INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 5, Issue 4)
Available online at: www.ijariit.com

3-DPGR (3-level Daubechies wavelet, PCA, GLCM and RBF Kernal) method used for brain MRI categorization

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ABSTRACT

Abnormal growth of cells in the brain is called a brain tumor. A brain tumor consists of a collection of abnormally functioning brain cells that have begun to grow and reproduce inappropriately. The uncontrolled growth of a group of cells compresses and damages normal brain structures, which causes a variety of neurological symptoms. According to the reports of National Cancer Institute, Primary brain tumors are the leading cause of tumor cancer deaths in children, now surpassing acute lymphoblast leukemia and are the third leading cause of cancer death in young adults ages 20 to 39. There are more than 120 different types of brain tumors, making effective treatment very complicated. As per classification system defined by the World Health Organization (WHO), a brain tumor is named for the cell type of origin. Brain tumors can either originate from within the brain or from cancer cells that have metastasized from other organs or tissues. Various techniques are developed in the past to detect brain tumor. This research work proposed a Modified Technique for Brain MRI Categorization using 3-DPGR (3-level Daubechies wavelet, PCA, GLCM and RBF Kernal) Method.

Keywords— *Brain tumor, MRI categorization, 3-DPGR, PCA, GLCM, RBF kernel*

1. INTRODUCTION

Image processing is a procedure of changing a picture into advanced organization to get an upgraded picture by playing out a few tasks with a specific end goal to see some helpful data. It is the investigation and control of a digitized picture particularly for the change of its quality. The principle motivation behind picture preparing system is to recognize the picture under thought for less demanding representation and for picture honing and reclamation, picture recovery and example estimation. Picture Processing shapes the center of the exploration territory inside designing, business and furthermore in software engineering disciplines [1].

Innovation in medical field and advancements in technology for treating patients towards a healthy living and cure for their ailment is possible through successful researches by the efficient researchers. Invent of every new medicine and treatment involves a great number of people who gather together for a healthy study. In the past, in the absence of advanced technology, treatments were often given to patients based on guesses by the doctors which turned out to be a failure in most of the cases. Good research has removed such guess works from medical field in recent days. Research in medical science evolves many methods of good treatment, care and cure for the patients.

Each year, more than 19,000 people in the United States, 10,000 people in Canada and 9000 people in India are diagnosed with brain tumor. The overall incidence of all brain tumors is 100,000 people per year. Although as many as 70% of children diagnosed with brain tumors survive, but they are often left with long-term side effects. Recently most of the research works are based on early detection of brain tumor and its reliability. This thesis is based on MRI brain tumor detection by segmentation using various soft computing techniques.

2. BACKGROUND

El-Dahshan et al. [2] suggested a hybrid technique, in which feed forward pulse-coupled neural network is applied for the segmentation of the brain images. For feature extraction they consider approximation component of DWT. For feature reductuion they used PCA and for the classification they used back propagation neural network and achieved 99% accuracy.

Chaplot et al. [3] have introduced a scheme for feature extraction and classification. To validate the introduced system

they are taken a standard dataset of 52 brain MRI images. For feature extraction, they consider coefficient of level-2 approximation sub band of 2D DWT. Daubechies-4 (DAUB4) filter is used as decomposition filter. After getting the features they employed Self-Organizing Map (SOM) and Support Vector Machine (SVM) as classifier and they achieved higher classification rate for SVM with Radial Basis Function (RBF) classifier that is. 98% compared to the self-organizing map that is. 94%.

Chatterjee et al. [4] have proposed a scheme for feature extraction and classification. For the feature extraction they have used slantlet transform (ST) and for the classification they used back-propagation neural network (BPNN) and archived ideal result. In [5] they introduced a scheme, they used ST for feature extraction and fuzzy c-means for classification and from the experimental result they observed that the proposed scheme outperformed.

Selvaraj et al. [5] suggested a system for brain MR image classification. For classification they have used many classifier that is. SVM classifier, Neural classifier, statistical classifier. Among all these classifier LS-SVM outperformed with 98% of success rate.

El-Dahshan et al. [6] suggested a technique. The suggested technique comprises three stages that is. feature extraction, feature reduction and classification. For feature extraction the approximation subband of DWT is considered. Principal Component Analysis (PCA) is used for feature reduction and for the classification Feed Forward Back-Propagation Neural Network (FP-ANN) and k-Nearest Neighbor (k-NN) used as classifier and they achieved 97% and 98% accuracy, respectively.

