

# An Ensemble Based Approach for Detection and Classification of Tumor in Human Brain

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## Abstract

A collection of cells which are abnormal in brain leads to brain tumor. Brain tumors can be malignant or benign. The most common type of brain tumor in humans is Glioma. It contributes to about 30% to brain and 80% to central nervous system of all tumors that are malignant. Magnetic Resonance Imaging (MRI) is the most sought tool for analysis of brain tumor. Traditional approach of detecting brain tumors does not provide accurate results, so we adopt an ensemble approach to improve the accuracy using proven training algorithms. In medical analysis automation of classifying these MRI accurately and interpreting the data plays a very important role. In our work carried out, to classify the MR images into normal and abnormal classes we have presented a hybrid method. In the proposed technique, all the possible feature to the minute level is extracted from the pre-processed image, after which the dimensions are reduced for the image. These reduced features are finally fed to kernel support vector machines on which k-fold cross validation is applied to enhance the generalization constant.

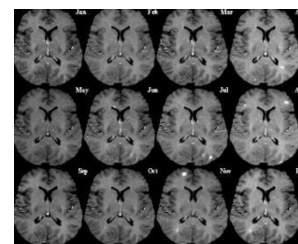
**Keywords:** Tumors, MR images, KNN, SVM

## INTRODUCTION

Tumors in brain can be of two types namely cancerous or non-cancerous known as malignant or benign tumors. The symptoms of brain tumor mau be headaches, vision problem, seizures, periodic vomiting, and changes in behavioural dynamics. The most common type of brain tumor in humans is Glioma which makes about 30% of all brain and central nervous system and 80% of all malignant brain tumors. A glioma can be seen either in brain or spine. It is called so because it arises from the glial cells.

In general, diagnosing a brain tumor usually begins with magnetic resonance imaging (MRI).An MRI uses magnetic fields, to produce detailed images of the body. These scans usually give a very clear picture of the brain and will almost certainly show up any brain tumor that is

present.



**Fig: 1.** Sample Brain MRI image.

Since MRI are capable enough to present anatomical information in reality which is too complex, it has been accepted as a powerful tool for medical diagnosis in recent years. One of those powerful tools used with MRI image processing is image segmentation [1].

Image segmentation can be used in different ways and can provide different results. A technique of cross-

validation is implemented to validate and test the images for recognizing the kind of tumor present in the image is rightly classified as benign or malignant based on the threshold value selected for classification.

SVM [2] and k-NN [3] is a supervised classifier method based on machine learning concepts [4-6] compared with other methods for predictive analysis. In this work, the SVMs are extended using kernel functions there by making these linear ones to behave non-linearly and thus replacing the dot product of linear SVMs [7]. In this attempt the maximum margin hyperplane is achieved and the same is fit into a transformed feature space.

## PROBLEM STATEMENT

In recent years, brain tumor has become one of the leading causes of deaths amongst children and adults. Studies has shown that the number of people suffering and dying from brain tumor has increased to 300 per year during the last few decades.

The aim of this project is to locate, detect, & classify a brain tumor as benign or malignant tumor. In our project, data has been collected from BRAINNIX data set that is globally available at the Kaggle website. On the collected data we perform the required computations. As the data obtained from the website would be in DICOM format, it is essential that it is converted into grey scale first, and then sent for analysis.

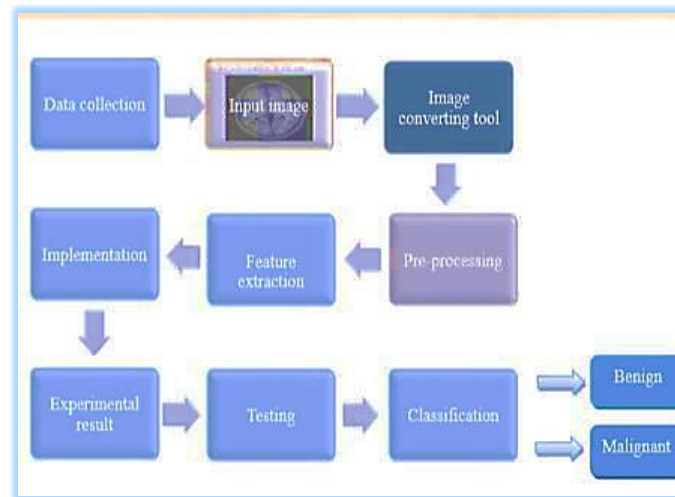
## LITERATURE SURVEY

Year	Method	Remarks
1992	Unsupervised Fuzzy C means approach. Supervised feed forward cascade correlation	Both methods were compared and found that FCM showed better results than FFCC.
2005	SVM for unary class for tumor segmentation	SVM gave better results than fuzzy clustering method.
2005	Alignment based feature encoding	For better results this technique is combined with machine learning.
2009	Mathematical morphology, wavelet transform, K-means technique	Applied in steps to obtain better results in comparison with clustering.
2010	Clustering algorithm, Fuzzy C means with intelligent optimization tools like Genetic algorithm and PSO	GA and Fuzzy C means require more time than proposed algorithm of PSO with fuzzy C means.
2014	K-means, Fuzzy C Means, histogram thresholding	Combination of all the three gives better results.
2015	Expectation Minimization	Proposed method is easy, fast and simulation time is approximately 5 to 8 seconds.
2016	SVM, Two tier classifiers	Comparatively SVM results are better seen in two tier classifier than SVM.

