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SVM-KNN Hybrid Method for MR Image

Ms. Priti Kale[1] , Prof. Priti Subramanium[2]

[1,2]Department of Computer Science and Engineering
Shri Sant Gadge Baba College of Engineering& Technology, Bhusawal, Maharashtra, India

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Abstract - *the most of automated systems in each area are operating with high definition multimedia contents, especially in the field of medical and healthcare. This allows experts to take tricky decisions very quickly and accurately. The data in the form of image is a most important factor which is used by the physicians to make conclusion. The image data is not sufficient; there should be a proper technique to classify those images according to the training data. In case of brain tumour detection magnetic resonance image of the brain plays an important role. Today getting MR images are not that much difficult, but analyzing and classifying those images afterward, needs an expertise work to extract interesting and potential data. Here comes an image mining concept. Classification of numerical data is really easy compare to image mining. Some classification techniques we study in this paper in the relevance of image classification are SVM (Support Vector Machine), KNN (Kth nearest Neighbour). Both the techniques having their own advantages and disadvantages and try to find best of them to form something interesting.*

Keywords – SVM, KNN, Classification, Texture

1. INTRODUCTION

. Analysis and classification both are easy for humans because of their understanding, learning, and reasoning abilities. But it get worst in case of machines, as machines do not able to understand, learn or being reasonable without human support. Then most important question arises, why human needs machine? An answer to this question is human tendency of getting bored or fed up of doing the same job. There human needs machine to operate on the same job often. But for this purpose, machines should be loaded with intelligence tools like humans have. The detection of brain tumor through the MR images first needs set of images which are the prototypes for the class brain tumor detected, rest of the images automatically termed as brain tumor not detected class. The basic steps in image classification are as follows

Collection of images (Digital Data)
Designing Image Classification scheme
Preprocessing of images
Feature Extraction
Selection of Training Data
Decision and Classification
Classification Output
Post Processing

Brain tissues in MRT images [1][10] can always be divided into two main types: normal tissues, including gray matter, white matter and cerebrospinal fluid (CSF), and abnormal tissues, usually containing tumor, etc. In case of some major disease patient diagnosis data should be observed and analyzed over the specific time period. Huge amount images are generated and needs to be analyzed in case of medical field for diagnosis of major disease. All these images should be in correct form for the purpose of classification; hence the raw images are pre-processed to remove noise or irrelevant information. In real world medical diagnosis physician get consult to the experts in case of major disease to be diagnosed. Here the fact is expert is also a human being. We can replace the human expert by a machine expert. Here machine expert is a system which having a capable hardware as well as the software installed. The software is responsible to classify the images according to given class labels. For this image classification purpose some of the well-known classifiers are Probabilistic Neural Network (PNN), Support Vector Machine (SVM), Bidirectional Associative Memory (BAM), Artificial Neural Network (ANN), Hidden Markov Model (HMM), Learning Vector Quantization (LVQ) and K-Nearest Neighbor (KNN) etc, and every classification technique having its own advantage and disadvantage.

II. Comparison among Different Image Classification Techniques

PNN is slow at classifying new cases as well as it consumes more memory space to store the model [3]. ANN performs better than other methods in terms of high dimensional features. The high computation requirement of ANN needs the high consumption of CPU as well as memory. KNN's performance is degraded when the noisy or unrelated data encountered and number of attributes increases [7]. In SVM, there is lower classification accuracy, if the sample data of the two classes in a binary classification are all close to the separating hyper plane[5][6][10]. In this paper, we study a hybrid algorithm designed by merging the concepts of the SVM and KNN classification algorithms to classify MR Images to conclude that human brain having tumor or not. The K-

Nearest-Neighbor (KNN)[1] algorithm measures the distance between a test sample and a set of training samples in the features space. Here, the training MR Images are supervised classification images which guides for classification and those images have already been labeled. The nearest neighbors for this test sample will be determined using distance measurement functions.

