

DETECTION OF BRAIN TUMOR USING MACHINE LEARNING

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Abstract - The classification of magnetic resonance brain images is very important for the classification and analysis in medical field. Various methods have been already proposed and in existence. In this project we are going to classify whether the given MRI image of brain is normal or abnormal. The initial stage of our project includes data collection and storage. The collected data are subjected to feature extraction of images using Discrete Wavelet Transform (DWT) method. Which is followed up by the feature reduction technic using Principal Component Analysis (PCA). The collection of data includes normal brain images and affected abnormal brain images. The features which are reduced are submitted to Support Vector Machine (SVM) and logistic regression. The cross-validation method was used for the generalization of Support Vector Machine. We compared our classification accuracy with previously available literatures of KNN. We acquired most accurate classification results. By comparing both KNN and SVM results the SVM gives better accuracy.

is known to be the Feature Extraction process. In order to work more efficiently without more expensive ideas, the Feature Reduction technique is used here which involves Principal Component Analysis (PCA). This PCA method helps in identification of various dimensionality of data and reduces the cost of analyzing new data.

This can be identified by categories known as, Supervised and unsupervised learning here we use supervised learning which include SVM and k-NN. Both the supervised and the unsupervised give fine output but the supervised one is considered to be better than the unsupervised by comparing the accuracy. However, many researchers were proposed lot of approach in recent times as the acquired accuracy is up to 95% So we tried to find the accuracy higher than that.

Here we choose SVM because it has many advantages like having higher accuracy, mathematical tractability and don't need much training samples.

Key Words: MRI, DWT, PCA, SVM, k-NN, MATLAB.

2.SYSTEM METHODOLOGY

1.INTRODUCTION

Magnetic Resonance Imaging (MRI) helps us to look at our organs and structures inside the body using a large magnet and radio wave. It is also helpful in the diagnosis of torn ligaments and tumors. The MRI in brain plays an essential role for detection of various types of disease in brain by detailed images by radio waves painlessly. The acquired MR images are accurately classified and automated by various methods.

The Wavelet Transform is the most effective way to treat MR images of brain for diagnosis. This help in analysis of the various resolution levels by its analytical property, this

Collection of databases is a first method in this process. After this, the collected data are extracted using Discrete Wavelet Transform (DWT) method called feature extraction. This method provides the color, accuracy of the database. And these databases are subjected to feature reduction method using Principal component analysis (PCA) method which includes the normal brain images and affected brain images in its data collections. These features are applied to two algorithms i.e., Support vector machine (SVM) and K-nearest Neighbors (KNN). At last, we compared our SVM accuracy with KNN.

BLOCK DIAGRAM

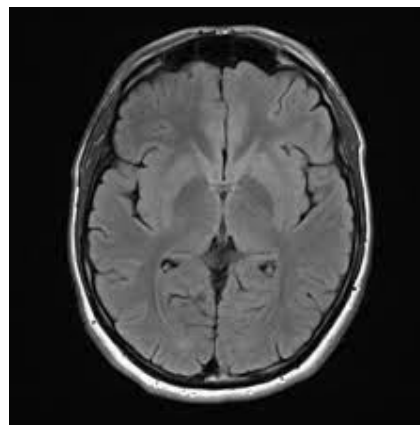
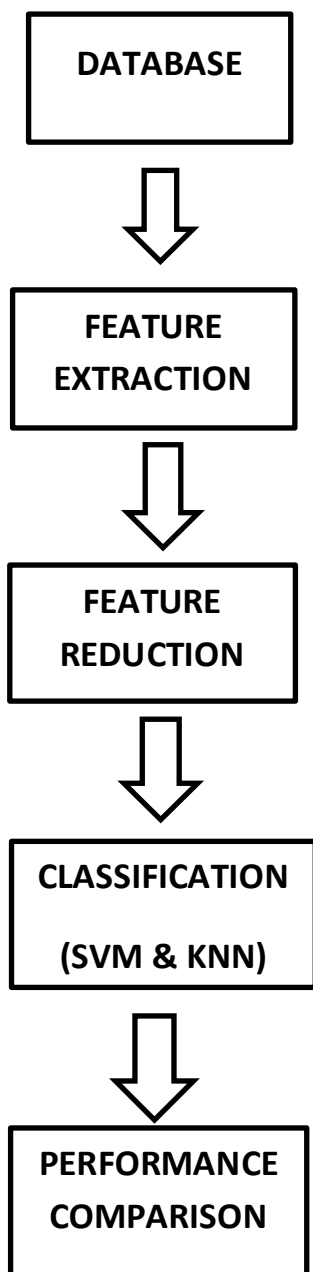