## METHODOLOGY

In the work carried out, an algorithm is developed by implementing some of the major image processing techniques to detect the tumor and also to separate it out from the normal brain by extracting the features that are dominant to the pre-processed image. A nonlinear classifier

with a kernel function is applied to the image to classify them into either a normal category or abnormal category by querying the obtained image with the acquired image. This software based approach is developed and tested using the MATLAB tool.



**Fig: 2.** Block Diagram of Brain Tumor

### DETECTION

- Step 1: Brain MRI image of patients are acquired from a hospital and an exhaustive database is built.
- Step 2: The entire work is divided into training and testing phase. For training the machine we need to perform the extraction of features to build a vector and then apply a cross validation technique to get the random images for testing.
- Step 3: Supply these trained data to the SVM and calibrate the kernel function to detect and classify the tumor into either cancerous or non-cancerous based on the values obtained.
- Step 4: Classify testing data using steps 2

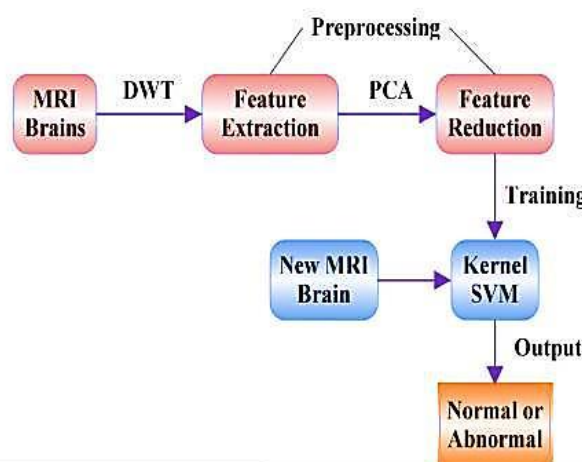
and 3.

If tumor is detected, it is classified into its appropriate type either benign or malignant tumor.

### PREPROCESSING

In total, our method consists of three stages:

- Step-1. Preprocessing (including feature extraction and feature reduction;
- Step-2. Training the kernel SVM;
- Step-3. Supply a test image of brain MRI to our already trained kernel SVM, and record the output predicted. As shown in Fig. 3, flowchart depicts the standard classification method proven as best classification technique.



**Fig: 3.** Feature Extraction block diagram

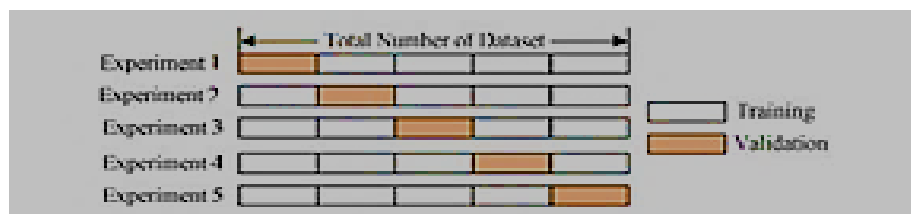
## FEATURE EXTRACTION

The three levels of wavelet decomposition greatly reduce the input image size. The segmented image is taken for analysis and a series of features like Mean, Average, Entropy, Skewness, Energy, Contrast, Correlation, Variance, Standard Deviation, IDM, Kurtosis, Smoothness, Homogeneity, RMS are collected for every sample of T1, T2, FLAIR data sets and further the results are fed for training using SVM classifier.

## K-FOLD STRATIFIED CROSS

## VALIDATION

In this method we create first a k-fold partition on the entire dataset. This procedure is repeated k times using k-1 folds for training the kernel machine and the remaining fold is used to test the machine repetitively. Finally averaging methodology is applied to find the error rates of all the K experiments carried out. In our project we have chosen k=5 and the same is as shown in the figure. Here that k-fold technique is used randomly to increase the generalization constant value of a classifier.



*Fig: 4. 5 fold cross validation system*

## KERNEL AND SVM

The SVM has been chosen for implementing since it has varied advantages like Tractability, decently high accuracy and measurable interpretation of the geometry. Recently kernel SVMs are the identified to be most sought and accurate so has been implemented in this work.

Kernel SVMs have the following advantages:

1. Remarkable in diverged fields.
2. Have been successful practically.
3. Have few tuneable parameters and,
4. Training often involves convex quadratic optimization.