Zhang et al. [7] have proposed a scheme for classification. They have taken 160 images (20 normal, 140 abnormal) to validate the scheme. For feature extraction level-3 approximation component using Haar wavelet is used. After feature extraction, PCA is used for feature reduction and for the classification forward neural network is used and they achieved 98.75% classification accuracy.

Saritha et al. [8] suggested a scheme, in which they have used entropy of wavelet approximation component at level-8 computed along with SWP for feature extraction. For the classification they used Probabilistic Neural Network (PNN) and their results indicate that they achieve high success rate.

Yang et al. [9] suggested a wavelet-energy based approach for brain MR image classification. For feature extraction they have used 2D DWT. For brain image classification SVM classifier was employed and BBO method was utilized to optimize the weights of the SVM. They noticed that their scheme was superior then KSVM, PSO-KSVM and BPNN.

Nayak et al. [10] have proposed hybrid technique for brain MR image classification. For feature extraction through brain MR images they utilizes the approximation coefficient of level-3 of discrete wavelet transform (DWT). To reduce the large set of extracted features from brain MR images they have employed kernel principal component analysis (KPCA). After getting the reduced set of features they have employed least square support vector machine (LS-SVM) as a classifier with different kernel function and they have reported that proposed scheme outperform with high accuracy.

Rao et al. [11] introduce a mechanized technique to distinguish and portion the cerebrum tumor districts. Medicinal picture preparing is an exceedingly difficult field. Medicinal imaging strategies are utilized to picture the internal bits of the human body for restorative conclusion. MR pictures are broadly utilized as a part of the analysis of mind tumor. The proposed strategy comprises of three principle steps: introductory division, demonstrating of vitality work and advance the vitality work. To influence our division more solid we to utilize the data exhibit in the T1 and FLAIR MRI pictures. We utilize Conditional Arbitrary Field (CRF) based structure to consolidated the data introduce in T1 and FLAIR in probabilistic area. Fundamental favourable.

Shree et al. [42] concentrated on commotion evacuation system, extraction of dark level co-event framework (GLCM) highlights, DWT-based mind tumor area developing division to lessen the many-sided quality and enhance the execution. This was trailed by morphological separating which expels the commotion that can be framed after division. The probabilistic neural system classifier was used to prepare and test the execution precision in the identification of tumor area in mind MRI pictures. The exploratory comes about accomplished almost 100% precision in recognizing ordinary and anomalous tissues from cerebrum MR pictures illustrating the viability of the proposed method.

3. PROPOSED TECHNIQUE

The proposed technique comprises of following steps:

a) Input the Brain MRI Image. The magnetic resonance image of brain is taken as input image for further processing.
b) Resize Image into 200x200 Size
c) Apply Otsu Method for binary Segmentation. Otsu method is used to automatically perform clustering-based image thresholding or the reduction of a graylevel image to a binary image.
d) Apply 3-Level Daubechies wavelet transform. The Daubechies wavelet transforms are defined in the same way as the Haar wavelet transform by computing running averages and differences via scalar products with scaling signals and wavelets the only difference between them consists in how these scaling signals and wavelets are defined.
e) Pass 3-Level Daubechies wavelet transform feature through Principal Component Analysis to generate best feature Matrix. Principal Component Analysis (*PCA*) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components.
f) Optimized Features Matrix using GLCM (Gray-Level Co-Occurrence Matrix). A factual strategy for looking at surface that considers the spatial relationship of pixels is the gray-level co-occurrence network (GLCM), otherwise called the dim level spatial reliance grid. The GLCM capacities portray the surface of a picture by ascertaining how frequently combines of pixel with particular esteems and in a predetermined spatial relationship happen in a picture, making a GLCM, and after that separating factual measures from this lattice.
g) Extract list of features like - Variance, Kurtosis, Skewness, Contract, Correlation and Entropy.
h) Create a Feature Matrix by combining all above features values.
i) Pass combined feature Matrix through Support Vector Training using Radial Basis Function (RBF)

j) Perform training using Support Vector Machine (SVM) and Classify Tumor type with accuracy percentage.