Fig -1: Normal image

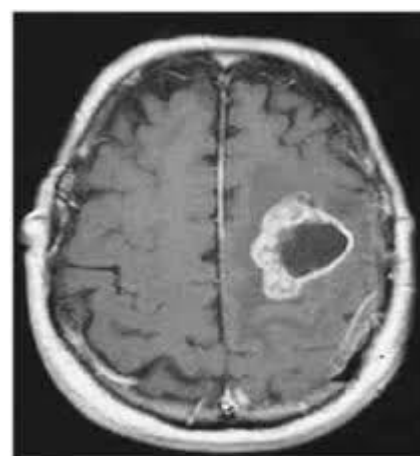


Fig -2: Affected image

3.SOFTWARW DESCRIPTION

MATLAB

MATLAB which is commonly known as Matrix laboratory is one of the programming languages developed by MathWorks. This is helpful in manipulation, data plotting, algorithm implementation and program interfacing. Simulink which is helpful in the simulation process in MATLAB. It helps in the simulation of embedded systems and give graphical and model-based design. It is one of the easiest ways to attain a required field of information with simple coding.

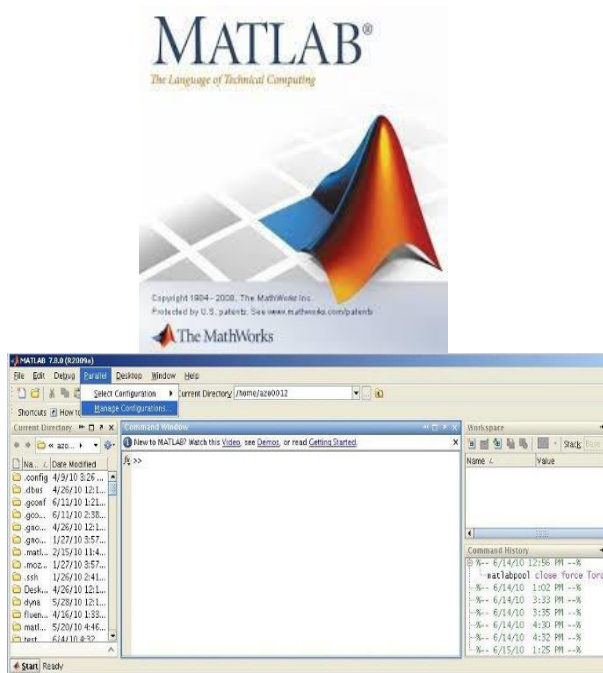


Fig -3: MATLAB software

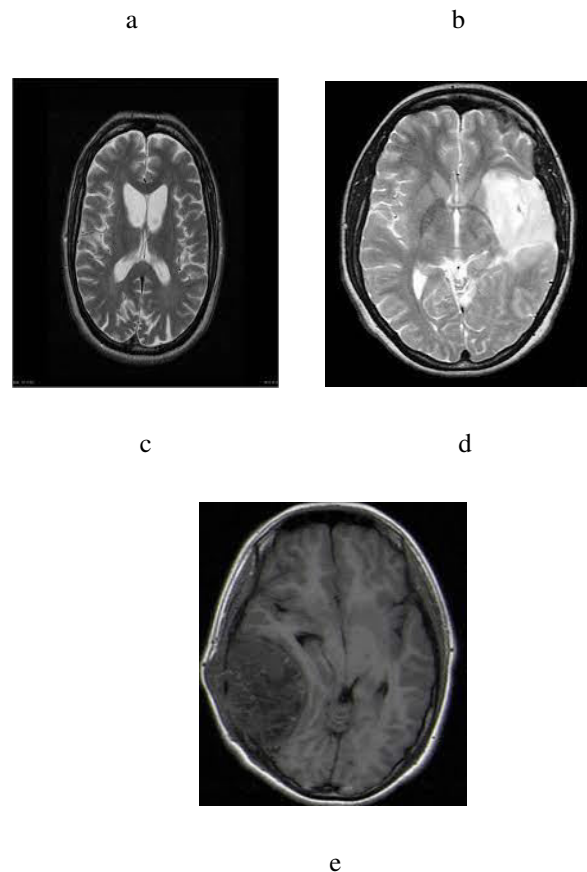


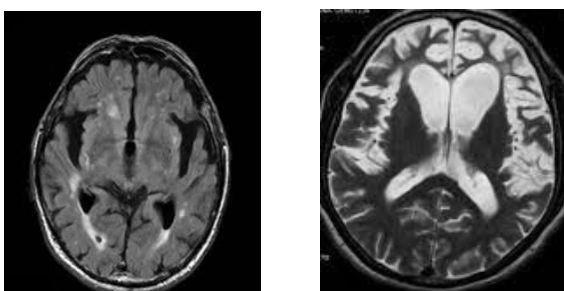
Fig -4: a) Alzheimer’s disease, b) Pick’s disease, c) Huntington’s disease, d) glioma, e) sarcoma

In this project we used this software to code down the algorithm which is involved in the identification of the detailed classification of MR brain images. We occurred the exact part of the affected brain using this code and further graphical representation is made and established

4.SYSTEM OPERATION

4.1. Database

- ▶ The datasets of MR brain images are collected with proper resolution. The drive link which includes the dataset image is, <https://drive.google.com/drive/folders/1rD7XZGtjXjPaQYeF32dIsp1xliTrYnIK?usp=sharing>). We choose the clear images for our project. The abnormal brain images have the variety of disease named Alzheimer’s disease, Pick’s disease, Huntington’s disease, sarcoma, glioma.



4.2. Feature Extraction

