skull is very stiff in nature. Any external development within such a rigid space can trigger serious difficulties in the living being body. Tumors in the brain of a living being may be cancerous or may not. Therefore, the main cure is the detections of the brain tumor, its magnitude, and place. This study paper proposes a combination of approaches which integrates statistical methods and machine-based training practices "Support for the Vector Machine (SVM)" and the "Artificial Neural Network (ANN)" to achieve greater efficiency in brain tumors and in their phase's identification as well as their place within magnetic resonance imaging pictures. In order to divide the magnetic resonance imaging pictures, an enhanced variant of standard "K-means" with Fuzzy C-means and temperature-based K-means & altered fuzzy clustering means. The value of K in the suggested method is an enhanced value, therefore, assists the fuzzy c to mean technique to perceive the tumor area.

Keywords: brain tumor, Fuzzy, K means, neural network, machine learning, SVM.

I. INTRODUCTION

All neurobiological operations of the human body are controlled by the brain. The unusual cell split or the development of tumors in the human brain can interrupt or damage this functioning of neurobiological operations and lead to various issues with the human body's system failure. There are several main regions in the living being's brain, and these main regions (see Figure. 1) relate to the various vital parts of the human brain. The human brain consists of several primary operational areas and these principal areas are (see Figure. 1) concerned with different essential components of the human body. The frontal lobe controls one's thoughts, emotions, creativity, and other cognitive activities. The central lobe is the component of the front lobe and regulates the tasks of human body's motion. The temporal lobe listens and helps to prevent the concept of ambiguity. The occipital lobe enables the human body to see or watch everything in the surrounding. The parietal gland is another significant component of the human brain for controlling voice handling through pressure learning, visual voice. Tumors present in the brain that are certainly hazardous to ordinary lives and may affect these significant regions in the human brain. This paper introduces an effective technique for tumor magnitude and location identification.

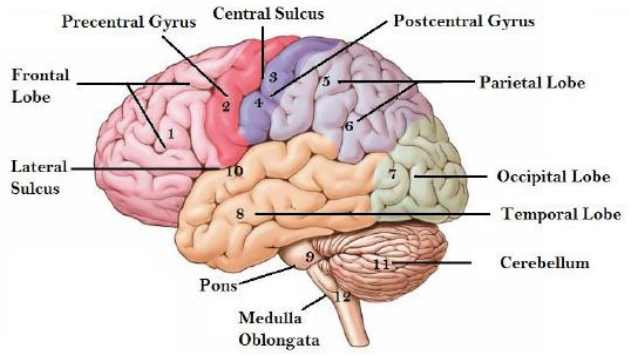

Figure 1 Main regions of the human brain

II. EXISTING STATE OF THE ARTS

Several scientists and researchers around the world have already collaborated on brain tumor identification and designed a heap of computations that evaluates how they have implemented their suggested approach.

A researcher [1] suggested a technique for finding the stage of tumor present in the brain of a human body by implementing artificial neural techniques and classification of the same. Also [1] disclosed about preprocessing of brain image, extracting features from the processed data by employing support vector machine.

A researcher [2] proposed a human brain tumor detection method by scanning MRI brain images, preprocessing it by employing a median filter, segmenting the MRI image by using threshold segmentation and performing morphological operations on that segmented image. Finally, the location, magnitude of the tumor inside the brain is extracted by employing "image subtraction technique".

Another researcher [3] proposed a system for living being's brain tumor detection and classification system by fuzzy clustering method for differentiation of images spatially consistent and noise-vigorous and disclosed about a local picture data is incorporated both into the resemblance measurement and affiliation to offset the impact of noise. An anisotropic quarter is implemented to permit more precise breakdown without picture mapping depending on phase-congruous characteristics. The segmentation findings show that our approach effectively maintains the homogeneousness of the areas and is stronger to noise than FCM techniques associates with both synthetic and actual pictures.

Another researcher [4] disclosed enhanced fuzzy C means protocol for segmenting the picture by implementing a weighted fluke and kernel metric coefficient tradeoff. The

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fluid-weighted variable in compensation relies on the distances and the distinction in gray level of all adjacent pixels at the same time. A rapid bandwidth control rule predicated on the deviation in a range of all data points of the compilation has been used to adapt the kernel parameter. In addition, two parameters are the measured fluctuation variable and the vector distance measurement. The findings of experiments on synthesized and actual pictures demonstrate that the renewed computer program is effective and reliable.