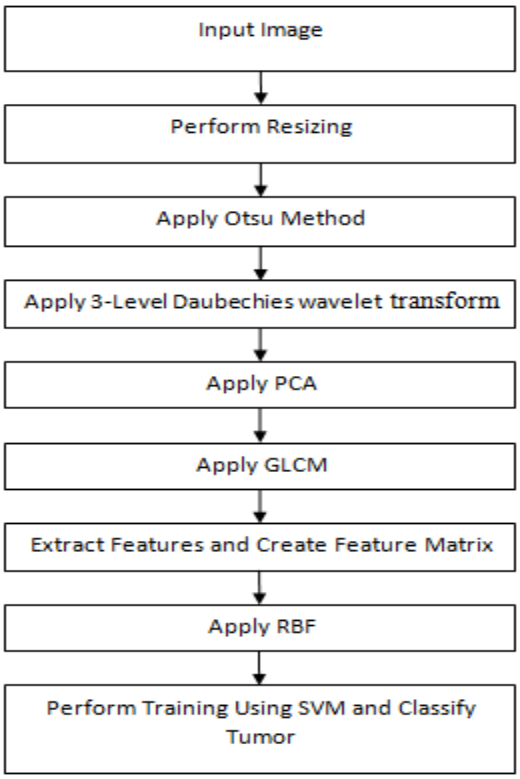

Fig. 1: Flowchart of Proposed Technique

4. EXPERIMENTAL RESULTS

This section presents experimental results of the proposed technique. Performance of proposed technique is evaluated on the basis of various parameters. Proposed technique is implemented using MATLAB tool.

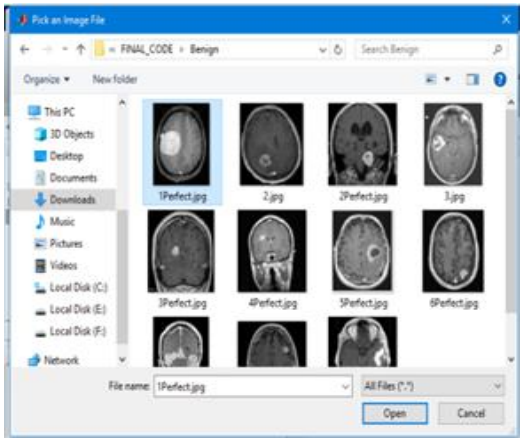

Fig. 2: Selecting the image

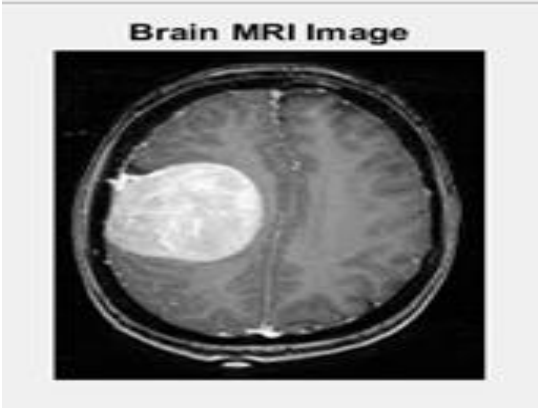

Fig. 3: MRI image of Brain

Above figure shows magnetic resonance image (MRI) of brain. MRI is a non-invasive method for imaging internal tissues and organs.

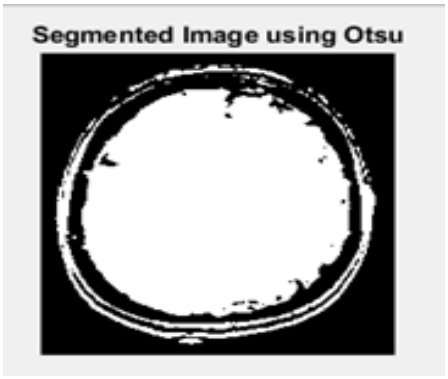

Fig. 4: Showing segmented image using OTSU method

Above figure shows segmentation of brain MRI (Magnetic Resonance Image) of the brain image using Otsu method. Otsu's method is a means of automatically finding an optimal threshold based on the observed distribution of pixel values.

Fig. 5: Showing objects in Cluster

Above figure shows objects in the form of cluster. Cluster is used to show similar type of objects together. A *cluster* is therefore a collection of objects which are "similar" between them and are "dissimilar" to the objects belonging to other clusters.