Feature extraction is dimension reduction process. This method is used for reducing the number of features in a dataset by creating the apt features from the existing one. These new features explain most of the information contained in the original set of images. It is more readable and we can easily process it. Feature extraction method is used to detect the features like shape, size, threshold, density etc. Normal and abnormal cells features are totally different. So, in this method helps to compare the normal and abnormal cells.

4.2.1. Discrete Wavelet Transform (DWT)

In this method we use Discrete Wavelet Transform (DWT) algorithm for image classification and detection. Wavelet transform technic is used in many applications such as remote sensing, noise removal in radar images and merging high resolution images. Here we have used WT for analyze the

signal according to the scale. This WT developed as a remedy to short time Fourier to overcome the time and frequency related problems.

$$\Psi_{a, b}(t) = 1/\sqrt{|a|} \psi((t-a)/b)$$

a denotes dilation factor and b denotes translation parameter. The most important and simplest Wavelet is Harr Wavelet.

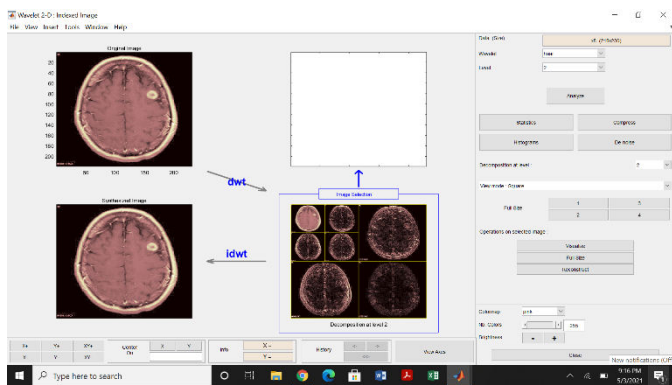


Fig -5: Wavelet decomposition

4.2.2. 2D-DWT

It is one of the preparing strategies. 2D-DWT produces three diverse sub-band wavelet coefficients called flat, vertical and corner to corner. These vertical and even sub-groups are utilized to examination the LMT include extraction. This method was applied to the tight and wide pictures.

