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An Ensemble Based Classification Approach for Medical Images

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Abstract

Ensemble classification is a classifier applied to improve the performance of the single classifiers by fusing the output of the individual classifier models. Research in ensemble methods has largely revolved around designing ensemble consisting of single classifier models. The main discovery of the ensemble classifier, constructed by ensemble machine algorithms is to perform much better accuracy than the single classifiers. The ability to perform classification accuracy in single classifier models has been increased but in single classifier accuracy of classification is less. The difficulty arises because the algorithms for single classifier algorithm have designed with less capacitance. Now-a-days more researchers are applying the ensemble learning algorithm for classification to obtain high accuracy in an effectual manner.

Keywords: MLP classifier, KNN classifier, SVM classifier, Ensemble Classifier, MRI image.

Introduction

Classification is the most popular, challenging problem in pattern recognition and machine learning algorithm. Classification is the process of grouping objects into categories according to their likeness or similarity. It is a form of learning which induces from antecedent attributes the classes and it utilizes a rule, a boundary or a function to the sample's attributes, in order to distinguish the classes. Classification can be applied to databases, text documents, web documents, web based text documents, etc. Currently classification is viewed as a challenging subject area and contains more scope for research.

This research paper is an endeavor to demonstrate that the accuracy of the ensemble classifiers is higher than single classifiers. In particular, medical images are taken to prove the ensemble classification algorithm. The texture features of the images are extracted as feature vectors. Extracted feature vectors are taken for training and testing in the binary, threshold Adaboost and ensemble classifier [1].

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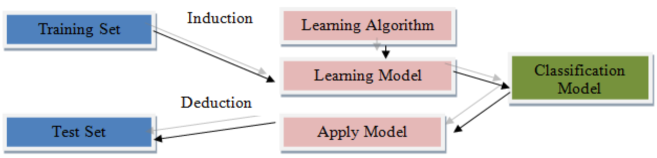

Figure 1. Classification Model

First, a training set consisting of set of feature vectors whose features are provided with corresponding class label and it is used to build a classification model, which is next applied to the testing set. The set of feature vectors without class labels are used to develop the testing set. In this paper, Multi- Layer Perceptron, K-Nearest Nghbor and Support Vector Machine are used as a base classifier in the ensemble learning algorithm. Extracted texture features of three applications are used to train base classifiers and obtain the accuracy of classification by combining these three classifiers using fusion methods. The performance metrics of the ensemble classifiers are evaluated with the neural network, threshold Adaboost and base classifiers.

Classification Techniques

Classification is a procedure for sorting pixels and assigning them to specific categories. The pixels using features, original band gray values, algebraic combinations of the original bands and texture measures are the characterized for classification. There are three types of learning in machine learning classification and they are summarized below,

- Supervised classification
- Unsupervised classification
- Reinforcement

Supervised - Supervised learning is a technique for creating a function for a training data. The training data consists of a set of input objects (a vector of characteristics) and desired output. The yield of the function can be a continuous value (regression) or can predict a class label (classification).
Unsupervised - Unsupervised learning is normally used to locate patterns in the input file. No information is given to the organization, which finds the patterns as to the correctness or incorrectness of the patterns. Unsupervised learning studies how organizations can learn to represent particular input patterns in a way that reflects the statistical structure of the overall collection of input patterns.
Reinforcement – Reinforcement is a type of machine learning, which allows machines and software agencies to automatically determine the idealized behavior within a specific context in order to maximize its performance. Reinforcement learning is intermediary between supervised and unsupervised learning. When reinforcement learning is used some information are given to the system at particular time regarding the correctness of a prediction it made. This information ranges in precision from a categorization of a response as "right" or "wrong" to a precise amount of error, expressed numerically. In the later degree of precision, it differs from supervised learning only in the way the information is presented.

Three paradigms can be identified during the classification (Figure II) and are listed below.

(i) Binary case
(ii) Multi-class case
(iii) Multi-label case

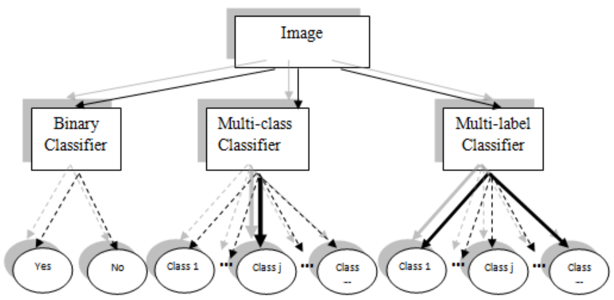

Figure 2. Paradigms in Image Classification

The binary classification classifies images into exactly two predefined classes. Here, a sample image belongs exactly to one of the two given categories. The classifier has to decide to which of the two sets the new image goes [3]. In machine learning algorithm, multi-class classification is the problem of classifying instances into more than two classes. Finally, in the multi-label case, multi-label classification and the strongly related problem of multi-output classification are variants of the classification problem where multiple target labels must be assigned to each instance.