Another system was suggested by [5] that utilizes the local binary model for extracting picture characteristics like borders, angles, and locations. The synthesized local binary model characteristics, together with global Gabor attributes and initial spectral functionality levels, are enforced with two concentrations of fusion, involving a string of multiple characteristics before the sequence categorization mechanism whereas fusion on the possible output of each individual category pipeline is performed on the decision level.

Cascade structure and feed-forward framework, two dissimilar frameworks were presented by [6] for pulling out of features by using a component analysis algorithm for reducing the number of complex computations.

A methodology for high voltage microscopy image attributes detection by implementing a gray level matrix was proposed by [6] for providing accurate detection of human virus images.

A hybrid system was disclosed by [7] by using support vector machine and fuzzy clustering for distinguishing brain tumor from normal images of the brain.

III. PROPOSED SYSTEM

Firstly magnetic resonance imaging (MRI) brain pictures from the network archive are gathered. Sources collect pictures of ordinary and tumor brains containing low gliosma or glioblastoma multiform. The number of the user data for each MRI image for cataloging of normal and tumor brain is of thirty-nine images. Forty image data has been employed for categorization of the initial and middle-level stage of the tumor. Then to improve the quality of raw MRI data image processing technique is applied to it. The steps to improve quality are as follow

1. Firstly the raw images are transformed from one format to another, i.e. (.mha, .dicom format to .jpg) by employing matrix laboratory conversion tool. But there are some impacts which are reflected on the transformed image, impacts such as a change in size, directions. This impact is solved by resetting the size and direction of the converted image to 256 x 256 pixels to enhance the quality of the image.

2. Secondly, the smoothing of the transformed image is done by hybridizing the transformed image by “weiner2” and “median2” screening units to ensure good results.

K mean algorithm is applied for detection of tumor in a living being’s brain, k mean algorithm is employed to divide MRI image on the foundation of gray level. The temper of the MRI image scans the brain tumor. Reformed Fuzzy c-means is reorganized through the centroid pair distance specified by the characteristics of the MRI picture showing the tumor. Now, the gross picture B (xi, yi) that is characterized by a black level-based temper and picture provided as showing the required temper for the k-means.

$$B(x_i, y_j) = \sum_{i=n+1}^{M+n} \sum_{j=n+1}^{N+n} P(x_i, y_j) \oplus T_{MN(resize)}$$

$$T_{MN} = \sum_{i=n+1}^{M-n} \sum_{j=n+1}^{N-n} P(x_i, y_j)$$

Independently tempered-based K-means and altered Fuzzy clustering means can be conveyed as below as equation.

$$J_k = \sum_{i=1}^{C} \sum_{j=1}^{K} B(x_i, y_j) \left\| x_i - c_j \right\|^2$$

$$J_m = \sum_{j=1}^{N} \sum_{i=1}^{K} (U_{ij})^m (d_{ij})^2$$

The separate crude picture box B(xi, yi) line and column is in here M and N. The information spots in cell centers and node numbers are described respectively by the amount of C, N and K. Combination of support vector machine and artificial neural network is employed to assist the classification process of the tumor present in the brain and also to identify its stages. Firstly the proposed structure identify whether the image represents the normal brain without any tumor or a brain with tumor using linear support vector machine kernel and then identifying about the stages of the tumor present in the human brain by employing artificial neural network. In support vector machine a hyperplane is present which is sandwiched between the data points set for making a decision boundary to decide whether the image of the brain is normal or comprise a tumor. The first, second-order of statistic features act as input which is fed to the artificial neural network.

IV. RESULT

Firstly, a repository of forty-six multifaceted brain injury pictures was developed to execute the approach suggested. To render the dynamic range of the suggested algorithm, a number of essential steps have been taken and for using the service of the network a database is generated. To this end, a thresholding technique with limit rate 0.8 was used for the earlier result and a morphological procedure was conducted. In order to reduce major disturbances from MRI pictures, medium and combined filters have been used. In figure 2 result have been presented by proposed temper k means fuzzy clustering technique. These resultant images are ported from the produced database and further used for the categorization of brain tumor and its region in the brain. The recognized brain tumors are indicated by red color outlining.

Figure 3 portrays the categorized brain tumor by linearization of temper based k means and modified fuzzy clustering. The region-based functions can be derived from the tier threshold, revised membership function and computer program of regional characteristics.