4.3. Feature Reduction

The data undergoes feature reduction which is used to reduce features to minimum numbers because, it increases memory storage and computation times. So that, the data will transfer from high dimensional into low dimensional in which the low dimensional classification keeps some efficient properties of the original data. This reduction is common in some sectors which deals with the large number of variables or observations such as neuroinformatic, bioinformatic, speech recognition and signal processing. Sometimes the classification is made more complicated for them. This

reduction is helpful in data visualization, cluster analysis, noise reduction, etc.,

4.3.1. Principal Component Analysis (PCA)

PCA is a tool which is helpful in the reduction of high dimensional data which includes various details and patterns in it. This tool has an advantage of computing the principal components and performing them on change of basis of data. The transformation of data to new set of variables is made by considering their priority and variance. This technique includes three methods. Orthogonalizing the input vectors components, ordering the resulting orthogonal components and eliminating those components which contributes the less amount to the variation in the acquired data set. Every feature has different range of values. For PCA, we want the values that lies in a particular range. For achieving the output, the normalized mean value of each feature is divided with standard deviation of each feature, Hence the formula follows:

$$x' = \frac{x - \bar{x}}{\sigma}$$

Here, \bar{x} denotes the feature mean values,

σ denotes the standard deviation,

x' denotes the final standard value.

Key points of PCA:

PCA should only be applied to the training datasets. For the cross-validation and test dataset, only the X -> Z mapping that is created by PCA should be applied. It occurs that PCA helps in reducing the number of input features and also it might as well prevent overfitting of a model. While this is true to an extent, in practice it always tries to address overfitting through regularization method since applying PCA doesn't make much of a difference in this regard. It might be forcing to use PCA for dimensionality reduction for every machine learning problem which includes a large number of features. But we should always try to train our first model with the

original feature set. If this doesn't make desirable results, only then we could consider applying PCA on the input features.

4.4. Support Vector Machine (SVM)

A SVM is a supervised model of machine learning which helps in classification of algorithm in two group classification problems.

Data training is the major part in establishing SVM. SVM is used in both classification and regression. It is also known as a predictive analysis data classification algorithm which is useful to assign new data elements especially helpful to recognize the images. SVM are of three types. SVM uses certain mathematical functions known as kernels which is used to extract the input data and transform it to the form we are required.

Advantages of SVM

- High accuracy
- More effective in high dimensional spaces
- Memory efficient
- Non parametric
- Easy understandable
- Good generalization capability.

Principles of SVM

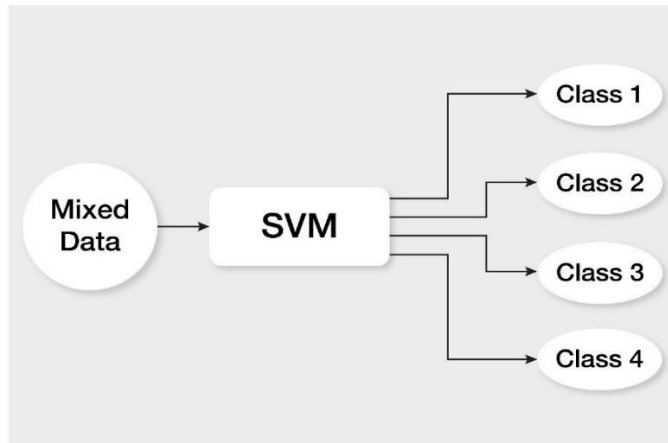


Fig -6: Classification of SVM

The main motive of the SVM is to locate the data from different class. For the classification of the data many hyperplanes are used. The hyperplane is responsible for the representation of the separation or margin between two classes therefore there will be better behaviour during training the data.

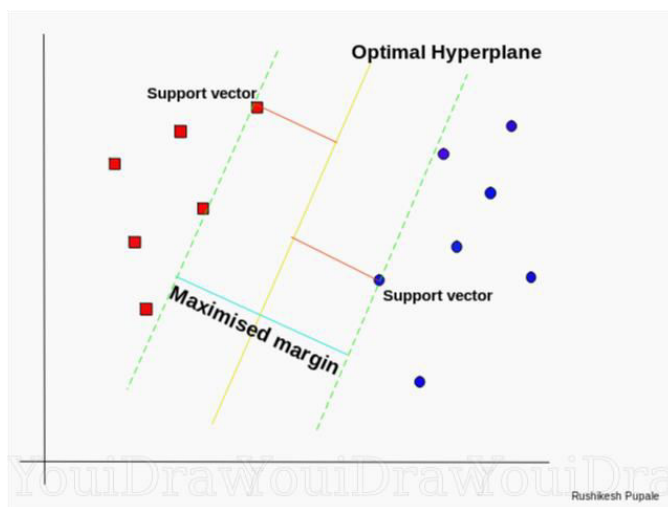


Fig -7: Optimal Hyperplane using the SVM algorithm

The classifier is trained by the datasets we acquired for achieving higher accuracy result. The overfitting of the system is prevented by the cross-validation method which may not help to increase accuracy in final classification but to generalize the datasets.