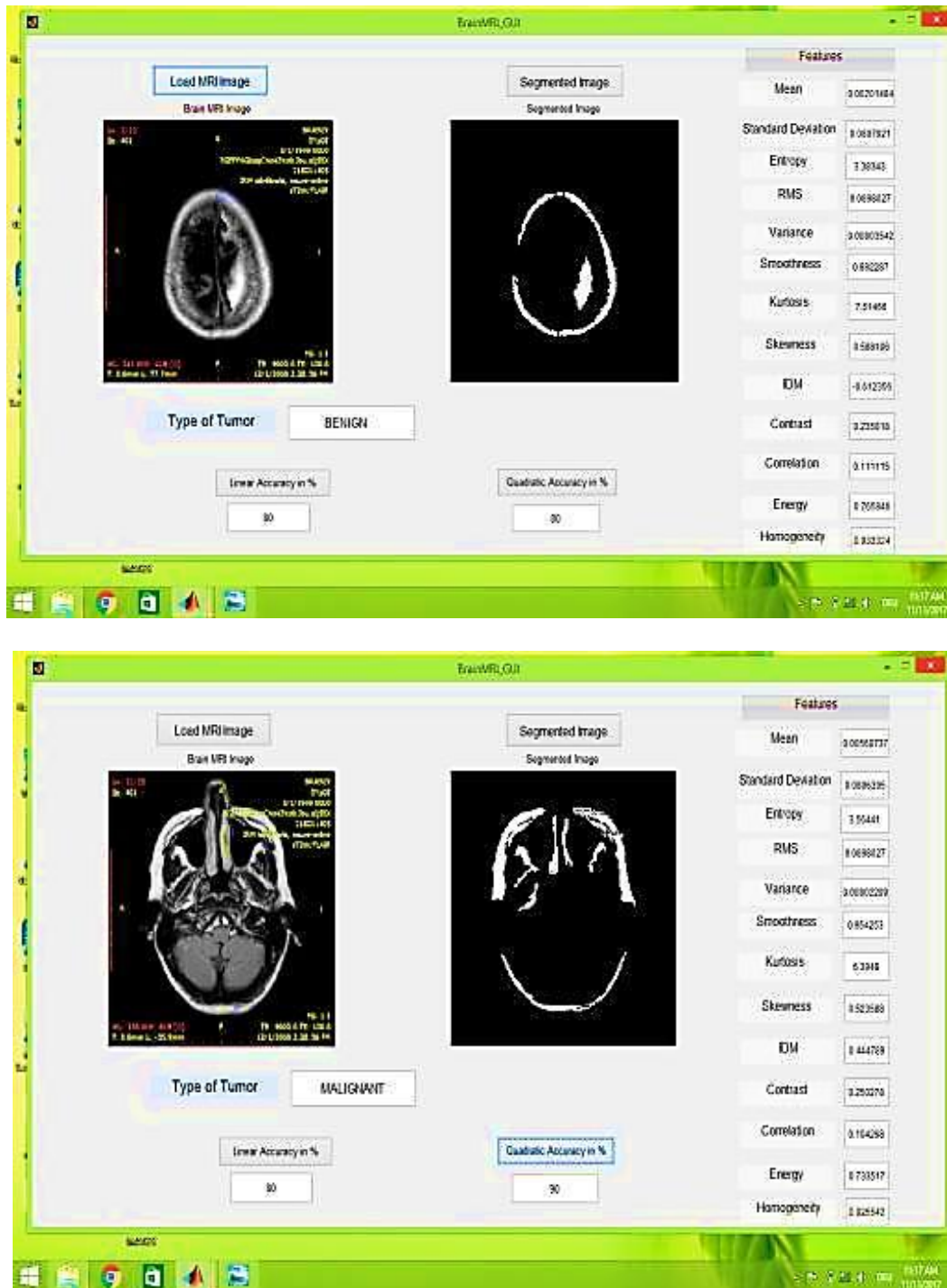
These solutions are unique and accepted globally, since they avoid convergence to local minima in comparison with other learning systems like NN which are purely statistical in nature.

## RESULTS

The comparative study of different MRI image processing methods for detecting brain tumor from MRI image has been carried out. Start researching the idea to have the methods in one place showing their results at the same time [8].

To achieve this a simple GUI, which can program faster and compute accurate result with more methods has been developed. In our approach, SVM tool box has been used extensively on Kernel SVM, and has been applied for MR brain image classification. The programs can be run or tested on any computer platforms where Matlab software is available.

The results are tabulated and careful analysis has been made on the dataset and an accuracy of the model used is also calculated which is around 70%– 80% with linear and quadratic model of SVM.



*Fig: 5. Snapshots*

## CONCLUSIONS AND DISCUSSIONS

In our work, we have been able to develop a GUI for making the functionality of the entire system secured into a black box view than applying the traditional methods. In our case, the GUI allows us to set and record the change in the values of parameters without even being rewritten

again in the program thereby detecting the presence of tumor very quickly. The results are tabulated and comparably they more accurate.

The original goal of this classifier is centered on classifying and improving the accuracy and robustness. The patients to



accept this as a proof of diagnosis, this classifier may also need some scope of improvement which can be obtained by building a reliable hybrid model by combining PCA, etc.

Finally this tool is advisable to be used for clinical diagnosis to identify the tumor as normal or abnormal growth.

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