III. Algorithm Hybrid Algorithm (SVM-KNN)

As we know SVM & KNN having their own drawbacks we can merge them to form stronger classification technique. First K nearest neighbor technique finds the distance between test sample and training sample. But if they give data contains noise or irrelevant information KNN gets trapped and will provide highly inaccurate results. Almost every technique of image classification computes the distance between test and training sample. An important task of KNN is to find out the neighbors first, and then it will classify the query sample on the majority class of its nearest neighbors. The construction of distance measurement function is really crucial and vary according to the problem where it to be applied. The general equation of finding distance between test and training samples can be as follows.

$$QC' = \sum_{(t_i, c_i) \in K_d} s(c=c_i)$$

Here 'c' is a class label, 't_i' is the training sample in i^{th} position, 'ci' is the class label for the 'i^{th}' nearest neighbors and 'K_d' represents the nearest neighbor list. Each and every possible neighbor's training sample and class label is examined against the class labels for classification. Then Majority voting can be performed to take decision. But suppose if the process ended with a blind or confusing conclusion then all the current process will be shifted to Support Vector Machine (SVM).

SVM comes in the action which has great capability of classifying images based on forming hyper plane which divides one sample from another by some distance. The performance of SVM gets degraded when samples are lying pretty much closer to the boundary. In SVM, the optimized hyper plane is to be formed in order to split one sample features class from another. The optimized hyper plane will cover the maximum distance margin which will be more accurate classifying feature data tuples than the other hyper planes. The optimized hyper plane is received using the following expression.

$wt+b = 0$

Support vectors can be defined as the training samples lies on hyper plane margin lines. t – Set of training vectors w – Vectors perpendicular to the separating hyper plane b– Offset parameter which allows the increase of the margin.

Flow for the hybrid algorithm to be carried out for classification is as follows.

Forming MRI Query Image
Pre-processing of MRI image
Features extraction
Selection of training samples
Application for KNN&SVM hybrid algorithm
KNN Justification
SVM Justification
Identifying the brain tumor condition
Further class wise description

IV.IMPLEMENTATION

We tried to implement the hybrid algorithm SVM&KNN with MATLAB software, which is the best tool for image processing research area. With the help of GUI design tool some of the following forms are designed and developed.

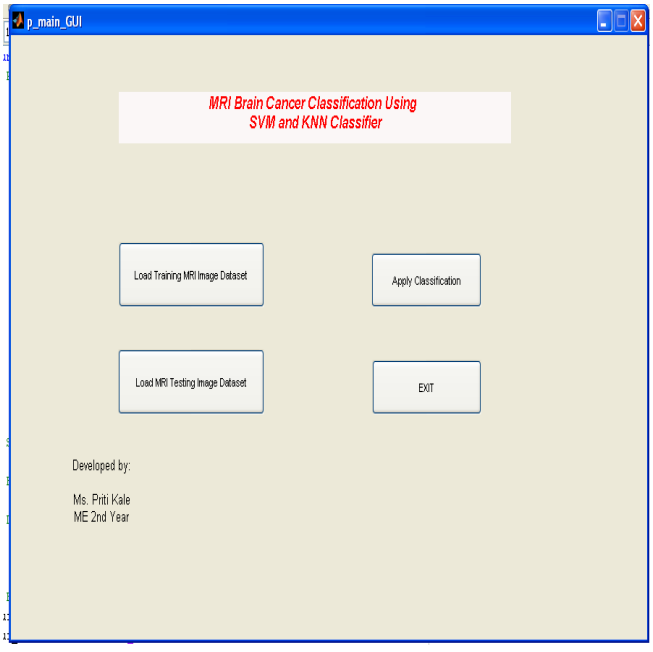
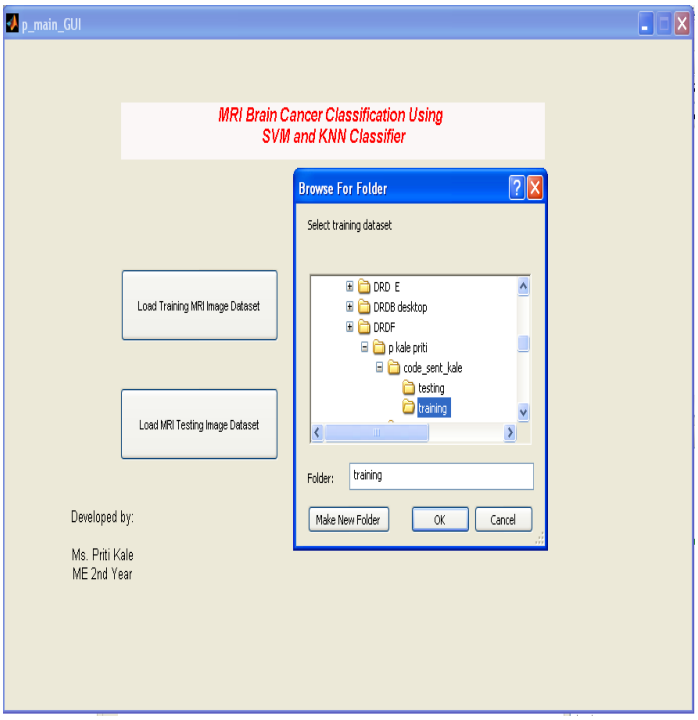