In binary classification, a classifier is trained by means of supervised algorithms, to assign a sample data to one of the two potential sets. The potential sets are usually referred to be same classes (positive) and different classes (negative) respectively. This method is otherwise termed as the one-against all approach or one-against one attack. The classifiers exist for binary classification is Naive Bayes, Linear Regression, Support Vector Machines (SVM), LVQ [4] and Neural Network.

In multi-class and multi-label classifier, the traditional approach consists of training a binary classifier for every class and then whenever the binary base case returns a measure of confidence on the classification, assigning either the top ranked one (multi-class assignment) or a given number of the top ranked ones (multi-label assignment) [13].

Binary Classification

Binary classification is one of the well-understood problems of machine learning algorithm and statistical learning algorithm. A wealth of efficient classification algorithms has been developed and applied to a wide range of applications. It is thus natural to aim and use it as a building block for solving other, more complex, newer or just dissimilar problems; in other words, one can try to obtain efficient algorithms for different learning problems by reducing them to binary classification [1].

In the past, binary classification was mainly motivated by the tasks of individual classifiers [11]. Today, many binary classification methods are used in ensemble learning classifiers and some typical binary classification tasks are discussed below

- Classification of diseases in human by medical testing (if a patient suffers a certain disease or not)
- Classification property is being good enough or discarded (quality control in factories).
- Classification property is the significance of the article, or the usefulness to the user
- Classification of crab sex.

In the proposed binary classification, classifiers used for medical image classification are listed below

1. Neural Network Classifier
2. Adaboost classifier
3. MLP classifier
4. KNN classifier
5. SVM classifier

Brain Tumor MR Image Classification

Classification of brain tumor using Magnetic resonance Imaging (MRI) is a difficult task due to the variance and complexity of tumors. The Images obtained using MRI scanning is used in Machine intelligence for detection of diseases like brain tumor using image processing techniques. For this algorithms are to be developed so that the normal & abnormal MRI Images can be classified by machine or computer. Few MRI brain tumor images used for this research are listed in Figure III.

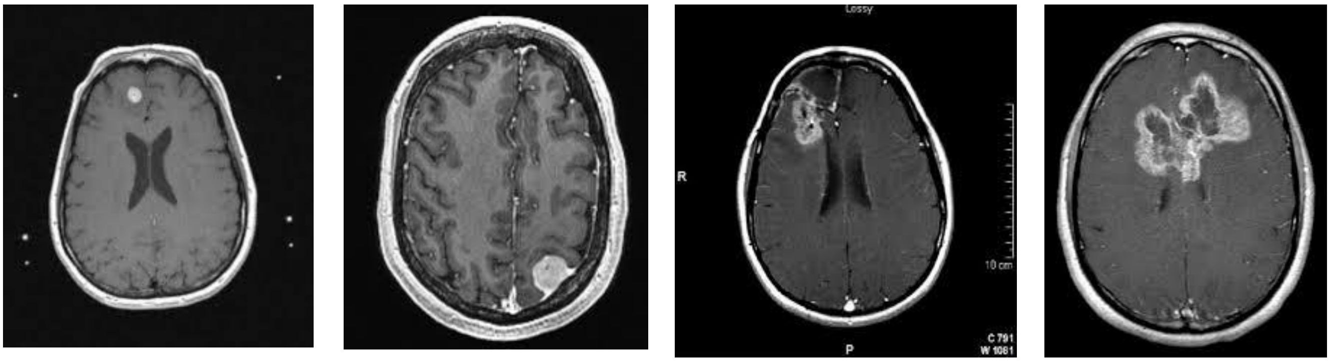

Figure 3. Brain Tumor MR images for classification

Image Features

The following ten measures of the MRI images are used to generate the feature vector in the present study [5].

1. Autocorrelation- It is calculation of linear spatial relationships between spatial sizes of texture.
2. Contrast- A measure of the intensity contrast between a pixel and its neighbor over the whole image are specified in contrast.
3. Dissimilarity- Dissimilarity is similar to contract but it will increase the value of linearity when local region has high contrast.
4. Correlation- A correlation used to calculate a statistic of texture.
5. Energy-Energy is also known as Angular Second Moment (ASM). The sum of squared elements in the GLCM is calculated in images by the formula.
6. Entropy- Entropy measures the randomness of intensity distribution.
7. Sum of square variance- The essence of the sequential variance feature puts relatively high weights of the elements that differ from the average value of P (I, j).

$$\text{variance} = \sum_{i=0}^{G-1}\sum_{j=0}^{G-1}(i-\mu)^2 \quad (P_i, P_j)$$

Where as μ means variance of the image p

8. Difference variance = variety of $g_{(x-y)}$
9. Difference Entropy

$$DE = -\sum g_{(x-y)}(i) \log \{ g_{(x-y)}(i) \}$$

10. Information measure of correlation

$$IMC = \frac{HXY - HYX1}{\max\{HX, HY\}}$$

$HXY = \sum\sum g_{ij}\log_2 g_{ij}$ where HX and HY are entropies of gx and gy images.