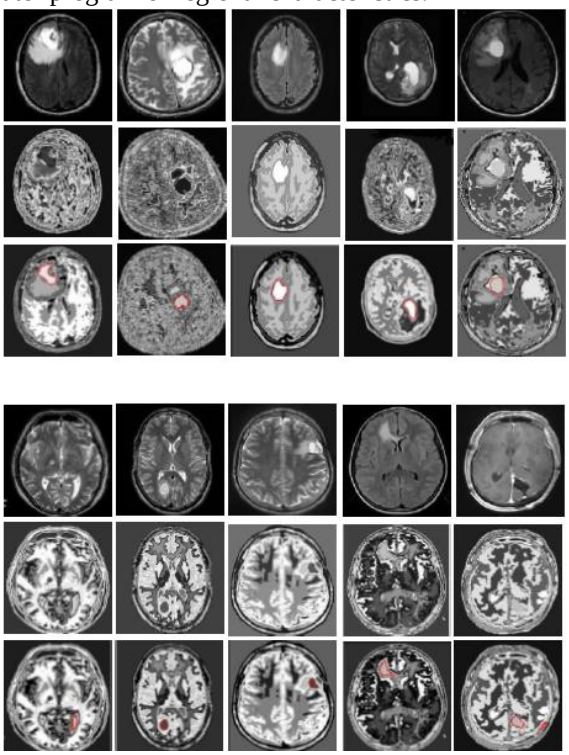

Figure 2 resultant images

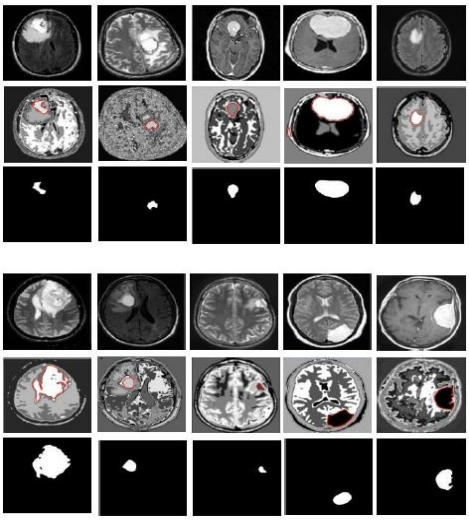

Figure 3 Categorized brain tumor

Valuation of the proposed framework and traditional methods is illustrated in table 1 and computed with the corresponding dataset. Thirty-seven brain tumor pictures are captured for computation. Table 1 depicts that the proposed structure in this paper is better than all traditional methods such as thresholding technique, growing region concept. The recommended method is an amalgamation of numerous appropriate techniques which make it more operational than any particular method.

Table 1 valuation of the proposed framework

Algorithms	Sensitivity (%)	Specificity (%)	Accuracy (%)	BER	Computational Time
Thresholding	85	80	81.3	0.175	~3 min
Region Growing	88.46	75	86.47	0.182	~6 min
ANN	95.42	100	95.07	0.022	~8 min
FCM	86.95	85.7	86.4	0.136	~5 min
SVM	96.2	66.67	90.44	0.0234	~4 min
K-means	75	92.85	83.7	0.160	~160-170 sec
TKFCM	88.9	100	91.89	0.055	~100 sec
Fuzzy Logic Method	96.3	100	96.667	0.018	~ 120 sec
Proposed SVM+ANN Method	**98**	**100**	**97.37**	**0.0294**	**~ 2 min**

*Image size=256x256, Software=MATLAB2014a, Processor= Core2duo, RAM=2GB, windows=7

V. CONCLUSION

The pictures were categorized as ordinary and tumorous in this research. Furthermore, the technique suggested the tumor magnitude and location in the brain cavity were also recognized from the MRI captured image. A series of statistical and machine-built learning algorithms such as temper-based K means and altered c-means, support vector machine (SVM) and artificial neural network (ANN) are coupled in order to achieve such an effective and smart algorithm. The suggested method has therefore solved the past boundaries such as lower classification precision, computing time requirements, unsatisfactory beat error rate, awareness and specificity of standard concepts. Other techniques already existed in the world have some performance differences. This proposed procedure delivers a sensitivity of 98%, 100%, 97,37%, BER = 0,0294, and requires less than two minutes to produce more particular results. On the other side, the suggested technique is much greater than ANN, SVM terms of precision and computer moment.

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