Comparative Analysis of MRI brain Cancer Classification using Hybrid Classifier (SVM-KNN)

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***ABSTRACT*: This research paper proposes a clever arrangement system to recognize typical and strange MRI mind picture. MRI is an imperative technique used for brain tumor detection and verdict. Study of medical MRI images by the radiologist is very difficult and time overwhelming task and correctness depending upon their experience. To overcome this problem, the automatic computer aided system becomes very obligatory. The proposed paper presents an automatic computer aided system for classification of malignant and benign tumor from the brain MRI. The texture features are extracted from MRI by using the highly accurate Gray Level Co-occurrence Matrix (GLCM) technique. The brain tumors are classified into malignant and benign using SVM and KNN classifiers. The proposed system gives an accuracy of 88.39% for SVM and 69.56% for KNN.**

To maintain a strategic distance from the human mistake, a computerized perceptive characterization framework is proposed which provides food the requirement for characterization of picture. One of the real reasons for death among individuals is Brain tumor. The odds of survival can be expanded in the event that the tumor is identified effectively at its initial stage. Attractive reverberation imaging (MRI) strategy is utilized for the investigation of the human mind. In this exploration work, grouping methods in view of Support Vector Machines (SVM) and K-Nearest Neighbor (KNN) are proposed and connected to mind picture arrangement. In this research paper we explore the hybrid classifier i.e. combination of two classifiers (SVM and KNN) so that the accuracy of the classifier will gets more. In this paper highlight extraction from MRI Images will be completed by dim scale, symmetrical and composition highlights. The primary target of this paper is to give a superb result (i.e. higher precision rate what's more, lower blunder rate) of MRI cerebrum disease grouping utilizing SVM and KNN.

KEYWORDS – Classification, MRI, SVM, KNN, PCA, Skull masking

I. INTRODUCTION

MRI is an indispensable contrivance in the clinical and surgical environment due to superior soft tissue differentiation, high spatial resolution, contrast and it does not use any harmful ionizing radiation which may have an effect on patients. The MRI image may contain both normal and abnormal images. Feature extraction refers to various quantitative measurement of medical images typically used for decision making regarding the pathology of a structure or tissue. In image processing, feature extraction is a special form of dimensionality diminution. When the input data to an algorithm is too large to be processed and it is assumed to be disgracefully unnecessary, then the input data will be transformed into a compact representation set of features. Brain tumors are abnormal masses in or on the brain. Tumor growth may appear as a result of uncontrolled cell proliferation, a failure of the normal pattern of cell death, or both. Brain tumors can be either primary or secondary. Primary tumors are composed of cells just like those that belong to the organ or tissue where they start. A primary brain tumor starts from cells in the brain. The reduced features are submitted to a support vector machine for training and testing. Therefore this method will decrease the computation time and complexity. Classifiers such as SVM, K-Nearest Neighbor (KNN), Artificial Neural Network (ANN), Probabilistic Neural Network (PNN), Hidden Markov Model (HMM), etc. are used for various applications.

Previously clustering approach was been used for biomedical area which focuses on MRI brain image segmentation process with modified fuzzy clustering. This work has not considered the noise removal and can be have better segmentation based on quantization. In our research, we will focus on finding the brain tumor detection with help of the binary tree quantization process with the different cluster formation. Segmented image will detect the brain tumor. Also, we are going to detect the size and stage of the tumor. The objective of this paper to find the solution for detection of brain tumor. To provide an optimized solution for highlighting the affected area of the brain with segmentation in color images. To detect the size and stage of Brain tumor.

II. METHODOLOGY

The aim of the proposed system is to classify malignant and benign tumor image from the brain MRI. In Proposed approach the input images are collected from the some standard database, like BRATS 2012 and some clinical database images from the Sahyadri hospital, Pune. T2-weighted MR images are fed as an input to the system. The MRI images contain different noise. To remove noise filtering operation is necessary. In the preprocessing, median filter is applied to MRI. The filtered image is converted to binary using threshold operation. Segmentation is done by threshold. The brain MRI consist of cerebral tissue along with the skull. Our region of interest is only cerebral area. The cerebral area is extracted by skull stripping. The features are extracted using GLCM. 14 features are extracted from the brain MRI and the it is trained with SVM and KNN classifier.
The proposed brain tumor classification system consists of six blocks.