Figure 1: Main Form



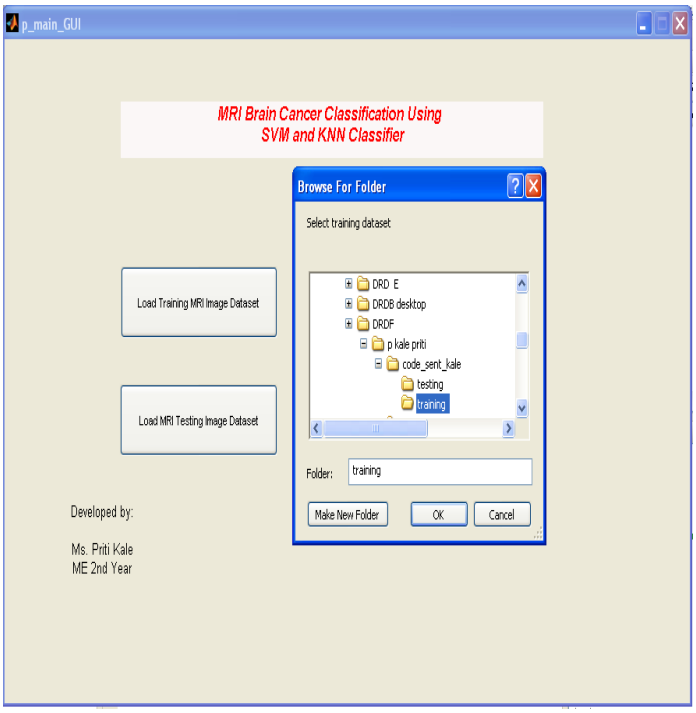


Figure 2: Loading Training Image Dataset

This form contains four buttons which have proper caption explaining their uses. Button with caption "Load Training MRI Image Dataset" displays a file dialog box for getting the path of training image dataset, similarly button "Load Testing Image Dataset" gets the path of testing image dataset. Button "Apply Classification" fires the code which classifies testing images by applying SVM&KNN hybrid technique. Figure 2 & 3 shows how to set training and testing image data set paths. We can see in figure 4 the given input images are classified as normal and abnormal. An implementation logic of the system can be explained as gets the paths of training and testing images first then number the image in as image 1, 2 3, ...so on. Then Apply classification on those images. These images are stored physically on the secondary storage in some directory. After application of SVM-KNN classifier we got the result in command window as shown in figure 4.

For example,

The input image (image number) is normal MRI brain image.

OR

The input image (image number) is abnormal MRI brain image.