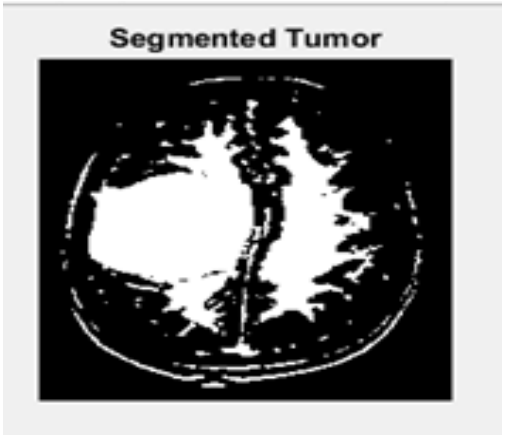

Fig. 6: Showing Segmented Tumor

Above figure shows segmented image of brain tumor.

Figure 7 shows the results of proposed technique. Accuracy of proposed technique is 91.0197%, time for proposed technique is 1.2699. Mean is 0.0031, variance is 0.0080, standard deviation is 0.0898, correlation is 0.1990, smoothness is 0.9205, contrast is 0.2088, energy is 0.7621, entropy is 3.1735.


```
Accuracy of Proposed Technique is: 91.0197%

Proposed_Techniq_time =

    1.2699

ans =

Accuracy of Linear kernel is: 65%

Result_parameters =

                Mean: 0.0031
            Variance: 0.0080
  Standard_Deviation: 0.0898
         Correlation: 0.1990
          Smoothness: 0.9205
            Contrast: 0.2088
              Energy: 0.7621
         Homogeneity: 0.9352
             Entropy: 3.1735
            Kurtosis: 7.3282
            Skewness: 0.4690
```

Fig. 7: Showing results of proposed technique

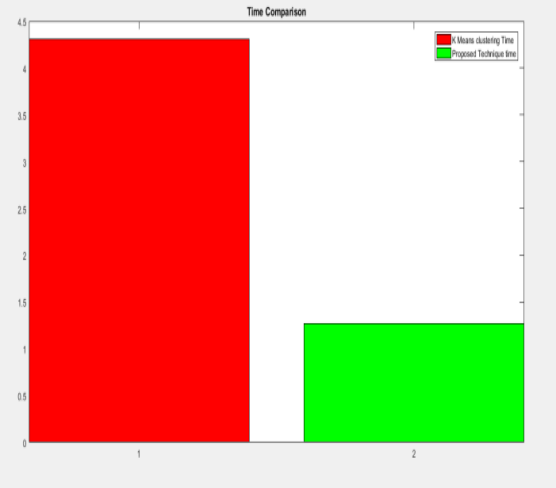

Fig. 8: Showing Time Comparison

Above figure shows comparison of time among proposed technique and K-means clustering technique. It is clear from the graph that time taken by proposed technique is less as compared to existing technique.

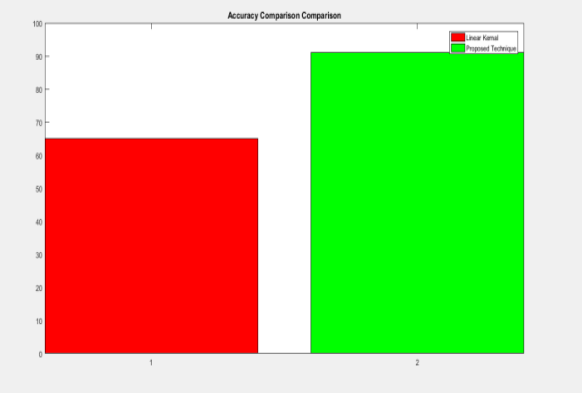

Fig. 9: Showing Accuracy Comparison

Above figure shows comparison of accuracy among proposed technique and K-means clustering technique. It is clear from the graph that proposed technique gives more accuracy as compared to existing technique.

5. CONCLUSION AND FUTURE SCOPE

This research work proposed a Modified Technique for Brain MRI Categorization using 3-DPGR (3-Level Daubechies wavelet, PCA, GLCM and RBF Kernal) Method. An abnormal growth of cells in the brain is called a brain tumor. Various techniques are developed in the past to detect brain tumor. Proposed technique is implemented using MATLAB tool and various parameters are used to compare the results if the proposed technique with the existing technique. the results of the proposed technique is compared with k-means clustering technique on the basis of time and accuracy and it is clear from the experimental results that proposed technique use less time and gives more accuracy as compared to k-means clustering technique.

In future, we may use neural network or any other machine learning application instead of using support vector machine. Also, in future feature set vector are optimized for further optimization so that time of classification will reduce.

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