1. Database
2. Input Image
3. Preprocessing
4. Segmentation
5. Extracting ROI
6. Feature extraction
7. Classification

Database

Tumor images are obtained from Brats 2012 website and clinical database from different hospital. Clinical database is obtained from Sahyadri hospital in Pune. We obtain images as T2-weighted MR images as coronal, axial and sagittal. But the datasets used for classification purpose were T2-weighted axial sequences. For experiment we have used 112 images.

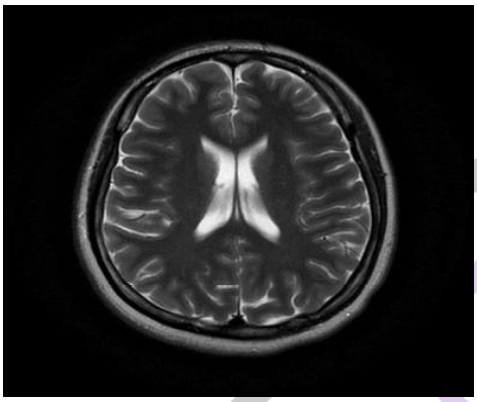


Figure 1 Normal Brain

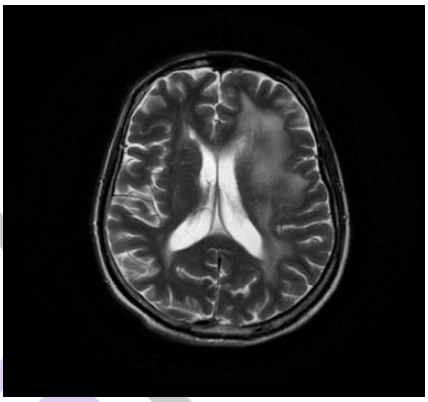


Figure 2 Abnormal Brain

Classifications Using Hybrid Classifier (SVM-KNN)

SVM classifier is equal to a 1NN classifier which chooses one representative point for support vectors in each class Even though the classifying ability of SVM is better than that of other pattern recognition methods, some problems still exist in its application, such as a low classifying accuracy in complex applications and difficulty in choosing the kernel function parameters. In an endeavor to solve these problems, a Simple and effective improved SVM c1assitying algorithm was proposed by Li et al. (2002), which combines SVM with the K-nearest neighbor (KNN) classifier. This new algorithm hybrid Classifier (SVM-KNN) has demonstrated to give excellent performance in various applications, especially in complicated ones (Li et al. 2002). In SVM samples lying near interface area are mainly support vectors. Instead of using SVM method, in which only one representative point is chosen for support vectors in each class and this representative point cannot signify proficiently the whole class; we use KNN algorithm in this case, in which every support vector is taken as representative point. That means more precious information can be utilized. In Hybrid classifier, we train the classifier SVM with radial basis kernel function with C=2 and (J =2e-l). In testing part we will calculate nearest neighbor (i.e. support vector) to the query point using KNN.

All classification result can have an error rate and might fail to identify an abnormality. It is common to describe this Accuracy rate in the terms true and false positive rate and true
And false negative rate as follows

• True Positive Rate (TPR): Abnormal correctly identified as abnormal.
• True Negative Rate (TNR): Normal correctly identified as normal.
• False Positive Rate (FPR): Normal incorrectly identified as abnormal.
• False Negative Rate (FNR): Abnormal incorrectly identified as normal.