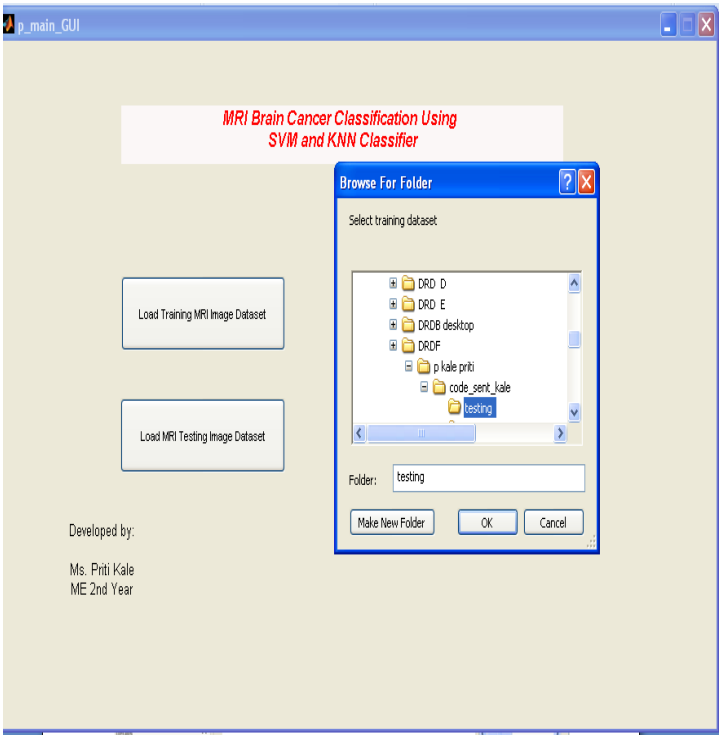


Figure 3: Loading Testing Image Dataset

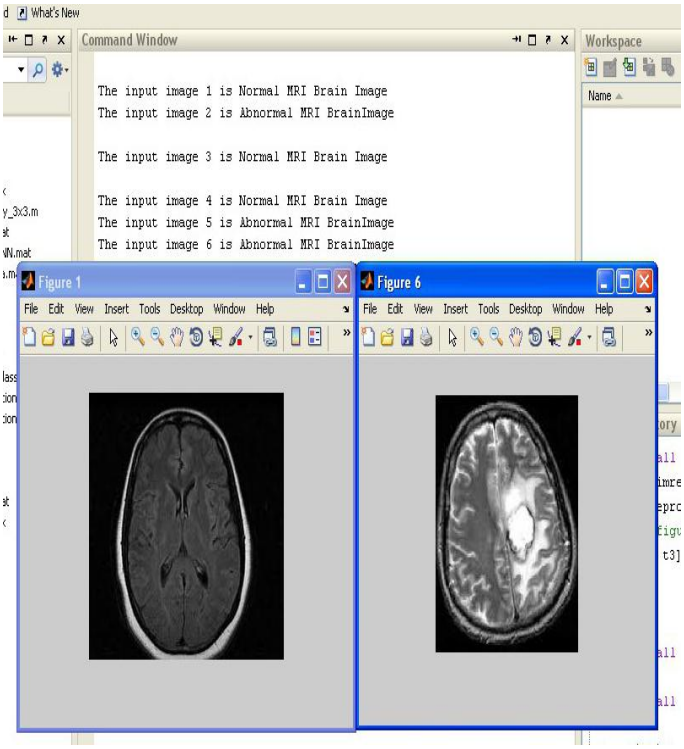


Figure 4: Output after application of classification

IV.CONCLUSION

Results of the system as shown in figure 4 can be clearly observed. An application of SVM or KNN separately is not that much beneficial for image classification. An accuracy of classifying these MR images is pretty high. Instead to span large number of problems to be solved we can combine both of them to get better results. SVM and KNN together can outperform, problem do not solve by KNN can get supplied towards SVM. In this way one can expect better performance from the system. Our system is easy to use and output is clearly stating that a particular image is normal or abnormal for the test of brain tumor.

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