5.RESULT & DISCUSSION

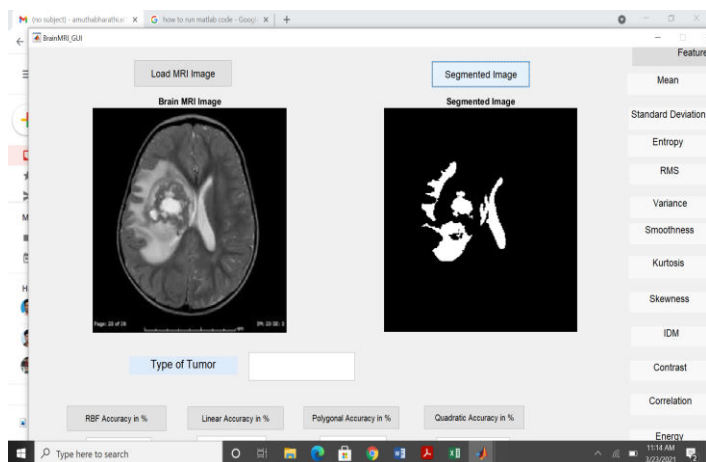


Fig -8: Segmented image after tumor detection

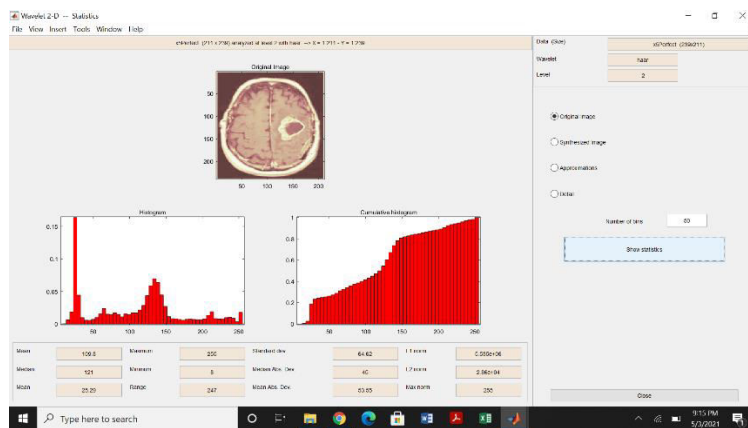


Fig -10: Histogram of Wavelet

6.CONCLUSIONS

Here In our project, we developed a technique to identify the image of brain using MRI whether it is normal or abnormal. We choose SVM kernel to identify the result with the help of DWT and PCA. We compared the result with already existing k-NN model. Where we obtained 99.38% accuracy which is more accurate one among both. We used about 150 images to read the data and identify the tumor.

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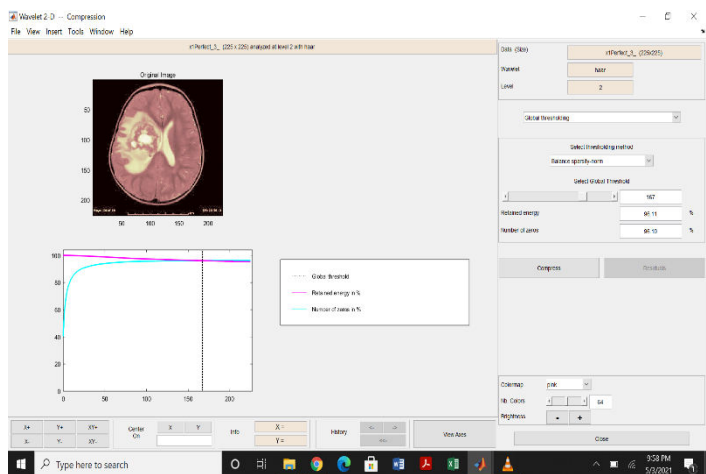


Fig -9: Wavelet recognition

By comparing the result from the previous approaches i.e., DWT+ PCA+ k-NN gives 98% accuracy and the method we used is DWT+PCA+SVM gives 99.38% accuracy so our model performed best than the k-NN system.

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