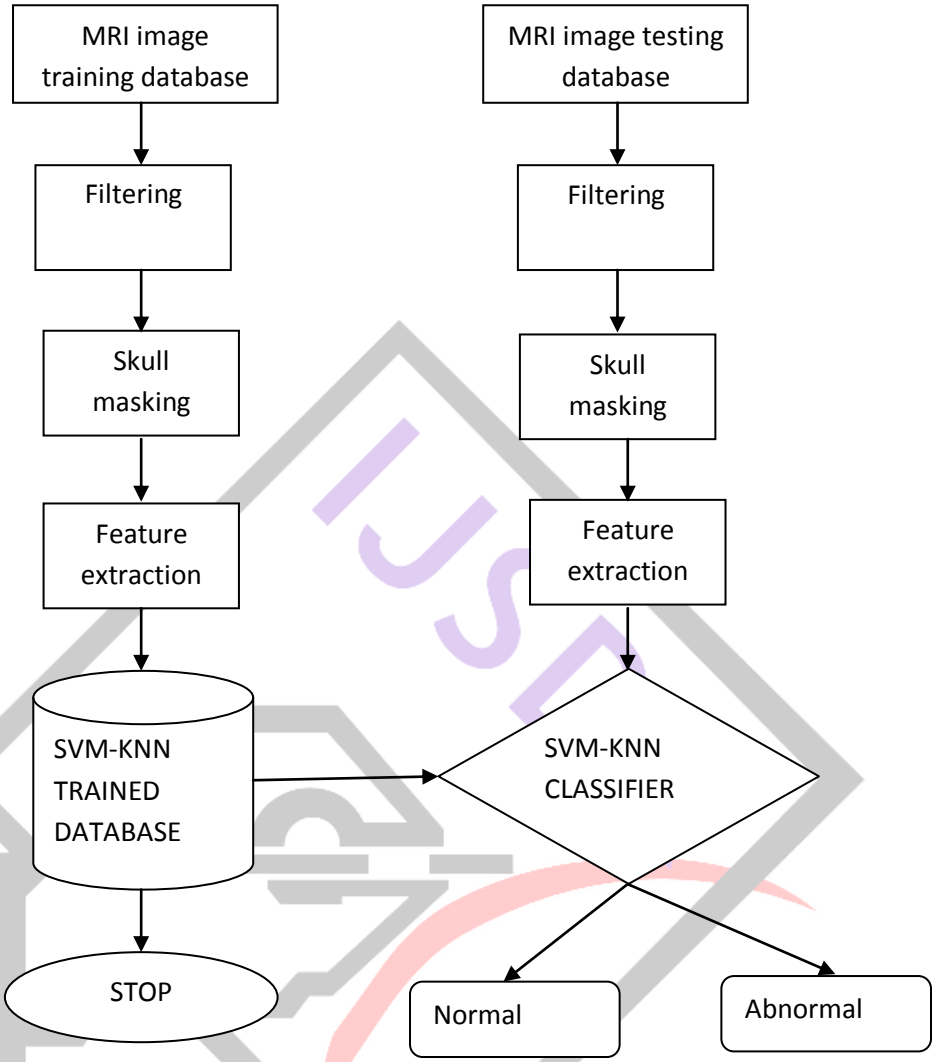
1) Sensitivity = TPRI (TPR+FNR) * 100%
2) Specificity = INRI (INR+FPR) * 100%
3) Accuracy = (TPR+INR)/(TPR+INR+FPR+FNR) * 100%

Are used to measure the performances of the classifiers.

This methodology includes following modules: Image preprocessing, Features extraction, Training and Testing. Image preprocessing is used to improve the quality of images. Medical images are corrupted by different type of noises like Rician noise etc. It is very important to have good quality of images for accurate observations for the given application. Median filter is used to remove noises while retaining as much as possible the important signal features.

Skull masking is used to remove non-brain from MRI brain image. For skull masking morphological operations is used. It helps to improve the speed and accuracy of investigation and predictive measures in clinical applications. Morphological operation is followed by region filling and power law transformation for image enrichment. Skull masked image is used to extract features. In Feature extraction we have extracted 14 features from each image. In training for 112 images, features have been extracted. The classification process is divided into two parts i.e. the training and the testing part. Firstly, in the training part known data are given to the classifier for training. Secondly, in the testing part, 40 images are given to the classifier and the classification is performed by using SVM-KNN after training the part.

Gaussian Radial Basis function (RBF) $K(y, y_i) = \exp(-\frac{|y - y_i|^2}{\sigma^2})$ was chosen to train SVM-KNN and the parameter (σ is set to 2e-l in the SVM-KNN model. The accuracy rate, sensitivity, specificity and error rate of classifiers depends on the efficiency of the training part and some other parameters associated with classifiers.



III. RESULTS AND DISCUSSIONS

A) Quantitative analysis

Classifier	Success Rate	Sensitivity	Specificity	Error Rate
SVM	92.86	89.80	95.24	7.14
KNN	69.57	06.12	20.63	30.43
Hybrid(SVM-KNN)	93.75	95.35	92.75	6.25

B) Qualitative analysis

The aim of qualitative analysis is to provide pictorial information of the research. The main advantage of the qualitative analysis of our research is it shows the location of the brain tumor in the Brain MRI.