The feature vector has eleven columns and 'n' rows, where n is the number of images in the dataset [6]. The data structure used to store the feature vector is a 2-dimensional matrix array as given in Table 1.

Table 1
Feature vector data structure

Feature 1	**Feature 2**	**Feature 3**	**Feature 4**	**Feature 5**	**Feature 6**	**Feature 7**	**Feature 8**	**Feature 9**	**Feature 10**	**Image Label**
Real Value	Real Value	Real Value	Real Value	Real Value	Real Value	Real Value	Real Value	Real Value	Real Value	Integer Value

The final column of the feature vector contains the integer code that acts as target (Label) of each figure. The integer code is a unique number assigned to images.

Ensemble Classifier Combination Method

The process of ensemble classifier allows users to find desired information faster by searching only the relevant categories and not the whole informational space. Ensemble classifier normally involves the processing of two main tasks [7].

The applications used to prove the accuracy of the ensemble learning algorithm MRI images. The feature vector is extracted from this application are used in individual and ensemble classifier.

The proposed ensemble classification method is depicted in above equation. The present study proposes five individual classifications and one three-classification fusion models as given below.

1. Neural Network
2. Adaboost threshold
3. MLP
4. KNN
5. SVM
6. MLP (purelin, tansig, hardlim, and logsig) + KNN (Euclidean, cityblock, cosine and correlation) + SVM (linear, RBF, sigmoid and polynomial) - three class fusion model

- Thus, the present study proposes to prove ensemble classifier algorithm perform better than single classifier models for the classification problem. All the proposed models work in a three-step process.Train the classifiers with the training feature vector
- Use the selected classifiers to classify the test feature vector to an output label
- Perform fusion methods to combine the results and make the final decision.

Ten features of the images were extracted to produce the feature vector that is used as input during classification. The selected features are autocorrelation, contrast, dissimilarity, correlation, energy, entropy, sum of sequential variance difference variance, Difference Entropy, Information measure of correlation. During training the last column of the feature vector contained the target label of each image [8].

The training and testing dataset was partitioned using the kfold method, which divided the data set into 60% and 40%. The fusion methods used to combine the results of the various classifiers is a majority voting scheme, Maximum, Sum, Min, Average, Product, Bayes, Decision Template, Dempster-Shafer method. Each classifier was trained on an individual basis and no training was provided on the fused model [9].

Table 2 shows the results obtained by all the proposed fusion system higher accuracy than single classifier. The results of the proposed fusion methods are compared with their single base classifier algorithms. In the proposed base classifiers MLP with purelin transfer function, KNN with cosig distance and SVM with polynomial kernel results produce a better accuracy because in this combination of classifiers, fusion method obtain high classification accuracy in a MRI dataset [10] .

Table 2
Ensemble Classifier Combination Method

Fusion methods	Majority Vote	Maximum	Sum	Min	Average	Product	Bayes	Decision Template	Dempster-Shafer
MLP (purelin) +KNN (Cosig) +SVM (Polynomial)	85%	78%	85%	77%	85%	82%	95%	85%	88%

In the proposed fusion algorithm, Bayes methods perform high accuracy of 95% when compared to the accuracy of base classifiers and single neural network classifier (83%). Hence, after comparing the outcome of the fusion classification models with their single and base classifiers, it is clearly evident that the ensemble fusion classifiers show significant improvement in term of accuracy in the MRI dataset.