The results of the proposed approach at different stages are shown below

a. **Input MRI**: - The input noisy image from the database is shown below. It is noisy; contain a skull, cerebral and non cerebral tissues.

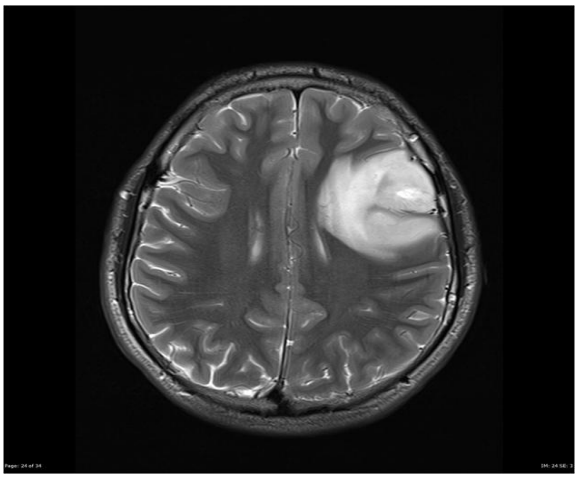


Figure 3 Input MRI

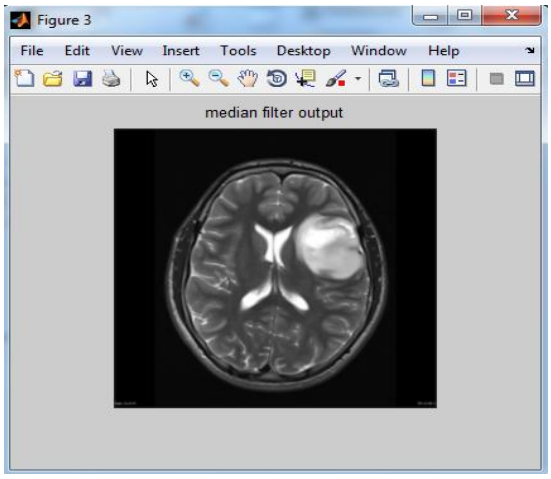


Figure 4 Median Filter output

b. Median filter -The paper and salt noise is removed by median filter. The result of median filter is shown below figure

c. Binary image - The image is converted into a binary image using thresholding operation. The local thresholding method is used for thresholding. The result of binary image is shown in figure 5

d.

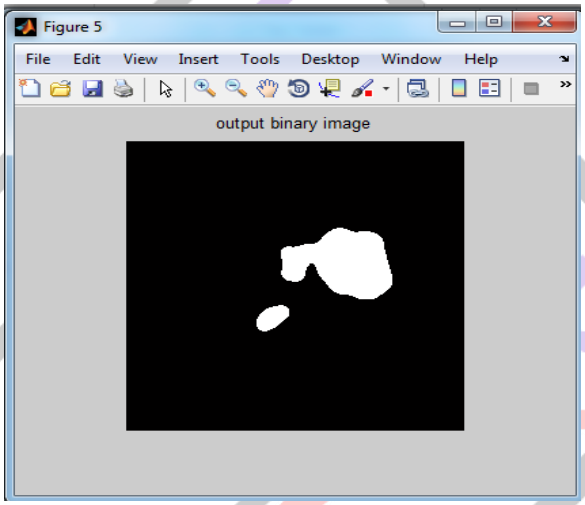


Figure 5 Output binary image

IV. CONCLUSION

The relevance of these techniques is the direct clinical application for segmentation. This proposed system is used to give more information about brain tumor detection and segmentation. The target area is segmented and the evaluation of this tool from the doctor, whom the project has cooperated with, is positive and this tool helps the doctors in diagnosis, the treatment plan making and state of the tumor monitoring. Results indicate that the implemented method is efficient for the classification of the human brain images into Benign vs. malignant. So the implemented system would be useful in clinical practice for the detection of brain tumor. Classifiers used in this project are SVM and KNN with an accuracy of 92.86% and 69.57% respectively, we have used hybrid classifier i.e. combination of these two and got an accuracy 93.75% compared to other methods, this system gives you the best results.

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