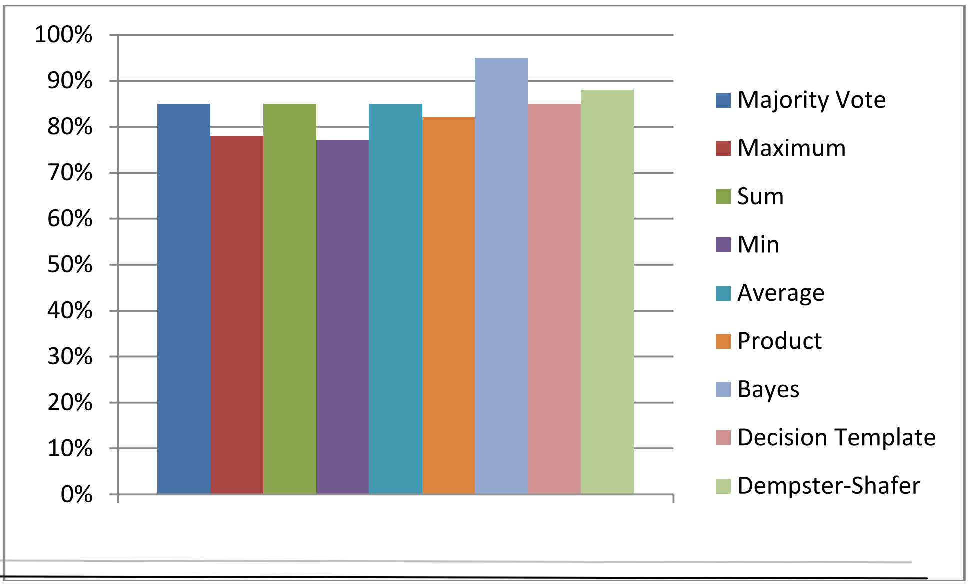

Figure IV
Comparison chart for Ensemble Classifier Combination Method

Conclusion

This Paper presents a brief introduction to the research problem, that is, ensemble classification of medical image application .The objectives formulated was also outlined. The results clearly indicate that the ensemble fusion algorithm that combines MLP, KNN and SVM is performing better than all the other single classifier proposed models. In the brain tumor MRI dataset, proposed fusion algorithm Bayes obtains high accuracy of95 % in combining output results of MLP with purelin transfer function, KNN with cosig distance and SVM with polynomial kernel when compare to an accuracy of a single neural network classifier (83%) and base classifiers.

Reference

1. Pujari, P. and Gupta, J. (2012) Improving Classification Accuracy by Using Feature Selection and Ensemble Model. International Journal of Soft Computing and Engineering (IJSCE), 2, 380-386.
2. T. Joachims. Text categorization with support vector machines: Learning with many relevant features. Technical Report 23, Universit□at Dortmund, LS VIII, 1997.
3. Subrata K. Bose Federico E. Turkheimer, Oliver D. Howes, Mitul A. Mehta, Rhian Cunliffe, Paul R. Stokes, Paul M. Grasby "Classification of schizophrenic patients and healthy controls using [18F] fluorodopa PET imaging" December 2008Volume 106, Issues 2-3, Pages 148–155.
4. Dr. N. Subhash Chandra, B.Uppalaiah, Prof. G. Charles Babu, K. Naresh Kumar, P. Raja Shekar "General Approach to Classification: Various Methods can be used to classify X-ray images " IJCSET ,March 2012, Vol 2, Issue 3,933-937.
5. Fazal Malik, , Baharum Baharudin "Analysis of distance metrics in content-based image retrieval using statistical quantized histogram texture features in the DCT domain ", Journal of King Saud University - Computer and Information Sciences, Volume 25, Issue 2, July 2013, Pages 207–218.
6. Karlinsky L, Dinerstein M, Ullman S (2009). Unsupervised feature optimization (UFO): simultaneous selection of multiple features with their detection parameters. In: Proc. CVPR
   R. Parekh, "Using Texture Analysis for Medical Diagnosis", IEEE Trans. Multimedia, vol. 19, no. 2, pp. 28-37.
7. R. Wolz, V. Julkunen, J. Koikkalainen et al., "Multi-method analysis of MRI images in early diagnostics of Alzheimer's disease," PLoS ONE, vol. 6, no. 10, Article ID e25446, 2011. View at Publisher · View at Google Scholar·
8. B. Magnin, L. Mesrob, S. Kinkingnéhun et al., "Support vector machine-based classification of Alzheimer's disease from whole-brain anatomical MRI," Neuroradiology, vol. 51, no. 2, pp. 73–83, 2009. View at Publisher. View at Google Scholar·
9. P.K Srimani and Manjula Sanjay Koti, "Medical Diagnosis Using Ensemble Classifiers-A Novel Machine-Learning Approach "International Journal of Advancing Computing, Volume 1,pp: 9-27, 2012.
10. L.Rokach,"Ensemble-BasedClassifiers" Artificial Intelligence, Rev. 33(1-2), PP: 1-39, 2010.
11. Subhash challa and Don koks," "Bayesian and Dempster–Shafer fusion" " Sadhana Academy Proceeding in Engineering Science, Vol. 29, Part 2, PP: 145–176, 2004.
12. Mohammad Ali Bagheri , Gholam Ali Montazer and Ehsanollah Kabir (2012),"A subspace approach to error correcting output codes", Pattern Recognition Letters 34,PP: 176– 184,2012.